FR. Conceicao Rodrigues College Of Engineering

Father Agnel Ashram, Bandstand, Bandra-west, Mumbai-50

Department of Computer Engineering

B.E. (Computer) (semester VII)

(2019-2020)

Course Outcomes & Assessment Plan

Subject: Digital Signal and Image Processing (Course Code CSC-701) Credits-5

Syllabus:

1. Discrete-Time Signal and Discrete-Time System

1.1 Discrete-Time Signal and Discrete-Time System

Introduction to Digital Signal Processing, Sampling and Reconstruction, Standard DT Signals, Concept of Digital Frequency, Representation of DT signal using Standard DT Signals, Signal Manipulations (shifting, reversal, scaling, addition, multiplication).

1.2. Classification of Discrete-Time Signals, Classification of Discrete Systems

1.3 Linear Convolution formulation for 1-D and 2-D signal (without mathematical proof), Circular Convolution (without mathematical proof), Linear convolution using Circular Convolution. Auto and Cross Correlation formula evaluation, LTI system, Concept of Impulse Response and Step Response, Output of DT system using Time Domain Linear Convolution

2. Discrete Fourier Transform

2.1 Introduction to DTFT, DFT, Relation between DFT and DTFT, IDFT

2.2 Properties of DFT without mathematical proof (Scaling and Linearity, Periodicity, Time Shift and Frequency Shift, Time Reversal, Convolution Property and Parsevals' Energy Theorem). DFT computation using DFT properties.

2.3 Transfer function of DT System in frequency domain using DFT. Linear and Circular Convolution using DFT, Convolution of long sequences, Introduction to 2-D DFT

3. Fast Fourier Transform

3.1 Need of FFT, Radix-2 DIT-FFT algorithm,

3.2 DIT-FFT Flow graph for N=4 and 8, Inverse FFT algorithm.

3.3. Spectral Analysis using FFT

4. Digital Image Fundamentals

4.1 Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization

4.2 Representation of Digital Image, Connectivity

4.3 Image File Formats: BMP, TIFF and JPEG.

5. Image Enhancement in Spatial domain

5.1 Gray Level Transformations, Zero Memory Point Operations,

5.2 Histogram Processing, Histogram equalization.

5.3 Neighborhood Processing, Spatial Filtering, Smoothing and Sharpening Filters, Median Filter.

6. Image Segmentation

6.1 Segmentation based on Discontinuities (point, Line, Edge)

6.2 Image Edge detection using Robert, Sobel, Previtt masks, Image Edge detection using Laplacian Mask.

Text Books

1. John G. Proakis, Dimitris and G.Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications' 4th Edition 2007, Pearson Education.
2. Anand Kumar, Digital Signal Processing', PHI Learning Pvt. Ltd. 2013.
3. Rafel C. Gonzalez and Richard E. Woods, Digital Image Processing', Pearson Education Asia, 3rd Edition, 2009,
4. S. Sridhar, Digital Image Processing', Oxford University Press, Second Edition, 2012.

Reference Books

1. Sanjit Mitra, _Digital Signal Processing: A Computer Based Approach', TataMcGraw Hill, 3rd Edition.
2. S. Salivahanan, A. Vallavaraj, and C. Gnanapriya, Digital Signal Processing' Tata McGraw Hill Publication 1st Edition (2010).
3. S. Jayaraman, E. Esakkirajan and T. Veerkumar, Digital Image Processing' TataMcGraw Hill Education Private Ltd, 2009.
4. Anil K. Jain, Fundamentals and Digital Image Processing', Prentice Hall of India Private Ltd, 3rd Edition.

ON-LINE COURSE –MATERIAL-REFERRED

MIT-OPEN-COURSEWARE

https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/

IMPERIAL COLLEGE -LONDON

http://www.commsp.ee.ic.ac.uk/~agc/course4.htm

UNIVESCITY OF TEXAS

http://signal.ece.utexas.edu/~arslan/courses/dsp/index.html

TUTORIAL-POINT

https://www.tutorialspoint.com/digital_signal_processing/

Course Outcomes:

Upon completion of this course students will be able to:

CO. No	Course Outcome	Blooms Taxonomy Level
CSC701.1	To understand the fundamental concepts of digital signal processing and Image processing. (Demonstrate understanding of discrete signals)	**B2-Understand**
CSC701.2	To explore DFT for 1-D and 2-D signal and FFT for 1-D signal (Characterizing the system)	**B4- Analyze**
CSC701.3	To apply processing techniques on 1-D and Image signals. (Understand the concept of converting a discrete signal from time domain to frequency domain)	**B2-Understand**
CSC701.4	To apply digital image processing techniques for edge detection (Apply the knowledge of signal processing to develop the small application)	**B3- Application**

Mapping of CO and PO/PSO

Relationship of course outcomes with program outcomes: Indicate 1 (low importance), 2 (Moderate Importance) or 3 (High Importance) in respective mapping cell.

	PO1 (Engg Know)	PO2 (Ana)	PO3 (De sign)	PO4 (inve stiga)	PO5 (tools)	PO6 (engg Soci)	PO7 (Env)	PO8 (Eth)	PO9 (ind Team)	PO10 (comm.)	PO11 (PM)	PO12 (life Long)
CSC701.1	3	1										
CSC701.2	3	3										
CSC701.3	3	1										
CSC701.4	3	3	3		1				3			
Course To PO	3	2	3		1				3			

CO	PSO1	PSO2
CSC701.1	3	
CSC701.2	3	
CSC701.3	3	
CSC701.4	3	3
Course to PSO	3	3

Justification

PO1: This subject all COs are mapped to PO1 because engineering graduates will be able to apply the knowledge Digital Signal Processing fundamentals to solve engineering problems

PO2 CSC 701.1 and CSC 701.2 are mapped to PO2 because students analyze the different operations of Discrete time signals and categories Discrete time system.

CSC 701.3 is mapped to PO2 because students are analyze the flow graphs

CSC 701.4 is mapped to PO2 because student perform review of literature of real world problem to develop an application of Signal processing

PO3: CSC 701.4 is mapped to PO3 because students design an application of signal processing

PO5: CSC 701.4 is mapped to PO5 because the students use the tools like scilab and matlab to implement application of signal processing

PO9 CSC 701.4 is mapped to this PO9 because the students work in a team to develop the mini project

PSO1: All COs are mapped to PSO1 because the graduates will be able to apply fundamental knowledge of digital signal processing to solve the real world problems.

PSO2: CO701.4 is mapped to this PSO2 because students design and implement the system to meet specific requirement.

CO Assessment Tools:

CO1 (CSC701.1) - To understand the fundamental concepts of digital signal processing and Image processing. (Demonstrate understanding of discrete signals)

CSC701.1: **Direct Methods(80%):** Test 1 quiz Lab Module Test UniExamTh

CO1dm = 0.2T1 + 0.1Q +0.1ModuleTest+0.3L+ 0.3UTh

InDirect Methods(20%): Course exit survey

CO1idm

CSC701.1 = 0.8*CO1dm + 0.2* CO1idm

Target level: 2.20

CO2 (CSC701.2) - To explore DFT for 1-D and 2-D signal and FFT for 1-D signal (Characterizing the system)

CSC701.2: **Direct Methods(80%):** Test 1 quiz Lab Module Test UniExamTh

CO1dm = 0.2T1 + 0.2 A+0.1Q +0.1MT+ 0.4UTh

InDirect Methods(20%): Course exit survey

CO1idm

CSC701.2 = 0.8*CO1dm + 0.2* CO1idm

Target level: 2.20

CO3 (CSC701.3) - To apply processing techniques on 1-D and Image signals. (Understand the concept of converting a discrete signal from time domain to frequency domain)

CSC701.3: **Direct Methods(80%):** Test2 Assignments Lab UniExamTh

CO3dm = 0.25Test2+0.15A + 0.3L + 0.3UTh

InDirect Methods(20%): Course exit survey

CO3idm

CSC701.3 = 0.8*CO3dm + 0.2* CO3idm

Target level: 2.20

CO4 (CSC701.4) – To apply digital image processing techniques for edge detection (Apply the knowledge of signal processing to develop an small application)

CSC701.4: **Direct Methods(80%):** MiniProject UniExamTh

CO4dm = 0.8MP + 0.2Report

InDirect Methods(20%): Course exit survey

CO4idm

CSC701.4 = 0.8*CO4dm + 0.2* CO4idm

Target level: 2.20

List of Experiments and Plan

Sr. No	Title	Mapped to CO	Planned Week
1	Sampling and reconstruction	CO1	Week1

2	Discrete Correlation	CO1	Week2
3	Discrete Convolution	CO2	Week3
4	Discrete Fourier Transform	CO2	Week4
5	Fast Fourier Transform	CO3	Week5
6	Implementation of Image negative, Gray level Slicing and Thresholding	CO3	Week6
7	Implementation of Contrast Stretching ,Dynamic range compression & Bit plane Slicing	CO4	Week7
8	Implementation of Histogram Processing	CO4	Week8
9	Implementation of Image smoothing/ Image sharpening		
10	Implementation of Edge detection using Sobel and Previtt masks		

Curriculum Gap and Content Beyond Syllabus:

In order understand current applications, trends and new directions in DSP following topics will be covered

Sr.No.	Curriculum gap contents	Action Plan	Mapped to PO
1	Open source Tool for Speech Processing	Online resource	Po5, PO12 (Life long learning)
2.	Role of DSP in Mobile phones	Power Point Presentation	PO12 (Life long learning)

Rubrics for the Assignments :

Indicator	Poor	Average	Good	Excellent
Timeline (2)	NA	Late (1)	NA	on time (2)
Organization (2)	readability very poor and not structured (0.5)	Poor readability and somewhat structured (1)	Readable with one or two mistakes and structured (1.5)	Very well written and structured without any mistakes (2)
Solution (4)	Partially correct Solution with minor mistakes(1)	Correct solution but some of the specifications or steps in solution are missing (2)	Correct and detailed solution (3)	Correct and most detailed solution (4)

Depth and breadth discussion (2)	No evidence, superficial at most (0.5)	Minor points/ missing information and minimal discussion (1)	Discussion centers on some of the points covering adequately (1.5)	Information is presented in detail depth and is accurate (2)

Rubrics for the Lab Experiments:

Sr. No	Performance Indicator	Excellent	Good	Below Average	Total Score
1	On time Completion & Submission (01)	01 (On Time)	NA	00 (Not on Time)	
2	Logic/Theory understanding(02)	02(Correct)	NA	01 (Tried)	
3	Coding Standards (03): Comments/indention/Naming conventions Output/Test Cases	03(All used)	02 (Partial)	01 (rarely followed)	
4	Post Lab Assignment (04)	04(done well)	3 (Partially Correct)	2(submitted)	

Unit Test-I

CSC701.1*:* Manipulate discrete time signal (Demonstrate understanding of discrete signals)

CSC701.2*:* Analyze discrete time system in time domain (Characterizing the system)

Q.1	Convert analog signal , $x(t) = 10e^{-5000t}u(t)$ into digital signal x(n), when sampling period is 125 microsecond, also plot sample values	**[CSC701.1]**	**5M**
Q.2	Determine any two new signals (a) y1(n) = w(n) + x(n) (b) y2(n) = 3 + x(n) (c) y3(n) = w(n)x(n) (d) y4(n) = 3 /2 x(n) (e) y5(n) = X(-3-x) from the following two signals of length 5 defined for $-1 \le n \le 3$:	**[CSC701.1]**	**5M**

	w(n) = {1.5, 2↑ , 3.4, −5, 10} x(n) = {2.2, 3 ↑, 2, 4.2, 8}		
Q3	Obtain the linear convolution of the following sequences by Graphical method x(n) = {1,2,1,2 } and h(n) = {1,1,1}	**[CSC701.2]**	**5M**
Q4	Determine the any two system properties (linear/non-linear, shift variant/invariant , causal/noncausal, static/ dynamic, stable/unstable) for the input-output relationships, y(n) = nx(n)	**[CSC701.2]**	**5M**

Unit Test-II

CSC-701.01 - To apply processing techniques on 1-D and Image signals. (Understand the concept of converting a discrete signal from time domain to frequency domain) **CSC-701.01 -** To apply digital image processing techniques for edge detection (Apply the knowledge of signal processing to develop an small application)

Q No 1. How Spatial Filtering Methods works in image processing?
(CO - CSC-701.01) **(10 Marks)**

Q No 2. Discuss how the derivative filters are used in Digital Image Enhancement? (CO - CSC-701.02) **(5 Marks)**

OR

Q No 2. Explain Gray level transformation functions with example for contrast enhancement in image (CO - CSC-701.02) **(5 Marks)**

Q No 3. Explain how histogram is useful in image enhancement? (CO - CSC-701.02) **(5 Marks)**

OR

Q No 3. Explain about Prewitt and Sobel edge Detectors. (CO - CSC-701.02) **(5 Marks)**

Assignments :

[First Assignment]Date: 20-08-19 Submission Date :26-08-19

CSC701.1: To understand the fundamental concepts of digital signal and Image processing.
CSC701.2 :To explore DFT for 1-D and 2-D signal and FFT for 1-D signal

1) Consider the sequence x[n] = {3,7} and h[n]={2,5, 4} Find y(n)

2) Determine the 4 part DFT and sketch the magnitude of DFT .x(n) = {1,1,0,0}

3) Find the value of x(n) = Cos (0.25□n) for n = 0,1,2,3 ... Compute the DFT of x(n) using FFT flow graph

4) Find the IDFT of X[K] ={10,-2+2j,-2,-2-2j) using IFFT

5) Perform Circular correlation of the following sequence $x_1[n]$ = {1,2,5,6} & $x_2[n]$ = {3,4,7,9}

[Second Assignment] Date: 01-10-19 Submission Date: 10-10-19

CSC701.3: To apply processing techniques on 1-D and Image signals.
CSC701.3: To apply digital image processing techniques for edge detection

Q 1. Discuss the importance of a kernel/ mask/window used in spatial filtering for digital image enhancement.
Q 2. What is meant by image enhancement by point processing? Discuss any two methods.
Q 3. Discuss how the derivative filters are used in Image Enhancement?
Q 4. Explain Gray level transformation functions for contrast enhancement
Q 5. Explain about Region Splitting and Merging with an example
Q 6. Perform the Histogram Stretching of below image with 8 intensity levels.

Grey Level	0	1	2	3	4	5	6	7
No. of Pixels	0	0	50	60	50	20	10	0

DSIP Course Exit Survey/ Acc. Year 19-20 /Sem VII

1. I have understood the fundamental concepts of digital signal processing and Image processing	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
2. I am able to characterize the discrete systems in terms of its properties(linear/non-linear, shift variant/invariant , causal/noncausal, static/ dynamic, stable/unstable)	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
3. I am able to Compute Discrete Fourier Transform and Fast Fourier Transform	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
4. I have used digital Signal Processing concepts in my B.E. project	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5. I think I have made progress and understood all lab practical's	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

FR. Conceicao Rodrigues College Of Engineering

Father Agnel Ashram, Bandstand, Bandra-west, Mumbai-50

Department of Computer Engineering

B.E. (Computer) (semester VII)

(2019-2020)

Modes of Content Delivery:

i	Class Room Teaching	V	Self Learning Online Resources	Ix	Industry Visit
ii	Tutorial	Vi	Slides	X	Group Discussion
iii	Remedial Coaching	Vii	Simulations/Demonstrations	xi	Seminar
iv	Lab Experiment	Viii	Expert Lecture	xii	Case Study

Lect. No.	Portion to be covered	Planned date	Actual date	Content Delivery Method/Learning Activities
Module 1: Discrete-Time Signal and Discrete-Time System				
1.	Introduction to Digital Signal Processing,	2/7/2019	3/7/2019	Class Room Teaching
2	Sampling and Reconstruction,	3/7/2019	4/7/2019	Class Room Teaching
3	Standard DT Signals, Concept of Digital Frequency,	4/7/2019	9/7/2019	Class Room Teaching
4	Representation of DT signal using Standard DT Signals,	5/7/2019	10/7/2019	Class Room Teaching
5	Signal Manipulations (shifting, reversal, scaling, addition, multiplication).	9/7/2019	11/7/2019	Class Room Teaching
6	Signal Manipulations (shifting, reversal, scaling, addition, multiplication).	10/7/2019	12/7/2019	Class Room Teaching
7	Classification of Discrete-Time Signals	11/7/2019	16/7/2019	Class Room Teaching
8	Classification of Discrete-Time Signals, Classification of Discrete-Systems	12/7/2019	17/7/2019	Class Room Teaching
9	Classification of Discrete-Systems	16/7/2019	18/7/2019	Class Room Teaching
10	Linear Convolution formulation for 1-D and 2-D signal (without mathematical proof)	17/7/2019	19/7/2019	Class Room Teaching

11	Circular Convolution (without mathematical proof)	18/7/2019	23/7/2019	Class Room Teaching, Lab Experiment
12	Linear convolution using Circular Convolution	19/7/2019	24/7/2019	Class Room Teaching , Lab Experiment
13	Auto and Cross Correlation formula evaluation, LTI system	23/7/2019	25/7/2019	
14	Concept of Impulse Response and Step Response, Output of DT system using Time Domain Linear Convolution	24/7/2019	26/7/2019	
Module 2: Discrete Fourier Transform				
15	Introduction to DTFT, DFT	25/7/2019	30/7/2019	Class Room Teaching
16	Relation between DFT and DTFT, IDFT	26/7/2019	31/7/2019	Class Room Teaching
18	Properties of DFT without mathematical proof - Scaling and Linearity	30/7/2019	1/8/2019	Class Room Teaching
18	Properties of DFT without mathematical proof - Periodicity, Time Shift and Frequency Shift	31/7/2019	2/8/2019	Class Room Teaching
19	Properties of DFT without mathematical proof - Time Reversal, Convolution Property and Parsevals' Energy Theorem	1/8/2019	6/8/2019	Class Room Teaching
20	DFT computation using DFT properties	2/8/2019	7/8/2019	Class Room Teaching
21	Transfer function of DT System in frequency domain using DFT. Linear and Circular Convolution using DFT	6/8/2019	8/8/2019	
22	Convolution of long sequences, Introduction to 2-D DFT	7/8/2019	8/8/2019	
Module 3: Fast Fourier Transform				
23	Need of FFT, Radix-2 DIT-FFT algorithm	8/8/2019	9/8/2019	Class Room Teaching
24	Need of FFT, Radix-2 DIT-FFT algorithm	9/8/2019	20/8/2019	Class Room Teaching
25	DIT-FFT Flow graph for N=4 and 8,	13/8/2019	21/8/2019	Class Room Teaching
26	Inverse FFT algorithm	14/8/2019	22/8/2019	Class Room Teaching

27	Spectral Analysis using FFT	16/8/2019	23/8/2019	Class Room Teaching
28	Spectral Analysis using FFT	20/8/2019	27/8/2019	Class Room Teaching
Module 4: Digital Image Fundamentals				
29	Introduction to Digital Image	21/8/2019	28/8/2019	Class Room Teaching
30	Digital Image Processing System	22/8/2019	29/8/2019	Class Room Teaching
31	Sampling and Quantization	23/8/2019	29/8/2019	Class Room Teaching
32	Sampling and Quantization	27/8/2019	30/8/2019	Class Room Teaching
33	Representation of Digital Image, Connectivity	28/8/2019	30/8/2019	Class Room Teaching
34	Representation of Digital Image, Connectivity	29/8/2019	3/9/2019	Class Room Teaching
35	Image File Formats: BMP, TIFF and JPEG	30/8/2019	4/9/2019	Class Room Teaching
36	Image File Formats: BMP, TIFF and JPEG	3/9/2019	5/9/2019	
Module 5: Image Enhancement in Spatial domain				
37	Gray Level Transformations	4/9/2019	5/9/2019	Class Room Teaching
38	Zero Memory Point Operations	5/9/2019	18/9/2019	Class Room Teaching
39	Histogram Processing	6/9/2019	18/9/2019	Class Room Teaching
40	Histogram equalization	11/9/2019	19/9/2019	Class Room Teaching, Slides
41	Neighborhood Processing	12/9/2019	20/9/2019	Class Room Teaching, Slides/online recourse
42	Spatial Filtering	13/9/2019	24/9/2019	Class Room Teaching, Slides
43	Spatial Filtering	17/9/2019	24/9/2019	Class Room Teaching, Slides
44	Smoothing and Sharpening Filters	18/9/2019	25/9/2019	Case Study , Slides
45	Smoothing and Sharpening Filters	19/9/2019	26/9/2019	Case Study , Slides
46	Median Filter	20/9/2019	26/9/2019	Class Room Teaching

Module 6: Image Segmentation				
47	Segmentation based on Discontinuities (point, Line, Edge),	24/9/2019	29/9/2019	Class Room Teaching, Slides
48	Segmentation based on Discontinuities (point, Line, Edge),	25/9/2019	27/9/2019	Class Room Teaching
49	Image Edge detection using Robert	26/9/2019	30/9/2019	
50	Sobel, Previtt masks	27/9/2019	30/9/2019	
51	Image Edge detection using Laplacian Mask	1/10/2019	1/10/2019	
52	Image Edge detection using Laplacian Mask	3/10/2019	3/10/2019	