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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**COURSE DESCRIPTION FILE**

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| --- | --- |
| **Academic Year & Semester** | **2018-19, Semester I** |
| **Course Code** | PC503EC |
| **Course Title** | **DIGITAL SIGNAL PROCESSING** |
| **Curriculum Regulation** | **CBCS – OU (Affiliated Colleges)** |
| **Semester** | **V** |
| **Course Instructor** | Mr. I.SRIKANTH, Associate Professor, ECE Department |

1. PREREQUISITE(S):

|  |  |  |  |
| --- | --- | --- | --- |
| **Level** | **Credits** | **Semester** | **Prerequisites** |
| UG | 3 | IV | SATT(PC304EC) |

1. SCHEME OF INSTRUCTIONS

|  |  |  |  |
| --- | --- | --- | --- |
| **Lectures** | **Tutorials** | **Practicals** | **Credits** |
| 3 | 1 | - | 3 |

1. SCHEME OF EVALUATION& GRADING

|  |  |  |  |
| --- | --- | --- | --- |
| **S. No** | **Component** | **Duration** | **Maximum Marks** |
|  | **Continuous Internal Evaluation (CIE)** |  |  |
| 1. | Internal Examination – I | 60 minutes | 20 |
| 2. | Internal Examination - II | 60 minutes | 20 |
|  | Average of the two internal exams |  | **20** |
| 3. | Assignments | - | **5** |
| 4. | Quizzes | - | **5** |
|  | **CIE (Total)** |  | **30** |
| 5. | **Semester End Examination**  (University Examination) | 3 hours | **70** |
|  |  | **TOTAL** | **100** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Marks Range | 85-100 | 70 to < 85 | 60 to < 70 | 55 to < 60 | 50 to < 55 | 40 to < 50 | < 40 | Absent |
| Grade | S | A | B | C | D | E | F | Ab |
| Grade Point | 10 | 9 | 8 | 7 | 6 | 5 | 0 | - |

1. SYLLABUS

|  |  |  |
| --- | --- | --- |
| **Unit** | **Syllabus Description** | **Target**  **Hours** |
| **I** | **Discrete and Fast Fourier Transform:** Discrete Fourier Transform (DFT), Computation of DFT- Linear and Circular Convolution, FFT algorithms: Radix-2 case, Decimation in Time and Decimation in Frequency algorithms- in place computation- bit reversal. | 12 |
| **II** | **Digital Filter (IIR) Design:** Butterworth and Chebychev approximation- IIR digital filter design techniques- Impulse Invariant technique- Bilinear transformation technique- Digital Butterworth &Chebyshev filters. | 12 |
| **III** | **Digital Filters (FIR) Design:** Amplitude and phase responses for FIR filters- Linear phase filters- Windowing techniques for design of Linear phase FIR filters- Rectangular, Bartlett, Hamming, Hanning, Kaiser windows- realization of filters- Finite word length effects, Comparison between FIR and IIR filters. | 8 |
| **IV** | **Multirate Digital Signal Processing:** Introduction- Decimation by factor D and interpolation by a factor I- Sampling Rate conversion by a Rational factor I/D- Implementation of Sampling.  **Rate conversion-** Multistage implementation of Sampling Rate conversion- Sampling conversion by a Arbitrary factor, Application of Multirate Signal Processing | 8 |
| **V** | **Introduction to DSP Processors:** Difference between DSP and other microprocessors architecture- their comparison and need for ASP, RISC and CPU- General Purpose DSP processors: TMS 320C 54XX processors, architecture, addressing modes- instruction set. | 8 |
|  | **Total** | 48 |

**SuggestedReading:**

1. Alan V. Oppenheim and Ronald W. Schafer, “Digital Signal Processing”, 2/e, PHI, 2010.
2. John G. Praokis and Dimtris G. Manolakis, “Digital Signal Processing: Principles, Algorithms and Application”, 4/e, PHI, 2007.
3. Avathar Singh and S. Srinivasan, “Digital Signal Processing using DSP Micrprocessor”, 2/e, Thomson Books, 2004.
4. John G Proakis and Vinay K Ingle, “ Digital Signal Processing using MATLAB” 3/e, Cengage Learning, 1997.
5. Richard G Lyons, “Understanding Digital Signal Processing”, 3/e, Prentice Hall.
6. E – RESOURCES
7. <https://www.sanfoundry.com/1000-digital-signal-processing-questions-answers/>
8. <https://www.gatestudy.com/multiple-choice-questions>
9. <https://nptel.ac.in/courses/117102060/>
10. https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/video-lectures/
11. COURSE OBJECTIVES:

**Course Overview:**

The present course covers the concepts and techniques of modern digital signal processing which are fundamental to all the signal/speech/image processing, applications. The course starts with a detailed overview of discrete-time signals and systems, representation of the systems by means of difference equations, and their analysis using Fourier and z-transforms. The notion of discrete Fourier transform is introduced, followed by an overview of fast algorithms for its computation. The methods for spectral analysis of discrete-time signals are discussed next, principal methods for design of FIR and IIR filters, followed by multi-rate signal processing and finite word length effects. While this course deals largely with the theory of DSP, we will use a powerful software package, MATLAB, to look at applications of this theory, particularly Fourier analysis and digital filter design.

**The objectives of this course are to impart to the following to the students:**

* Understand the basic structure of DSP system
* Determine DFT , apply properties of DFT
* Construct Radix-2 FFT algorithms
* Design FIR and IIR filters &Implement Digital filter structures
* Learn Interpolation & Decimation concepts
* Understand DSP processor, its architecture, Addressing modes

1. COURSE OUTCOMES

**After completing this course the student will be able to:**

|  |  |  |
| --- | --- | --- |
| **CO No.** | **Course Outcome** | **Taxonomy**  **Level** |
| 503.1 | Students will be able to  **identify** the importance of DSP in real time processing (TL:3) | **Apply** |
| 503.2 | Students will be able to  **compute** DFT & **apply**  its properties in problem solutions , also **optimize** the calculation using FFT algorithm (TL:3) | **Apply** |
| 503.3 | Students will be able to  **design, evaluate& construct**  FIR filters to satisfy desired frequency response by hand (TL:6) | **Create** |
| 503.4 | Students will be able to **design,evaluate& construct**  IIR filters on the basis of an analogue design by hand (TL:6) | **Create** |
| 503.5 | Students will be able to**compute & comprehend**  sampling rate conversions & their applications(COMPUTE/DETERMINE,TL:5) | **Evaluate** |
| 503.6 | Students will be able to understandtheimportance of DSP processor **applications** and also **comprehend** thearchitecture, addressing modes & instruction set of TMS processor(TL:3) | **Apply** |

1. MAPPING OF COs WITH POs & PSOs

Correlation Level: High – 3; Medium – 2; Low – 1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PO / CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PS01** | **PSO2** | **PSO3** |
| **C503.1** | 2 | 1 | 0 | 0 | 1 | - | - | - | - | - | - | - | 2 | - | - |
| **C503.2** | 2 | 2 | 2 | 0 | 2 | - | - | - | - | - | - | - | 3 | - | - |
| **C503.3** | 3 | 3 | 2 | 1 | 2 | - | - | - | - | - | - | - | 3 | - | - |
| **C503.4** | 3 | 3 | 2 | 1 | 2 | - | - | - | - | - | - | - | 3 | - | - |
| **C503.5** | 3 | 2 | 2 | 1 | 2 | - | - | - | - | - | - | - | 3 | - | - |
| **C503.6** | 2 | 2 | 1 | 1 | 2 | - | - | - | - | - | - | - | 2 | - | - |
| **C503** | 2.5 | 2.16 | 1.8 | 1 | 1.83 | - | - | - | - | - | - | - | 2.66 | - | - |

**Revised mapping closing the gaps:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PO / CO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PS01** | **PSO2** | **PSO3** |
| **C503.1** | 2 | 1 | 0 | 0 | 1 | - | - | - | 1 | - | - | - | 2 | - | - |
| **C503.2** | 2 | 2 | 2 | 0 | 2 | - | - | - | 1 | - | - | - | 3 | - | - |
| **C503.3** | 3 | 3 | 2 | 1 | 2 | - | - | - | 1 | - | - | - | 3 | - | - |
| **C503.4** | 3 | 3 | 2 | 1 | 2 | - | - | - | 1 | - | - | - | 3 | - | - |
| **C503.5** | 3 | 2 | 2 | 1 | 2 | - | - | - | 1 | - | - | - | 3 | - | - |
| **C503.6** | 2 | 2 | 1 | 1 | 2 | - | - | - | 1 | - | - | - | 2 | - | - |
| **C503** | 2.5 | 2.16 | 1.8 | 1 | 1.83 | - | - | - | 1 | - | - | - | 2.66 | - | - |

1. TEACHING-LEARNING METHODOLOGY ADOPTED
2. Chalk and Talk
3. PPTs, Animations and Videos for illustrations
4. Group Assignment.
5. Presentation
6. METHOD OFASSESSMENT OFCOs and POs:

|  |  |  |
| --- | --- | --- |
| Cos | Relevant Pos | Mode of Assessment |
| C503.1-C503.6 | PO1: ENGINEERING KNOWLEDGE  PO2: PROBLEM ANALYSIS  PO3: DESIGN/ DEVELOPMENT OF SOLUTIONS  PO4: CONDUCT INVESTIGATION ON COMPLEX PROBLEMS  PSO1: PROFESSIONAL COMPETENCE | Assignments, Quizzes, Internal Examinations and External Examination result |
| C503.1-C503.6 | PO5: MODERN TOOL USAGE | Exercises to learn through ICT tools and internet websites, Usage of Excel worksheets for problem solving |
| C503.1-C503.6 | PO9: IINDIVIDUAL AND TEAM WORK | Group Assignments, Writing skills in documenting assignments, Presentations |

1. LESSON PLAN:

The course plan is meant as a guideline. There may probably be changes.

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| --- | --- | --- | --- | --- |
| Period | Unit | *Topics to be covered* | Methodology used | No. of Classes |
| 2tnd July 2018 to 28th October 2018 | I | Introduction to DSP, Block diagram of DSP, Advantages of DSP over ASP | PPTs | 1 |
| DFT : Efficient Computation of DFT-Properties of DFT | Board | 1 |
| DFT Properties continued and solving Problems on DFT | Board | 1 |
| Linear and Circular convolution concepts, comparison and problems | Board | 2 |
| FFT Algorithms- Radix-2 FFT Algorithms (DIT-FFT) | Board | 2 |
| In-Place Computation-Bit Reversal & Problems on DIT-FFT Algorithm | Board | 2 |
| Decimation In Freq. DIF-FFT Algorithms, and IFFT | PPTs | 2 |
| Problems on DIT-FFT & DIF-FFT Algorithms. | Board | 2 |
| II | Digital Filters(IIR) Design: Butterworth Approximation | Board | 1 |
| Chebyshev Approximation,Comparison b/w Butterworth &Chebyshev filters | Board | 1 |
| Frequency transformations in Analog& Digital domain; Steps to design Analog Butterworth, Chebyshev LPF | Board | 2 |
| Problems on Butterworth &Chebyshev filters | Board | 2 |
| Impulse Invariant Transformation technique | Board | 1 |
| Bilinear Transform Techniques, Warping Effect | Board | 2 |
| Digital Butterworth-Chebyshev Filters ,Steps to design a Digital filter using IIT,BLT | Board | 2 |
| Problems on Digital Butterworth &Chebyshev filters, Realization of IIR | Board | 1 |
| III | DigitalFilters(FIR) Design: Amplitude & Phase Response of FIR Filter | PPTs | 2 |
| Gibbs PhenomenonLinear Phase Filters-Windowing Techniques-Bartlett, Rectangular, Kaiser | Board | 4 |
| Hamming, Blackman-Realization of FIR filters, Problems on windowing techniques & Realizations | Board | 4 |
| Finite Word Length Effects | PPTs | 1 |
| Comparison b/w FIR & IIR Filters | Board | 1 |
|
| IV | Multirate DSP: IntroductionDecimation by a Factor D Interpolation By a Factor I | Board | 2 |
| Sampling Rate Conversion By a Rational Factor I/D-& Its Implementation | Board | 2 |
| Multistage Implementation Of Sampling Rate Conversion | Board | 2 |
| Sampling Rate Conversion By An Arbitrary Factor | Board | 2 |
| Application OfMultirate Signal Processing | Board | 1 |
| V | Introduction To DSP Processors: Difference B/W DSP & Other Mp Architectures-Their Comparision | Board, PPTs | 3 |
| & Need For Asp, RISC & CPU | Board | 2 |
| General Purpose DSP Processors –Tms320c54xx Processor, Architecture | PPTs | 2 |
| Addressing Modes-Special Addressing modes of DSP processor | PPTs | 2 |
| Instruction Sets with examples | PPTs | 2 |
|  |  | Total Classes |  | 58 |

**Prepared by:** Mr.I.SRIKANTH,Associate Professor, ECE

**Signature:**

**Date :0**1 July, 2018

**HOD, EcE**