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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

 $\label{eq:Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels$

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

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

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

3. Course Material

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

4. Course Prerequisites

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

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

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. | Concept | Instr | Assessmen | Blooms' |
|-----|-------------------------------------|--------|------------|----------|-----------|------------|
| | | Hours | | Method | t Method | Level |
| CO1 | Understand signal reconstruction | 8 | Sampling | Lecture | Assignmen | L2 |
| | from the samples at Nyquist rate | | analog | | t | Understand |
| | | | signals | | CIA | |
| CO2 | Understand DFT behavior with input | 7 | DFT | Lecture | Assignmen | L2 |
| | of Variable condition | | properties | | t | Understand |
| | | | | | CIA | |
| CO3 | Understand DFT behavior with input | 10 | DFT | Lecture | Assignmen | L2 |
| | of Variable condition | | properties | | t | Understand |
| | | | | | CIA | |
| CO4 | Compare DFT with FFT on efficient | 2 | Radix 2 | Lecture/ | Assignmen | L2 |
| | Computation | | Algorithm | PPT | t | Understand |
| | | | | | CIA | |
| CO5 | Develop DIT-FFT algorithm to find | 6 | Radix2 DIT | Lecture | Assignmen | L2 |
| | DFT for a given input length | | algorithm. | | t | Understand |
| | | | | | CIA | |
| CO6 | Develop DIF-FFT algorithm to find | 6 | Radix2 DIF | Lecture | Assignmen | L5 |
| | DFT for a given input length | | algorithm. | | t | Evaluate |
| | | | | | CIA | |
| C07 | Implement IIR structures using DF-1 | 5 | IIR | Lecture/ | Assignmen | L5 |
| | &2 | | structure | РРТ | t | Evaluate |
| | from IIR filter co-efficients | | | | CIA | |
| CO8 | Design an IIR filter using analog | 8 | IIR Filter | Lecture | Assignmen | L5 |
| | filters | | design | | t | Evaluate |
| | to meet given specification | | using | | CIA | |
| | | | analog | | | |

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| | | | filters | | | |
|-----|------------------------------------|----|------------|---------|-----------|----------|
| CO9 | ImplementFIR structures using DF-1 | 5 | FIR | Lecture | Assignmen | L5 |
| | &2 | | structure | | t | Evaluate |
| | from IIR filter co-efficients | | | | CIA | |
| C10 | Design an FIR filter using window | 8 | FIR Filter | Lecture | Assignmen | L5 |
| | method to meet given specification | | design | | t | Evaluate |
| | | | using | | CIA | |
| | | | windows | | | |
| - | | 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 | C07 | 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 | PO2 | PO | PO | PO | PO6 | PO | PO | PO9 | PO | PO | PO | Level |
| | | 1 | | 3 | 4 | 5 | | 7 | 8 | | 10 | 11 | 12 | |
| 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 | | х | | | | | | | | L2 |

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

4. Mapping Justification

| Mapping | | Justification | | | | |
|---------|-----|--|-------|--|--|--|
| | | | Level | | | |
| CO | PO | - | - | | | |
| CO1 | PO1 | Apply the Knowledge of sampling to understand the concept of | L1 | | | |
| | | A–D & D–A conversion | | | | |
| C01 | PO2 | To formulate the sampling rate of any digital system requires | L3 | | | |
| | | the Knowledge of Signal reconstruction | | | | |
| C01 | PO3 | Sampling rate conditionsare used to build a digital system for | | | | |
| | | aliasing error. | | | | |
| C01 | P04 | Investigate other sampling method to minimize the sampling | | | | |
| | | errors | | | | |
| C01 | P05 | Tools:MATLAB,Scilab | | | | |
| C01 | P10 | Communicate the algorithm to other programs as concept of | | | | |
| | | signal is interdisciplinary. | | | | |

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| 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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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

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

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| of FIR | Filtors | | | | | | | CO10 | - |

| | | | - | - | - | _ | _ | | 0010 | |
|---|----------------------------------|----|---|---|---|---|---|----|------|---|
| - | Total | 63 | 4 | 4 | 4 | 5 | 5 | 10 | - | - |
| | . Distingt sector was the sector | | | | | | | | 1 | |

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 | СО | Levels |
|---------------------------|--------------------|--------------------|------------|
| CIA Exam - 1 | 30 | C01, C02, C03, C04 | 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 | | CO1 to Co9 | L2, L3, L4 |
| – Slip test | | | |
| 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 | 15 Hrs |
|--------|---|-------|--------|
| | | Time: | |
| а | 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 | Module Content Covered | СО | Level |
| No | | | |
| 1 | Sampling of Analog signals. | C01 | L2 |
| 2 | Type of spectrum obtained. | | |

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| 3 | Sampling of Co | ontinuous spectrum to discretize it | | |
| 4 | Reconstruction | from samples | | |
| 5 | Obtaining DTF | T | | |
| 6 | Conversion fro | m DTFT to DFT | | |
| 7 | Relationship of | DFT with other Trasforms(ZT, DTFT, DTFS) | | |
| 8 | DFT and IDFT of | definition | | |
| 9 | Computation o | f DFT by expansion method | | |
| 10 | Computation o | f DFT by Matrix method | | |
| 11 | Examples to co | ompute DFT for finite length input sequences | | |
| 12 | Examples to co | ompute DFT for N-pt input sequences | | |
| 13 | DFT properties | : Linearity Property | CO2 | L2 |
| 14 | Time shifting P | Property. | | |
| 15 | Frequency Shif | ting Property. | | |
| | | | | |
| С | Application A | reas | СО | Level |
| 1 | Analog to digit | al conversion and vice versa | C01 | L2 |
| 2 | All Digital sign | al processing Applications | CO2 | L2 |
| | | | | |
| | | | | |
| d | Review Ques | tions | _ | _ |
| d | Review Ques Prove that the | tions sampling of DTFT of a sequence x(n) result in N-point | - CO1 | - L1 |
| d 1 | Review Ques Prove that the DFT | tions sampling of DTFT of a sequence x(n) result in N-point | - CO1 | - L1 |
| d 1 2 | Review Ques Prove that the DFT Find the 4 poin | tions sampling of DTFT of a sequence x(n) result in N-point nt DFT of the sequence x(n)=(0, 1, 2, 3) plot IX(k)I and | - CO1 CO1 | - L1 L3 |
| d 1 2 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) | tions sampling of DTFT of a sequence x(n) result in N-point nt DFT of the sequence x(n)=(0, 1, 2, 3) plot IX(k)I and | - CO1 CO1 | - L1 L3 |
| d 1 2 3 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT | tions sampling of DTFT of a sequence $x(n)$ result in N-point nt DFT of the sequence $x(n)=(0, 1, 2, 3)$ plot IX(k)I and of the sequence $x(n)=0.5^n$ U(n) for $0 \le n \le 3$ by | - CO1 CO1 CO2 | - L1 L3 L2 |
| d 1 2 3 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) | tions sampling of DTFT of a sequence x(n) result in N-point nt DFT of the sequence x(n)=(0, 1, 2, 3) plot IX(k)I and of the sequence x(n)= 0.5^n U(n) for $0 \le n \le 3$ by = a^n for $0 \le n \le N-1$ | - CO1 CO1 CO2 | - L1 L3 L2 |
| d 1 2 3 4 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) Find the relation | tions sampling of DTFT of a sequence x(n) result in N-point nt DFT of the sequence x(n)=(0, 1, 2, 3) plot IX(k)I and of the sequence x(n)= 0.5^n U(n) for $0 \le n \le 3$ by $=a^n$ for $0 \le n \le N-1$ on between DFT and Z transformation | - CO1 CO1 CO2 | - L1 L3 L2 |
| d 1 2 3 4 5 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) Find the relation Find the 4 poin | tions sampling of DTFT of a sequence x(n) result in N-point nt DFT of the sequence x(n)=(0, 1, 2, 3) plot IX(k)I and of the sequence x(n)= 0.5^n U(n) for $0 \le n \le 3$ by = a^n for $0 \le n \le N-1$ on between DFT and Z transformation nt DFT of the sequence x(n)= $6 + cos(2\pi/N n)$ | - CO1 CO2 CO2 | - L1 L3 L2 L4 |
| d 1 2 3 4 5 6 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) Find the relation Find the 4 poin Find the 8 poin | tions sampling of DTFT of a sequence x(n) result in N-point nt DFT of the sequence x(n)=(0, 1, 2, 3) plot IX(k)I and of the sequence x(n)= 0.5^n U(n) for $0 \le n \le 3$ by = a^n for $0 \le n \le N-1$ on between DFT and Z transformation at DFT of the sequence x(n)= $6 + cos(2\pi/N n)$ at DFT of the sequence x(n)= $(1,1,1,1,1,0,0)$ | - CO1 CO2 CO2 | - L1 L3 L2 L4 |
| d 1 2 3 4 5 6 7 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) Find the relation Find the 4 point Find the 8 point | tions sampling of DTFT of a sequence x(n) result in N-point int DFT of the sequence x(n)=(0, 1, 2, 3) plot IX(k)I and of the sequence x(n)= 0.5^n U(n) for $0 \le n \le 3$ by $=a^n$ for $0 \le n \le N-1$ on between DFT and Z transformation int DFT of the sequence x(n)= $6 + cos(2\pi/N n)$ of DFT of the sequence x(n)= $(1,1,1,1,1,0,0)$ DFT and IDFT of a sequence. | - CO1 CO2 CO2 | - L1 L3 L2 L4 |
| d 1 2 3 4 5 6 7 8 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) Find the relation Find the relation Find the 4 point Find the 8 point Define N point An analog sign | tions sampling of DTFT of a sequence x(n) result in N-point int DFT of the sequence x(n)=(0, 1, 2, 3) plot IX(k)I and of the sequence x(n)= 0.5^n U(n) for $0 \le n \le 3$ by = a^n for $0 \le n \le N-1$ on between DFT and Z transformation int DFT of the sequence x(n)= $6 + \cos(2\pi/N n)$ of the sequence x(n)= $(1,1,1,1,1,0,0)$ DFT and IDFT of a sequence. and is sampled at 10KHZ and the DFT of 512 samples is | - CO1 CO2 CO2 CO2 | - L1 L3 L2 L4 L2 |
| d 1 2 3 4 5 6 7 8 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) Find the relation Find the relation Find the 4 point Find the 8 point Define N point An analog sign computed Det | tions sampling of DTFT of a sequence x(n) result in N-point nt DFT of the sequence x(n)=(0, 1, 2, 3) plot IX(k)I and of the sequence x(n)= 0.5^n U(n) for $0 \le n \le 3$ by $=a^n$ for $0 \le n \le N-1$ on between DFT and Z transformation nt DFT of the sequence x(n)= $6 + \cos(2\pi/N n)$ nt DFT of the sequence x(n)= $(1,1,1,1,1,0,0)$ DFT and IDFT of a sequence. all is sampled at 10KHZ and the DFT of 512 samples is ermine the frequency sampling between the spectral | - CO1 CO2 CO2 CO2 | - L1 L3 L2 L4 L2 |
| d 1 2 3 4 5 6 7 8 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) Find the relation Find the relation Find the 4 point Find the 8 point Define N point An analog sign computed Det samples of DFT | tions sampling of DTFT of a sequence $x(n)$ result in N-point int DFT of the sequence $x(n)=(0, 1, 2, 3)$ plot IX(k)I and of the sequence $x(n)=0.5^n$ U(n) for $0 \le n \le 3$ by $=a^n$ for $0 \le n \le N-1$ on between DFT and Z transformation int DFT of the sequence $x(n)=6 + \cos(2\pi/N n)$ of the sequence $x(n)=(1,1,1,1,1,1,0,0)$ DFT and IDFT of a sequence. and is sampled at 10KHZ and the DFT of 512 samples is ermine the frequency sampling between the spectral r | - CO1 CO2 CO2 CO2 | - L1 L3 L2 L4 L2 |
| d 1 2 3 4 5 6 7 8 9 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) Find the relation Find the 4 poin Find the 4 poin Find the 8 poin Define N point An analog sign computed Det samples of DFT Compute the I | tions sampling of DTFT of a sequence $x(n)$ result in N-point int DFT of the sequence $x(n)=(0, 1, 2, 3)$ plot IX(k)I and of the sequence $x(n)=0.5^n$ U(n) for $0 \le n \le 3$ by $=a^n$ for $0 \le n \le N-1$ on between DFT and Z transformation at DFT of the sequence $x(n)=6 + \cos(2\pi/N n)$ at DFT of the sequence $x(n)=(1,1,1,1,1,1,0,0)$ DFT and IDFT of a sequence. The sequence at 10KHZ and the DFT of 512 samples is ermine the frequency sampling between the spectral DFT of the sequence $x(n)=\cos(n\pi/4)$ for N=4 and plot | - CO1 CO2 CO2 CO2 | - L1 L3 L2 L4 L2 L2 |
| d 1 2 3 4 5 6 7 8 9 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) Find the relation Find the 4 point Find the 4 point Find the 8 point Define N point An analog sign computed Det samples of DFT Compute the I IX(k)I and angle | tions sampling of DTFT of a sequence x(n) result in N-point int DFT of the sequence x(n)=(0, 1, 2, 3) plot IX(k)I and of the sequence x(n)= 0.5^n U(n) for $0 \le n \le 3$ by = a^n for $0 \le n \le N-1$ on between DFT and Z transformation int DFT of the sequence x(n)= $6 + \cos(2\pi/N n)$ of the sequence x(n)= $(1,1,1,1,1,1,0,0)$ DFT and IDFT of a sequence. all is sampled at 10KHZ and the DFT of 512 samples is ermine the frequency sampling between the spectral DFT of the sequence x(n)= $\cos(n\pi/4)$ for N=4 and plot e of X(k) | - CO1 CO2 CO2 CO2 | - L1 L3 L2 L4 L2 L2 |
| d 1 2 3 4 5 6 7 8 9 10 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) Find the relation Find the relation Find the 4 point Find the 8 point Define N point An analog sign computed Det samples of DFT Compute the ID IX(k)I and angle Find the IDFT of | tions sampling of DTFT of a sequence $x(n)$ result in N-point int DFT of the sequence $x(n)=(0, 1, 2, 3)$ plot IX(k)I and of the sequence $x(n)=0.5^n$ U(n) for $0 \le n \le 3$ by $=a^n$ for $0 \le n \le N-1$ on between DFT and Z transformation at DFT of the sequence $x(n)=6 + \cos(2\pi/N n)$ at DFT of the sequence $x(n)=(1,1,1,1,1,1,0,0)$ DFT and IDFT of a sequence. all is sampled at 10KHZ and the DFT of 512 samples is ermine the frequency sampling between the spectral DFT of the sequence $x(n)=\cos(n\pi/4)$ for N=4 and plot x of X(k) = (4,-2j, 0, 2j) | - CO1 CO2 CO2 CO2 CO2 | - L1 L3 L2 L4 L2 L2 L5 L2 |
| d 1 2 3 4 5 6 7 8 9 10 11 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) Find the relation Find the relation Find the 4 point Find the 8 point Define N point An analog sign computed Det samples of DFT Compute the ID IX(k)I and angle Find the IDFT of Explain Lineari | tions sampling of DTFT of a sequence $x(n)$ result in N-point int DFT of the sequence $x(n)=(0, 1, 2, 3)$ plot IX(k)I and of the sequence $x(n)=0.5^n$ U(n) for $0 \le n \le 3$ by $=a^n$ for $0 \le n \le N-1$ on between DFT and Z transformation int DFT of the sequence $x(n)=6 + \cos(2\pi/N n)$ of DFT of the sequence $x(n)=(1,1,1,1,1,1,0,0)$ DFT and IDFT of a sequence. tal is sampled at 10KHZ and the DFT of 512 samples is ermine the frequency sampling between the spectral f DFT of the sequence $x(n)=\cos(n\pi/4)$ for N=4 and plot e of X(k) of X(K)=(4,-2j, 0, 2j) ty property of DFT with an example. | - CO1 CO2 CO2 CO2 CO2 CO2 | - L1 L3 L2 L4 L4 L2 L5 L5 L2 L2 L3 |
| d 1 2 3 4 5 6 7 8 9 10 11 | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) Find the relation Find the relation Find the 4 poin Find the 4 poin Define N point An analog sign computed Det samples of DFT Compute the ID IX(k)I and angle Find the IDFT of Explain Lineari | tions sampling of DTFT of a sequence $x(n)$ result in N-point int DFT of the sequence $x(n)=(0, 1, 2, 3)$ plot IX(k)I and of the sequence $x(n)=0.5^n$ U(n) for $0 \le n \le 3$ by $=a^n$ for $0 \le n \le N-1$ on between DFT and Z transformation int DFT of the sequence $x(n)=6 + \cos(2\pi/N n)$ of the sequence $x(n)=(1,1,1,1,1,1,0,0)$ DFT and IDFT of a sequence. all is sampled at 10KHZ and the DFT of 512 samples is ermine the frequency sampling between the spectral DFT of the sequence $x(n)=\cos(n\pi/4)$ for N=4 and plot e of X(k) of X(K)=(4,-2j, 0, 2j) ty property of DFT with an example. | - CO1 CO2 CO2 CO2 CO2 CO2 CO2 | - L1 L3 L2 L4 L2 L2 L5 L2 L2 L3 |
| d 1 2 3 4 5 6 7 8 9 10 11 e | Review Ques Prove that the DFT Find the 4 poin angle of X(k) Find the DFT evaluating x(n) Find the relation Find the relation Find the 4 poin Find the 4 poin Define N point An analog sign computed Det samples of DFT Compute the ID IX(k)I and angle Find the IDFT of Explain Lineari | tions sampling of DTFT of a sequence x(n) result in N-point int DFT of the sequence x(n)=(0, 1, 2, 3) plot IX(k)I and of the sequence x(n)=0.5 ⁿ U(n) for $0 \le n \le 3$ by = a^n for $0 \le n \le N-1$ on between DFT and Z transformation at DFT of the sequence x(n)=6 + cos(2 π /N n) at DFT of the sequence x(n)=(1,1,1,1,1,1,0,0) DFT and IDFT of a sequence. all is sampled at 10KHZ and the DFT of 512 samples is ermine the frequency sampling between the spectral DFT of the sequence x(n)=cos(n π /4) for N=4 and plot e of X(k) of X(K)=(4,-2j, 0, 2j) ty property of DFT with an example. | - CO1 CO2 CO2 CO2 CO2 CO2 CO2 | - L1 L3 L2 L4 L4 L2 L5 L5 L2 L3 - |

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| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | CO3 | L3 | | | | |
| 5 | | | | | | | | |

Module – 2

| Title: | DFT Properties | Appr | 10 Hrs |
|--------|---|-------|--------|
| | | Time: | |
| а | 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 | Module Content Covered | CO | Level |
| No | | | |
| 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 |
| | | | |
| С | Application Areas | СО | 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 $(0,1,2,3,4,5,6,7)$ | CO3 | L3 |
| | a) Illustrate $x((n-2))_8$ b)what is the DFT of $x((n-2)_8$ | | |
| 14 | Compute the DFT of the sequence $x(n) = -(1,0,1,0)$. Also find $y(n)$ if | CO3 | L2 |
| | $Y(k) = X((k-2))_4$ | | |

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| 84NGALORE | Title: | Course Plan | Page: 12 | 2 / 30 |
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| 15 | Compute the | 5 pointDFT of the sequence $x(n)=(1,0,1,0)$ and hence | CO4 | L4 |
| | verify the DFT | properties | | |
| 16 | The First 5 po | ints of the 8-point DFT of a real valued sequence are | CO4 | L2 |
| | (0.25,0.5-j0.5, | 0,0.5-j0.86,0).Find the remaining 3 points | | |
| 17 | Find 4 point ci | rcular convolution of the sequences $x1(n)=(1,2,3,1)$ and | CO3 | L5 |
| | x2(n)=(4,3,2,2 |). | | |
| 18 | Prove the com | nutative property of circular convolution. | CO3 | L2 |
| 19 | Find the energ | y of 4 point sequence $x(n)=sin(2pi/N*n)$, $0 <= n <= 3$ | CO3 | L3 |
| | | | | |
| е | Experiences | | - | - |
| 1 | | | CO1 | L2 |
| 2 | | | | |
| 3 | | | | |
| 4 | | | CO3 | L3 |
| 5 | | | | |

E1. CIA EXAM - 1

a. Model Question Paper - 1

| Crs | | CS501PC | Sem: | 1 | Marks: | 30 | Time: | 75 | 5 minutes | | | |
|------|------|---|-----------------------------------|---------------|-----------------------|----------------|---------------|------|-----------|-----|-----|--|
| Code | e: | | | | | | | | | | | |
| Coui | rse: | Design and | Design and Analysis of Algorithms | | | | | | | | | |
| - | - | Note: Answer any 3 questions, each carry equal marks. | | | | | Mark | СО | Level | | | |
| | | | | | | | | | S | | | |
| 1 | а | Prove that | the sampli | ng of DTFT | of a sequer | ice x(n) res | ult in N-po | oint | 5 | CO1 | L1 | |
| | | DFT | | | | | | | | | | |
| | b | Find the 4 | point DFT | of the sequ | ence x(n)= | (0, 1, 2, 3) | plot IX(k)I a | Ind | 4 | CO1 | L2 | |
| | | angle of X | (k) | | | | | | | | | |
| | с | Find the I | OFT of the | e sequence | x(n)=0.5 ⁿ | U(n) for | 0≤ n ≤3 | by | 6 | CO1 | L2 | |
| | | evaluating | $x(n) - a^n$ for | . () < n < N. | _1 | | | | | | | |
| | 4 | Cind the re | lation both | | d 7 transfe | rmation | | | Г | CO1 | 1.2 | |
| | u | rind the re | Iation betw | een Dria | iu z transio | mation | | | 2 | CUI | LZ | |
| | | | | | | | | | | | | |
| 2 | a | Find the 4 | point DFT o | of the seque | ence x(n)=6 | $+ \cos(2\pi/$ | N n) | | 6 | CO1 | L2 | |
| | b | Find the 8 | point DFT o | of the seque | ence x(n)=(| ,1,1,1,1,1, | 0,0) | | 10 | CO1 | L2 | |
| | с | Define N p | oint DFT ar | nd IDFT of a | sequence | | | | 4 | CO1 | L2 | |

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| | | |

| | | | | | 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 $x(n){=}cos(n\pi/4)$ for N=4 and plot $ X(k) $ and angle of $X(k)$ | 10 | CO2 | L2 |
| | с | Find the IDFT of $X(K) = (4, -2j, 0, 2j)$ | 4 | CO2 | L2 |
| | | | | | |
| 4 | а | If $x(n)=(1,-1,1,-1)$, find the DFT of the sequence $y(n)=x((n-2))_4$ | 4 | CO2 | L2 |
| | b | Suppose $x(n)$ is a sequence defined on 0-7 only as $(0,1,2,3,4,5,6,7)$ | 5 | CO2 | L2 |
| | | a) IIIUStrate $X((n-2))_8$ b)what is the DFT of $X((n-2)_8$ | | | |
| | с | 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 | а | 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 |
| | с | 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 | | Tii | me: | 90 - 120 | minut | es | | | | | |
| Cour | Course: Design and Analysis of Algorithms | | | | | | | | | | |
| Note | Each | student | to answer 2 | -3 assig | nments. Each | assignn | nent ca | rries equa | al mark. | | |
| SNo | ι | JSN | | Ass | ignment Des | criptio | n | | Mark | СО | Level |
| | | | | | | | | | S | | |
| 1 | 1KT1 | 6ECOO3 | Find the 4 po | oint DFT | of the sequer | ce x(n) | =(0,1,2 | 2,3) | 5 | CO1 | L2 |
| 2 | 2 1KT16ECOO4 Compute the DFT of the Sequence $x(n) = cos(n\pi/4)$ for | | or 5 | CO2 | L2 | | | | | | |
| | N=4 and plot $ X(k) $ and $< X(k)$. | | | | | | | | | | |
| 3 | 1KT1 | 6ECOO5 | Find the 4 po | oint DFT | of the sequer | ce x\(n | i)=6+si | n(2π/4n) | | CO2 | L2 |
| 4 | 1KT1 | 6ECOO6 | Find the | 8 | point DFT | of | the | sequenc | e 5 | CO1 | L2 |
| | | | x(n)=(1,1,1, | 1,1,1,0,0 |)) | | | | | | |
| 5 | 1KT1 | 6ECOO8 | Find the IDF | Γ of X(k) | =(4,-2j,02j) | | | | | CO2 | L2 |
| 6 | 1KT16ECOO9 Compute inverse DFT of the sequence $X(k)=(2,1+j,0,1-j)$ | | | | CO2 | L2 | | | | | |
| 7 | 1KT1 | 6ECO11 | Find the DFT | of the | sequence x(n) | =0.5 ⁿ U | l(n) for | 0 <n<3 b<="" td=""><td>γ</td><td>CO2</td><td>L2</td></n<3> | γ | CO2 | L2 |
| | | | evaluating x | (n)=a ⁿ fo | or 0 <n<n-1< td=""><td></td><td></td><td></td><td></td><td></td><td></td></n<n-1<> | | | | | | |

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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 | CO2 | L2 |
| | | in N-point DFT. | | |
| 10 | 1KT16ECO14 | An analog signal is sampled at 10kHz and the DFT of 512c | CO2 | L2 |
| | | samples is computed. Determine the frequency spacing | | |
| | | between the spectral samples of DFT | | |
| 11 | 1KT16ECO15 | Define N-pont DFT and IDFT of a sequence | CO2 | L2 |
| 12 | 1KT16ECO16 | Compute the 5 pointDFT of the sequence $x(n) = (1,0,1,0)$ | CO2 | L2 |
| | | and hence verify the DFT properties | | |
| 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) = | CO2 | L2 |
| | | 26(n) output of the system if the input $x(n) = \{6(n) + 36(n)\}$ | | |
| | | - 1) + 26(n using circular convolution. | | |
| 15 | 1KT16EC019 | Determine 8 - point DFT of the signal $x(n) = \{1, 1, 1, 1, 1, \}$ | CO2 | L2 |
| | | magnitude and phase. | | |
| 16 | 1KT16EC020 | Compute the DFT of the sequence $x(n) = \cos -lal 4$ for $N =$ | CO2 | L2 |
| | | 4, plot 1x(k)1 d L x(k). | | |
| 17 | 1KT16EC021 | ind the DFT of the sequence $x(n) = 0.5$ " $u(n)$ for $0 < n \3$ | CO2 | L2 |
| | | by evaluating x(n) = a" for \cdot '3 0. 0 < n < N –1 | | |
| 18 | 1KT16EC022 | state and prove the linearity property of DFT and | CO2 | L2 |
| | | symmetrical property | | |
| 19 | 1KT16EC023 | Find the IDFT of $X(K) = (255, 48.63 + j166.05, -51-4-j$ | CO2 | L2 |
| | | 02, -78 -78.63-j46.05, -51-j102, 48.63 — 166j}. | | |
| 20 | 1KT16EC024 | State and prove the relationship between z-transform and | CO2 | L2 |
| | | DFT | | |
| 21 | 1KT16EC025 | If w(n) = $1/2 + 1/2COS(2\pi/N(n-N/2))$ what is the DFT of | CO3 | L2 |
| | | the window sequence $y(n) = x(n).w(n)$? Keep the answer in | | |
| | | terms of X(k). | | |
| 22 | 1KT16EC026 | Compute the inverse DFT of the sequence $X(k) = \{2, 1 + j, $ | CO3 | L2 |
| | | 0, 1– j) | | |
| 23 | 1KT16EC027 | Given the following $x(n) : x(n) = 8(n) + 8(n-1) + 8(n-2)$ | CO3 | L2 |
| | | (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) | | |
| 24 | 1KT16EC028 | Consider the sequence $x (n) = (0,1, 2,3, 4)$ and $x, (n) = .$ | CO3 | L2 |
| | | 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. | | |
| 25 | 1KT16EC029 | X(t) is an analog signal having a bandwidth of 4 kHz. It is | CO3 | L2 |

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| | | 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 | CO3 | L2 |
| | | N. Consider the following DFTs DFT Xp(n) Xi (k) Xp(n) | | |
| | | X3(k). What is the relationship between $xi(k)$ and $x3(k)$? | | |
| 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 $y(n)$, | CO3 | L2 |
| | | x(n) = (1, 2, 0, 1) y(n) = (2, 2, 1, 1) | | |
| 29 | 1KT16EC035 | Find IDFT for the sequence : $x(k) = \{5, 0, (1 - j), 0, 1, 0, (1 - j), (1 $ | CO3 | L2 |
| | | + j), 0) | | |
| 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 $x(n) = \{1, 1, 1, 1, \}$ | CO3 | L2 |
| | | and plot its magnitude and phase spectra | | |
| 32 | 1KT16EC039 | State and prove Linearity property of DFT. | CO3 | L2 |

D2. TEACHING PLAN - 2

Module - 3

| Title: | FFT | Appr | 16 Hrs |
|--------|---|-------|--------|
| | | Time: | |
| а | 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 | Module Content Covered | CO | Level |
| No | | | |
| 1 | Decimation in time FFT algorithm to compute DFT-Butterfly structure | C6 | L5 |
| 2 | Decimation in time FFT algorithm to compute IDFT-Butterfly | C6 | L5 |
| | structure | | |
| 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 | C5 | L5 |
| | structure | | |
| 7 | Decimation in frequency FFT algorithm to compute IDFT-Butterfly | C5 | L5 |
| | structure | | |

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| 8 | Chirp Z transf | formation |
| 9 | Goertzel Algoi | rithm |
| 10 | Linear filtering | g of Long data sequences using DFT |
| 11 | Overlap save r | nethod |
| 12 | Overlap add M | lethod |
| | | |
| С | Application / | Areas |
| 1 | Real time Proc | essing |
| 2 | Telecommunic | cation |
| | Biomedical Sig | nal Processing, image / speech / video Processing |
| d | Review Ques | stions |
| 1 | plain with nec | essary diagrams and equations the concept of overlap - |
| | save method f | or linear filtering |
| 2 | Write a note o | n Goertzel algorithm |
| 3 | What is in-pla | ce computation? What is the total number of complex |
| | additions and | multiplications required for $N = 64$ point, if DFT is |
| | computed dire | ectly and if FFT is used? Also find the number of stages |
| | required and i | ts memory requirement. |
| 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 | e remaining points. Hence find the original sequence |
| | v(n) using DIT | - FFT algorithm |

| | x(n) using DIT – FFT algorithm. | | |
|----|--|----|----|
| 5 | Find the 4 – pt circular convolution of $x(n) = \{1, 1, 1, 1\}$ and $h(n) =$ | C6 | L5 |
| | {1, 0, 1, 0} using radix 2 DIF - FFT algorithm. | | |
| 6 | In the direct computation of N-point DFT of $x(n)$, how many i) | C6 | L5 |
| | Complex multiplications, ii) Complex additions iii) Real | | |
| | multiplications iv) Real additions and v) Trigonometric function | | |
| | evaluations are required | | |
| 7 | Find the output $y(n)$ of a filter whose impulse response $h(n) = \{1, 2\}$ | C6 | L5 |
| | and input signal $x(n) = \{1, 2, -1, 2, 3, -2, -3, -1, 1, 1, 2, -1\}$ using | | |
| | overlap save method | | |
| 8 | Develop 8-point DIT-FFT radix-2 algorithm to compute DFT and | C5 | L5 |
| | draw the signal flow graph. | | |
| 9 | Develop 8-point DIT-FFT radix-2 algorithm to compute IDFT and | C5 | L5 |
| | draw the signal flow graph. | | |
| 10 | Develop 8-point DIF-FFT radix-2 algorithm to compute DFT and | C5 | L5 |
| | draw the signal flow graph. | | |
| 11 | Develop 8-point DIF-FFT radix-2 algorithm to compute IDFT and | C5 | L5 |
| | draw the signal flow graph. | | |
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| е | Experiences | |
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| 1 | | |
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Module - 4

| Title: | IIR FILTER | Appr | 16 Hrs |
|--------|---|-------|--------|
| | | Time: | |
| а | Course Outcomes | _ | Blooms |
| - | The student should be able to: | - | Level |
| 1 | Implement IIR structures using DF-1 &2 from IIR filter co-efficients | C07 | L5 |
| 2 | Design an IIR filter using analog filters to meet given specification | CO8 | L5 |
| | | | |
| b | Course Schedule | | |
| Class | Module Content Covered | СО | Level |
| No | | | |
| 1 | Filter introduction | C07 | L5 |
| 2 | Direct form realization of IIR filters | C07 | L5 |
| 3 | Parallel realization of IIR filters | C07 | L5 |
| 4 | Cascade realization of IIR filters | C07 | L5 |
| 5 | Classification of Analog filters | C07 | L5 |
| 6 | Butterworth filters | C07 | L5 |
| 7 | Frequency transformation | C07 | L5 |
| 8 | Design of Low pass Butterworth filters | C07 | L5 |
| 9 | Chebychev filters | C07 | 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 | СО | Level |
| 1 | Design of IIR filter where linear phase is not a constraint | CO8 | L5 |
| 2 | Communication Application. | C07 | L5 |
| | | | |
| d | Review Questions | _ | - |
| 1 | Obtain direct form-I, direct form - II, cascade and parallel form | C07 | L5 |
| | realization for the following t t system: $y(n) = 0.75y(n - 1) - 0.125y(n - 1)$ | 1 | |

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| | (-2) + 6x(n) + 7x(n-1) + x(n-2) | | |
| 2 | Design an analog Chebyshev filter with the following specifications : | C07 | L5 |
| | Passband ripple : 1 dB for 0 Q 10 rad/sec Stopband attenuation : -60 | | |
| | dB for Q 50 rad/sec. | | |
| 3 | Derive the expressions of order and cutoff frequency of a analog | CO8 | L5 |
| | butter worth filt | | |
| 4 | Obtain Direct form I and II , Cascade and Parallel form realization for | C07 | L5 |
| | the following system | | |
| | Y(n)=0.75y(n-1)-0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2) | | |
| 5 | Design a Chebyshev analog filter (low pass) that has a -3dB cutoff | CO8 | L5 |
| | frequency of 100 rad/sce .9., O and a stopband attenuation 25dB or | | |
| | greater for all radian frequencies past 250 rad/sec | | |
| 6 | Compare Butterworth and Chebyshev filters. | CO8 | L5 |
| 7 | Let $H(s) = 2 \ 1$ represent the transfer function of LPF with a passband | | L5 |
| | 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 | | |
| 8 | Obtain block diagram of the direct form I and direct form II | | L5 |
| | 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) | | |
| 9 | Design a Chebyshev filter to meet the following specifications: i) Pass | | L5 |
| | 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 | | |
| 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 | | L5 |
| | impulse invariance method. What are the limitations of the method? | | |
| 12 | Obtain direct form – I and lattice structure for the system described | | L5 |
| | by the difference equation $y(n) = x(n) + 2 x(n - 1) + 3 x(n - 2) + 1$ | | |
| | x(n-3). | | |
| | | | |
| е | Experiences | _ | _ |
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E2. CIA EXAM – 2

a. Model Question Paper - 2

| Crs | | CS501PC | Sem: | 1 | Marks: | 30 | Time: | 75 | 5 minutes | | |
|------|------|---|--|-----------------------------|-----------------------------|--------------------------------|------------------------------|-------------|-----------|-----|-------|
| Code | e: | | | | | | | | | | |
| Cou | rse: | Design and | l Analysis o | f Algorithm | IS | 1 | | | | | |
| - | - | Note: Ans | wer any 2 | questions | s, each ca | r <mark>ry equal</mark> n | narks. | I | Mark | СО | Level |
| - | | | | <u> </u> | | | | | S | | |
| | a | realization | realization for a digital IIR fitter described by the system function. 8 | | | | | | | CO5 | |
| | | $-4z/Z^{2}+$ | 11z — 2 | C | | | | | | | |
| | D | Obtain block diagram of the direct form I and direct form I realization for a digital IIR fitter described by the system function $H(z) (z-1)/(z^2-z+12)$ | | | | | | ion | | | |
| 2 | а | Obtain dire | ect form - | I and lattic | e structure | for the sys | tem describ | bed | 20 | C07 | L2 |
| | | by the difference equation $y(n) = x(n) + 2 x(n-1) + 3 x(n-2) + 1 x(n-3)$. | | | | | | - 1 | | | |
| | 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) + 6y(n) + 7y(n-1) + y(n-2) | | | | | | for | | | L4 |
| | | | | | | | | | | | |
| 3 | a | Derive the butter wor | expression th filt | ns of order | and cutof | f frequency | ofa ana | log | 20 | CO8 | L1 |
| | b | Compare B | utterworth | and Cheby | shev filters. | | | | | CO8 | L2 |
| | | | | | | | | | | | |
| 4 | a | Explain ho impulse inv | w an analo variance me | og filter is ethod. What | mapped or are the lim | n to a digit hitations of t | al filter usi the method | ing ? | 20 | | L2 |
| | b | Design an Passband r dB for Q 50 | analog Che ipple : 1 dE) rad/sec. | byshev filt for 0 Q 10 | er with the) rad/sec St | following s opband atte | pecification enuation : - | ns : -60 | | | L2 |

b. Assignment – 2

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

| Model Assignment Questions | | | | | | | | | | |
|----------------------------|------|-----------|-------------|-------------|-------------|----------|-----------------|----------|------|-------|
| Crs C | ode: | CS501PC | Sem: | 1 | Marks: | 5 / 10 | Time: | 90 - 120 | minu | tes |
| Cours | se: | Design ar | nd Analysis | of Algorith | nms | | l | | | |
| Note: | Each | student t | o answer 2 | –3 assignm | nents. Each | assignme | nt carries equa | al mark. | | |
| SNo | ι | JSN | | Assig | nment Des | cription | | Mark | СО | Level |
| | | | | | | | | s | | |

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| | | SECOO3 | | pute the eight point DFT of the sequence $X(n) = \{ \frac{1}{2}, \frac{1}{2} \}$ | 5 | 08 | LZ |
| | | | 72, 72 | , ⁹ 2, 0,0,0,0} using the inplace radix-2 decimation in | | | |
| 2 | 1/10 | | Evola | hency FFT algorithm and obtain the direct form | E | <u> </u> | 12 |
| 2 | | BECO04 | ll rea | lization. | 2 | 09 | LS |
| 3 | 1KT16 | SECOO5 | Obta | in the cascade realization for a system described by _ | | CO10 | L4 |
| 4 | 16716 | SECOOG | Evola | ain the design of IIR filter by Impulse invariance | 5 | C09 | 13 |
| | | | techr | nique. | 5 | 005 | LJ |
| 5 | 1KT16 | SECOO8 | Detei | rmine the order and cut off frequency of Butterworth | | CO10 | L4 |
| | | | analo | og highpass filter to meet the specifications: | | | |
| | | | Maxi | mum passband attenuation = 2 dB, Minimum stop | | | |
| | | | band | attenuation = 20 dB, Passband edge frequency = | | | |
| | | | 200 ı | rad/sec, stopband edge frequency = 100 rad/sec. | | | |
| 6 | 1KT16 | SECOO9 | Obta = | in the parallel realization of the system function H(z) | | CO9 | L3 |
| 7 | 1KT16 | SECO11 | Desig | gn a digital low pas Butterworth filter using bilinear | | | |
| | | | trans | formation to meet the specifications: i) -3 dB cut-off | | | |
| | | | frequ | iency at 0.5 π rad, ii) –15 dB at 0.75 π rad. Obtain | | | |
| | | | H(Z) | assuming T=1 sec | | | |
| 8 | 1KT16 | SECO12 | What | are the characteristics of Chebyshev filters? Define its | | | |
| | | | magr | nitude response and list the properties of polynomial | | | |
| | | | for ty | /pe I Chebyshev filters. | | | |
| 9 | 1KT16 | SECO13 | What | are the characteristics of Butterworth filters? Define | | | |
| | | | its ı | magnitude response and list the properties of | | | |
| | | | polyr | nomial | | | |
| 10 | 1KT16 | SECO14 | Obta | in 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 | 1KT16 | SECO15 | Desig | gn an analog Chebyshev filter with the following | | | |
| | | | speci | fications : Passband ripple : 1 dB for 0 Q 10 rad/sec | | | |
| | | | Stop | pand attenuation : -60 dB for Q 50 rad/sec. | | | |
| 12 | 1KT16 | SECO16 | Deriv | e the expressions of order and cutoff frequency of a | | | |
| | | | analo | og butter worth filt | | | |
| 13 | 1KT16 | 5ECO17 | Obta | in Direct form I and II , Cascade and Parallel form | | | |
| | | | realiz | zation for the following system | | | |
| — | 1 | | Y(n)=0 | 0.75y(n-1)-0.125y(n-2) + 6x(n) + 7x(n-1) + x(n-2) | | | |
| 14 | | DECO18 | Desig | on a Chebyshev analog filter (low pass) that has a | | | |
| | | | -3dB | cutoff frequency of 100 rad/sce .9., O and a | | | |
| | | | stop | pand attenuation 25dB or greater for all radian | | | |

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| | | 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 | IKII6EC029 | How to convert Analog Band elimination filter to analog | | |
| 26 | | low pass filter, write the frequency transformation. | | |
| 26 | IKII6EC032 | What are the characteristics of Butterworth analog filter | | |
| 27 | IKII6EC033 | Write the design steps for design of IIR filter using Bilinear | | |
| | | transformation. | | |
| 28 | IKII6EC034 | Write the design steps for design of IIR filter using | | |
| 20 | | Backward difference method | | |
| 29 | IKII6EC035 | write the design steps for design of lik filter using | | |
| 20 | | Impulse invariant method | | |
| 30 | IKII6EC037 | List the number of Adders required for direct form- | | |
| | | i, airect form 2 method of lik filter implementation. | | |

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| 31 | 1KT16 | 5EC038 | Com | pare direct form-1,direct form 2 method of IIR filter | | | |
| | | | imple | ementation. | | | |
| 32 | 1KT16 | 5EC039 | Write | a note on Analog filters. | | | |

D3. TEACHING PLAN - 3

Module – 5

| Title: | FIR FILTER | Appr | 16 Hrs |
|--------|---|-------|--------|
| | | Time: | |
| а | 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 | Module Content Covered | СО | Level |
| No | | | |
| 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 |
| | | | |
| С | 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 $h(n) = \Box(n)$ | CO10 | L1 |
| | + $\frac{1}{4}$ $\Box(n-1)$ - $\frac{1}{2}\Box(n-1)$ + $\frac{1}{4}\Box(n-3)$ + $\Box(n-4)$ using direct form | | |
| 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 |

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| eep)iigiit eee | in a variantight of test real | | |
|----------------|---|-----|----|
| | 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. | | |
| 4 | Consider an FIR lattice filter with coefficients $K1 = 0.65$, $K2 = -0.34$ and | CO9 | L4 |
| | K3=0.8. Find its impulse response and draw the direct form structure. | | |
| 5 | Determine the impulse response of an FIR filter to meet the | | L2 |
| | 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 | Compare the different window functions used in FIR filter design | | L5 |
| 7 | Design a normalized linear phase FIR filter having the phase delay of | | L2 |
| | T 40 dB attenuation in the stopband. Also obtain the magnitude | | |
| | /frequency response Use rectangular window. | | |
| 8 | Determine the frequency response of the FIR if Hamming window is | | L3 |
| | used with $N = 8$. | | |
| 9 | Compare IIR filter and FIR filters | | L4 |
| 10 | A FIR filter is given by, $y(n) = x(n) + 2 x(n-1) + 3 x(n-2) + x(n-1)$ | | L1 |
| | 3). Draw the direct form I and lattice 4 structure . | | |
| 11 | Design a linear phase low pass FIR filter with 7 taps and cutoff | | L4 |
| | frequency of W_c , = 0.3pi rad, using the frequency sampling method. | | |
| | | | |
| е | Experiences | _ | _ |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| | | | |

E3. CIA EXAM - 3

a. Model Question Paper - 3

| Crs | Code | 15EC52 | Sem:V | I | Marks: | 30 | Time: | 75 minutes | | |
|-----|------|--|----------------|--------------|---------------|---------------|--------|------------|-------|----|
| Cou | rse: | Design and | l Analysis of | f Algorithm | S | | | | | |
| - | - | Note: Answer any 2 questions, each carry equal marks. | | | | | Mark | CO | Level | |
| | | | | | | | | S | | |
| 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 | | | | | its 20 | CO9 | L5 | |
| | b | Realize the FIR filter H(Z)= $\frac{1}{2}$ + 1/3 Z ⁻¹ +Z ⁻² + $\frac{1}{4}$ Z ⁻³ +Z ⁻⁴ + 1/3 Z ⁻⁵ +1/2 Z ⁻⁶ in Direct form | | | | | rect | | L5 | |
| | | | | | | | | | | |
| 2 | a | Compare the | different wind | dow function | s Used in FIR | filter design | | 20 | CO10 | L5 |

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| | 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 $H(w)=e^{-j^{3}w}(1+1.8\cos^{3}w + 1.2\cos^{2}w + 0.5\cos^{2}w)$. 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 $Hd(\omega)=e^{-j^{2w}} w < pi/4$, $H_d(w)=0$ 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 C | Crs Code: CS501PC Sem: I Marks: 5 / 10 Time: | | | Time: | 90 - 120 |) minut | es | | | |
| Cour | se: | Design | and Analysis | of Algorith | ims | | | | | |
| Note | : Each | student | to answer 2- | -3 assignm | ents. Each | assignmer | nt carries equ | al mark. | | |
| SNo | ι | JSN | | Assign | ment Des | cription | | Mark | CO | Level |
| | | | | | | | | S | | |
| 1 | ΙΚΤΙ | 6ECOO3 | Consider an F k3=0.8. Find its | IR Lattice fi impulse resp | Iter with coo oonse and the | efficients k1 direct form | L=0.65, k2=-0.3 structure | 84, 5 | CO9 | L2 |
| 2 | $\frac{1 \text{ KT16ECOO4}}{\text{ Realize the FIR filter H(Z)} = \frac{1}{2} + \frac{1}{3} \text{ Z}^{-1} + \frac{2}{3} + \frac{2}{3} + \frac{2}{3} + \frac{2}{3} + \frac{1}{3} \text{ Z}^{-5} + \frac{1}{2} \text{ Z}^{-6}}{\text{ in Direct form}}$ | | | | | z⁻ ⁶ 5 | CO9 | L3 | | |
| 3 | 1KT1 | 6ECOO5 | Compare the di | fferent wind | ow functions | Used in FIR f | ilter design | | CO10 | L4 |
| 4 | 1KT1 | 6ECOO6 | Detremine tl | he filter c | o–efficients | of a FIR | filter for t | ne 5 | CO10 | L3 |
| | | | desired frequ | uency resp | onse Hd(w) | e=e ^{−j3w} , w | v < 0 3π/4< v | ~I | | |
| | < π Determine the frequency response of the FIR filter if Hamming window is used with N=7 | | | | | | ng | | | |
| 5 | ικτι | 6ECOO8 | Determine th | ne Impulse | response | of an FIR | filter to me | et | | |
| | | | the specifica [.] | tions a) Pa | iss band ed | ge freque | ncy of 1.5KH | Ζ, | | |
| | b) stop band edge frequency of 2KHz c) Sampling | | | | | | ng | | | |
| | | | frequency of | 8KHz. Use | the Hamm | ing windo | w function. | | | |
| 6 | 1KT1 | 6ECOO9 | The frequenc | cy response | e of an FIR f | ilter is giv | en by | | | |
| | | | H(w)=e ^{-j3w} (1+1 | .8cos3w + | 1.2cos2w | + 0.5cosw) |).Determine t | he | | |

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| | | 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 $Hd(\omega)=e^{-j2w}$ $w ,$ | | |
| | | $H_d(w)=0$ otherwise | | |
| | | Use rectangular window function. Find the frequency | | |
| | | response $H(\omega)$ of the filter. | | |
| 9 | 1KT16ECO13 | Determine the filter coefficients of an FIR filter for the | | |
| | | desired frequency response $Hd(\omega)=e^{-j2w}$ w <pi ,<="" 4="" th=""><th></th><th></th></pi> | | |
| | | $H_d(w)=0$ otherwise | | |
| | | Use Barlet window function. Find the frequency response | | |
| | | $H(\omega)$ of the filter. | | |
| 10 | 1KT16ECO14 | Determine the filter coefficients of an FIR filter for the | | |
| | | desired frequency response $Hd(\omega)=e^{-j2w}$ w <pi ,<="" 4="" th=""><th></th><th></th></pi> | | |
| | | $H_{d}(w)=0$ otherwise | | |
| | | Use Blackman window function. Find the frequency | | |
| | | response $H(\omega)$ of the filter. | | |
| 11 | 1KT16ECO15 | Determine the filter coefficients of an FIR filter for the | | |
| | | desired frequency response $Hd(\omega)=e^{-j2w}$ w <pi .<="" 4="" th=""><th></th><th></th></pi> | | |
| | | H₄(w)=0 otherwise | | |
| | | Use Hamming window function. Find the frequency | | |
| | | response $H(\omega)$ of the filter. | | |
| 12 | 1KT16ECO16 | Determine the filter coefficients of an FIR filter for the | | |
| | | desired frequency response $Hd(\omega)=e^{-j2w}$ w <pi .<="" 4="" th=""><th></th><th></th></pi> | | |
| | | H₄(w)=0 otherwise | | |
| | | Use Hanning window function. Find the frequency | | |
| | | response $H(\omega)$ of the filter. | | |
| 13 | 1KT16ECO17 | Determine the filter coefficients of an FIR filter for the | | |
| | | desired frequency response $Hd(\omega)=e^{-j2w}$ w <pi ,<="" 4="" th=""><th></th><th></th></pi> | | |
| | | H _d (w)=0 otherwise | | |
| | | Use Kaiser window function. Find the frequency response | | |
| | | $H(\omega)$ 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 | | |

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| 18 | 1KT16EC022 | Write the Hamming window sequence and plot its | | | | | | |
|----|-------------|--|--|--|--|--|--|--|
| 10 | 1471650023 | Write the Kaiser window sequence and plot its magnitude | rite the Kaiser window sequence and plot its magnitude | | | | | |
| 19 | TKTTOEC023 | and phase response | | | | | | |
| 20 | 1// 1// 2// | and phase response | | | | | | |
| 20 | IKII6EC024 | write the design steps to design FIR filter using | | | | | | |
| 21 | | Write the design store to design FID filter using | | | | | | |
| 21 | IKII0EC025 | write the design steps to design FIR filter using | | | | | | |
| | | Exclangular window when window function is given. | | | | | | |
| 22 | IKTI6EC026 | Explain lattice structure of FIR Fliter realization. | | | | | | |
| 23 | TKT16EC027 | State and explain condition required for design of linear | | | | | | |
| | | phase FIR filter. | | | | | | |
| 24 | TKT16EC028 | Realize the Linear phase FIR filter having the following impulse response $h(n) = \delta(n) + 1/4 \delta(n-1) - 1/8 \delta(n-2) + 1/4 \delta(n-3)$ | | | | | | |
| | | response n(n)=0(n)+1/4 0(n+1)=1/80(n+2)+1/40(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 $x(n) = \{1, 1, 1, 1, 1\}$ 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? | | | | | | |
| | 1 | | | | | | | |

F. EXAM PREPARATION

1. University Model Question Paper

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

| Dept:EC | |
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| Prepared by | Checked by |
| Approved by | |
| M.Nagaraja | Mrs.Mythreye |
| Dr.Devananda S N | |

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| | | | | | | | | | minut | es |
|---|------|--|---|--|---|------------------------------|--------------|------|-------|------|
| - | Note | Answer all FIVE | E full questio | ns. All ques | tions carry ed | qual marks. | | Mark | СО | Leve |
| | | | • | · | , | | | s | | 1 |
| 1 | a | Explain the frequency domain sampling and reconstruction of discrete time signals. | | | | | | 8 | CO1 | |
| | b | The first five po are {0.25, 0.125-j0.3 points. | oints of the e | ight point DF 5-j0.0518, 0}. | T of a real va | alued seque e remaining | nce three | 3 | | |
| | С | Determine the x2(n)={4,3,2,2} | circular conv using time c | olution of the | e sequences, bach. | x1(n) = {1,2 | 2,3,1}, | 5 | CO2 | |
| 2 | 2 | Obtain the rela | ationship of | DET with the | - 7-transform | n | | 5 | C03 | |
| 2 | b | Show that the n respective time sequence | nultiplication c | of two DFTs le | eads to circula | ir convolutio | n of | 7 | 205 | |
| | c | Consider a finite (i) Determine (ii) Determine Imaginary[| e duration sec the sequenc the sequenc [X(k)] | quence x(n) = e y(n) with si ce v(n) with s | {0,1,2,3,4}. ix point DFT ` six point DFT | Y(k) = Real V(k) = | [X(k)] | 4 | CO4 | |
| | | Evoloin the line | or filtoring o | flong data a | | ing overlan | 001/0 | 6 | COL | |
| 3 | a | method. | ear mitering o | | | ing overlap- | save | 0 | COS | |
| | b | The 4-point DF DFTs of the fol i) X ₁ (ii) ii) | T of a real so lowing. (n) = $(-1)^n x(n)$ $x_2(n)=x((n+1)$ $x_3(n) = x(4-n)$ | equence x(n), I))₄, |) is X(k) = (1, | j, 1, -j). Fin | d the | 6 | | |
| | с | Explain the com are the efficient algorit | thms for the | mplexity of di | irect computat | tion of DFT. | What | 4 | CO6 | |
| | | | | | | | | | | |
| 4 | a | Find the respon (3,2,1) for the in and add method | se of an LTI s iput x(n) = (2, d. Use 8 poin | system with a -1, -1, -2, -3, t circular con | n impulse res 5,6,-1, 2,0,2, ivolution. | ponse h(n) = 1) using ove | = rlap | 7 | C07 | |
| | b | The 5-p0int DF Compute Y(k), i y(n)=x*(n). | T of a comple f | x sequence x | :(n) is X(k)=(j, | 1+j, 1+j2, 4- | +j). | 4 | | |
| | С | State and prov | e the propert | y of circular | time shift of a | a sequence. | | 5 | C08 | |
| | | | | | | | | | | |
| 5 | a | Derive the radix flow graph | -2 decimatior | n in time FFT | algorithm and | l draw the si | gnal | 8 | CO9 | |

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| | | for eight point | t DFT computation. | 0 | 6010 | |
| | b | Find the numbe | er of complex additions and complex multiplications required | 3 | COTO | |
| | | 101 120- naint DET aam | nutation using i) Direct method, ii) FET method, What is the | | | |
| | | speed improve | putation using i) Direct method, ii) FFT method. What is the | | | |
| | <u>с</u> | Find the A-noint | real sequence $y(n)$ if its DET samples are $Y(0)=6$, $Y(1)=-2+i2$ | 5 | | |
| | Ľ | X(2)=-2 | Teal sequence $X(1)$, it is Diff samples are $X(0)=0$, $X(1)=2$, $Z(1)=2$, | 5 | | |
| | | Use DIF-FFT a | algorithm. | | | |
| | | | | | | |
| 6 | а | Compute the e | ight point DFT of the sequence $x(n) = \{\frac{1}{2}, \frac{1}{2}, \frac{1}{2}, \frac{1}{2}, 0.0, 0.0\}$ | 8 | | |
| | | using the | 5 - [] | | | |
| | | inplace radix-2 | 2 decimation in frequency FFT algorithm. | | | |
| | b | Explain the G | oertzel algorithm and obtain the direct form II | 8 | CO9 | |
| | | realization. | | | | |
| | с | | | _ | | |
| 7 | a | Obtain the case | cade realization for a system described by $H(z) =$ | 5 | C010 | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | b | Explain the de | esign of IIR filter by Impulse invariance technique. | 6 | | |
| | с | Determine the | order and cut off frequency of Butterworth analog highpass | 5 | | |
| | | filter to meet th | e specifications: Maximum passband attenuation = 2 dB, | | | |
| | | Minimum stop | | | | |
| | | 200 rad/sec, s | | | | |
| | | frequency = 10 | UU rad/sec. | | | |
| 0 | - | | | 6 | | |
| 0 | d | Obtain the para | allel realization of the system function H(z) = | 0 | | |
| | | | | | | |
| | h | L Design a digita | I low has Butterworth filter using hilinear transformation to | 6 | | |
| | U | meet the speci | fications: i) -3 dB cut-off frequency at 0.5 π rad. ii) -15 dB at | U | | |
| | | 0.75π rad Obt | rain | | | |
| | | H(7) assuming | | | | |
| | с | What are the c | haracteristics of Chebyshev filters? Define its magnitude | 4 | | |
| | _ | response and | - | | | |
| | | list the proper | | | | |
| | | | | | | |
| 9 | | Realize the lin | 3 | | | |
| | | h(n)= □(n)+ ¼ □(n-1)- ½□(n-1)+ ¼ □(n-3)+ □(n-4) using direct form. | | | | |
| | | Describe the f | 7 | | | |
| | | Determine the | filter coefficients of an FIR filter for the desired frequency | 6 | | |
| | | | 、 、 | | | |
| | | response H _d (ω | | | | |
| Dent | FC | | | | | |

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| | | Use rectangu | lar window function. Find the frequency response $H(\omega)$ of | | | |
| | | the filter. | | | | |
| | | | | | | |
| 10 | a | Consider an FIR lattice filter with coefficients K1=0.65, K2=-0.34 and7K3=0.8. Find its7 | | | | |
| | | imnulse resno | onse and draw the direct form structure | | | |

| L | | | | |
|---|---|---|---|--|
| | b | Determine the impulse response of an FIR filter to meet the specifications: | 6 | |
| | | Passband | | |
| | | edge frequency of 1.5 KHz, Stopband edge frequency of 2 KHz, | | |
| | | Sampling frequency of 8 KHz. Use the Hamming window function. | | |
| ſ | с | 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 | | |
| | | n | | | | | | | minut | es |
| | Note | Answer all FIV | E full question | ons. All ques | tions carry | equal marks | | - | - | |
| Мо | Qno. | Important Que | estion | | | | | Mark | СО | Year |
| dul | | | | | | | | S | | |
| e | | | | | | | | | | |
| 1 | 1 | Find the N poir | nt DFT of x(n) | =a ⁿ for 0 <a< td=""><td><1</td><td></td><td></td><td>4</td><td></td><td>2016</td></a<> | <1 | | | 4 | | 2016 |
| | 2 | Compute the D | FT of the sequ | ience x(n)=co | s(npi/4) for N | \= 4 | | 4 | | 2015 |
| | 3 | Find the relatior | n between DF | T and Z transf | orm | | | 4 | | 2015 |
| | 4 | Prove that s | ampling of | DTFT of a | sequence | x(n) resu | ılt in N | 5 | | 2014 |
| | | point DFT | | | | | | | | |
| | 5 | Find the IDFT | of X(K)=(4, - | -2j, 0, 2j) | | | | 3 | | 2016 |
| | | | | | | | | | | <u> </u> |
| 2 | 1 | Prove parseva | ls 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 prov | e the follow | ing propertie | es | | | 8 | | 2015 |
| | | a)Symmetry p | roperty b) Pa | rsevals there | em | | | | | |
| | 4 | State and prov | /e convolutio | on property | | | | 6 | | 2016 |
| | 5 | Given x(n)={1 | ,2,3,4} and h | n(n)={1,2,2} o | compute I) (| Circular Con | volution | 8 | | 2016 |
| | | ii) Linear conv | olution iii) Li | near convolı | ution using | circular con | volution | | | |
| | | | | | | | | | | |
| 3 | 1 | First five poir | nts of the 8 | - point DFT | Г of a real | valued sequ | uence is | 10 | | 2016 |
| | | given by x(0) | = 0, x(1) = 2 | 2 + 2j, x(2) | =4j, x(3) |) = 2 - 2j, x | (4) = 0. | | | |
| | | Determine the | e remaining | points. Her | nce find the | e original s | equence | | | |
| | | x(n) using DIT | – FFT algori | thm. | | | | | | |
| | 2 | Find the 4 – p | ot circular co | nvolution of | $f(x(n) = \{ 1, $ | 1, 1, 1} and | d h(n) = | 10 | | 2016 |

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|---------|---------|---|----|------|
| | | {1, 0, 1, 0} using radix 2 DIF - FFT algorithm | | |
| | 3 | d the circular convolution of $x(n) = \{1, 1, 1, 1, 1\}$ 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 | 1 | Design an analog Chebyshev filter with the following specifications : | 12 | 2016 |
| | | Passband ripple : 1 dB for 0 Q 10 rad/sec Stopband attenuation : -60 dB for Q 50 rad/sec. | | |
| | 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 $w_{01} = 1$ 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 |