#### INNOVATIVE TEACHING LEARNING METHODS

The Contributions made by ECE Department Faculty towards inculcating innovative methods in Teaching and Learning are clearly elucidated both in our Department Records and on the Institute Website for peer review and critique. These methods provide scopes to enhance and reproduction of the same.

Method: Mind Mapping Faculty: Dr.P K Pradhan Associate Prof. Subject: Image and computer vision Academic Year: IV / I Sem , 2023-24



Method: Mind Map Name of the Faculty: Bijaya Muni Name of the Subject: Signals and Systems Year & Semester: II Year I Sem, AY:2023-34

This mind map picture helps the students to visualize the signals and systems in details, so that students finds easy for them to remember the complete picture of signals and systems like continuous time signals and discrete time signals etc.



Method: Mind mapping Faculty Mrs. K Shilpa Designation: Asst. Prof, ECE Course Name: Disaster Management AY: 2022-23 Topic covered: NDMA Guidelines for various Disasters Goals/objective of method: To evaluate the student's awareness of the course and their progress.



The above map gives an idea of storming the mind with complete knowledge of various disasters and managing the disaster

The students were able to learn whats disaster with various aspects and its classification.

Mind Map was used to brainstorm and generate discussions. Mind Map image was displayed to students and they are asked to discuss it among themselves. Mind map represents various applications of image and computer vision in different fields. This further illustrates the steps involving in applications.

**OUTCOME:** Students were encouraged not only to participate but also to fully understand the topic and its depth by creating connections between ideas. This makes students remember the topic for a longer time

Method/Activity: Mind Mapping Faculty: Mrs. Samatha Gaddam Designation: Assistant Professor, ECE Course Name: MPMC Academic Year: 2022-23

Goals/objective of method: **To generate**, visualize, organize, problem-solving **and to** show the overall structure of a subject and the relative importance of individual parts of it.

Topic covered through activity: Classification and Register organization of 8086 microprocessor.



Benefits of method:

The mind mapping gives the pictorial picture of programmable registers, a flexible and enjoyable way to learn.

For review: samatha.gaddam99@gmail.com

Method/Activity: Mind map Method Faculty/Inventor: Mrs.K. Snehalatha Designation: Assoc. Prof, ECE Course Name: Digital Signal Processing Academic Year: 2022-23 Goals/objective of method: To evaluate the student's awareness of the course and their progress.

#### **Topic covered through activity**: FFT algorithms & applications.

This map will give a best picture about the different transform techniques and analysis of their representation whether in continuous or discrete domains. This will give a best mark in memory about the DFT's and FFT's and their importance in digital system domain.



Method/Activity: Mind map Method Faculty/Inventor: Mrs.K. Snehalatha Designation: Assoc. Prof, ECE Course Name: Signals and Systems Topic covered through activity: Fourier analysis Academic Year: 2022-23

Goals/objective of method: To evaluate the student's awareness of the course and their progress.

The mind map will mark the importance of Fourier Analysis in the frequency representation of signal and spectral analysis. This also depicts the use of different transforms and their need in communication systems and signal analysis.



Method/Activity: Mind Map Faculty/Inventor: Dr. Himanshu Sharma Designation: <sup>1</sup>Assoc. Professor, ECE Department Course Name: Wireless Communication & Networks AY: 2021-22 Goals/objective of method: To evaluate the student's awareness about the concept of Wireless Networking Topic covered through activity: Concept of Wireless Networking & GSM

#### **Description of method:**

Creating a Kahoot Quiz on wireless networking helped to organize and visualize the key concepts, components, and relationships within this broad and dynamic field. This served the students as a helpful study tool for learning.

#### **Benefits of method:**

Kahoot is an online game-based learning platform that allows educators to create quizzes, surveys, and discussions to engage students in an interactive and fun way. Here are some benefits of using Kahoot quizzes for students: Visual Learning Aid, Engagement and Motivation, Active Learning, Immediate Feedback, Formative Assessment, Customization, Fun Learning Environment, Data Analysis



Incorporating Kahoot Quiz into their study routine allowed students to approach learning in a more engaging and effective way.

Email ID: <u>himanshu.ece@jbiet.edu.in</u>

Method/Activity: Mind map Method Faculty/Inventor: Mrs. K Shilpa Designation: Asst. Prof, ECE Course Name: Network Analysis AY 2021-22 Topic covered through activity: Basics of Network Analysis

Goals/objective of method: To evaluate the student's awareness of the course and their progress.



Here is an example of Basics of Network Analysis

Oral Quiz was conducted on the terms related to Network analysis and Analysis techniques. Outcome: It allowed the students to visually structure their ideas to recall. Method/Activity: Mind map Method Faculty/Inventor: Mrs. B. Supriya Designation: Asst. Prof, ECE Course Name: Probability Theory and stochastic process Academic Year: 2021-22 Goals/objective of method: To evaluate the student's awareness of the course and their progress. Topic covered through activity: Different types of stochastic process



Referring the map, students will get an idea about different Stochastic process and sub classification and then faculty will explain in brief the topics with reference

#### Benefits of Mind Maps for Students

Students are struggling with cramming a vast amount of information delivered in lectures? , Getting frustrated before exams because they have no idea of where to start with bulks of lecture notes? A mind map comes to rescue students.

Instead of going hierarchically from top to bottom, condensed ideas branch out radially from the central concept. Hence, students can rapidly grasp all data and visualize their connections simultaneously. Simplification makes it more memorable.

Method/Activity: Flip class Faculty/Inventor: Mr. Rajkumar D Bhure Designation: Assoc.Professor, ECE Course Name: Satellite Communication Academic Year: 2021-22 Goals/objective of method: To understand the concept of working of satellite Communication Topic covered through activity: all the methodology used for communication and concept of working

#### Description of method

Certainly! Mind mapping is a visual way to organize information and ideas, allowing for better understanding and recall. Here's a simple mind map on satellite communication. This mind map provides a structured overview of satellite communication, including its components, communication process, frequency bands, applications, challenges, and future trends. Feel free to customize and expand upon it based on your specific needs or use it as a starting point for more detailed exploration.



Benefits of method:

This text-based mind map outlines the main components, communication process, frequency bands, applications, challenges, and future trends of satellite communication. You can use this as a basis for creating a visual mind map using drawing tools, mind mapping software, or even on paper. Each major point can be expanded with more details and sub points as needed.

For Details: Mr.Rajkumar Bhure Bhure.rajkumar@gmail.com

Method/Activity: Mind map Method Name of the Faculty member: Bijaya Muni Branch: B.TECH, III-II Semester Academic Year: 2020- 2021 Topic: Spread Spectrum

The session describes the switching networks with multiple access techniques in communication. By visualizing this mind map students will be able to understand FDM, TDM, SSA techniques.



Method: Flipped classroom Name of the Staff: Dr Towheed Sultana Subject: Digital Electronics Academic Year:23-24 I Sem Topic: Flip Flops

NPTEL Video lecture no 29 and 30 were shared to students to study and to note down their doubts. The same vedio was played in the class and discussed to clear the doubts

Links of Lectures for the topic Flip Flops

http://www.infocobuild.com/education/audio-video-courses/electronics/DigitalCircuits-IIT-Kharagpur/lecture-29.html http://www.infocobuild.com/education/audio-video-courses/electronics/DigitalCircuits-IIT-Kharagpur/lecture-30.html



At the end of the class a quiz of 10 questions on the topic Flip Flop was conducted. The performance was amazing.

The activity helped the students do belter as it included interactions and discussions which helped them to understand the topic better.

#### Quiz

- 1. The basic building block of sequential logic gate
- 2. The basic latch consists of \_\_\_\_\_\_ In S-R flip-flop, if Q = 0 the output is said to be \_\_\_\_\_\_
- 3. A single Flip Flop is modulo \_\_\_\_\_\_counter
- 4. The basic building block of sequential circuit is
- 5. Which condition of inputs in JK FF is no change in output
- 6. D FF can be made from JK FF by making J and K as \_\_\_\_\_
- 7. The clear input is used to make output \_
- 8. When reset is low and set is high in a NOR D-latch table then the output will be \_\_\_\_\_
- 9. What is the standard form of D flip flop?
- 10. The type of operation performed by flip flop is \_\_\_\_\_
- © Synchronous
- Asynchronous

Method/Activity: Flipped Classroom Faculty/Inventor: Mrs. Akula Jyothi Designation: Asst. Prof, ECE Course Name: Electromagnetic Wave & Transmission Lines Academic Year - 2022-23 Goals/objective of method: To evaluate the student's awareness of the course and their progress.

Topic covered through activity: Voltage standing wave ratio and reflection quotient

Students were instructed to study the topic Voltage standing wave ratio. The students are made to learn independently. In the class questions were posed to the students by giving information in the form of a diagram. The faculty then correlates the knowledge acquired by the students to provide complete information about the topic



Students were actively involved in knowledge acquisition as they participated in Quiz and evaluated their learning

#### QUIZ

1. Relation between SWR 'S' and reflection coefficient 'p' is given by \_\_\_\_\_

- a) s =1+ $\rho/1-\rho$
- b)s=1- $\rho$ /1+ $\rho$
- c) s=1+ $\rho/\rho$
- d) s= $\rho/1-\rho$
- 2. Which of the following statements is true?
- a) Standing waves occur when mismatches occurs
- b) Standing waves occur when no mismatches occurs
- c) Minimum value of SWR is 0
- d) Maximum value of SWR is 1

3. If there are no any reflections, then the value of the SWR will be \_\_\_\_\_\_\_
a) 1
b) 0
c) ∞
d) 2
4. The value of the SWR when the reflection power is equal to the incident power is -----a) 1
b) 0

- c)  $\infty$
- d) 2
- 5. Voltage standing wave ratio is expressed as:
- a) |<u>Vmax|</u>

Vmin

b) |Vmax| \* |Vmin|

- c) |Vmax| + |Vmin|
- d)  $|\underline{Vmin}|$

|Vmax|

6) A Transmission line having Zo=75 $\Omega$  is used to deliver to 300ohm load. The VSWR of the circuit is

1)2.5

2)4

- 3)0.5
- 4)0.2

Method: Flipped classroom Name of the Staff: Dr Towheed Sultana Subject :MPMC AY 22-23 NPTEL Video lecture



In 8086 the overflow flag is set when\_\_\_\_.

The sum is more than 16 bit

Carry and sign flags are set

0

Signed numbers go out of their range after an arithmetic operation

During subtraction

3. If	flag is set: the processor enters the single step execution mode	1 point
0		
Direction		
0		
Trap		
0		
Interrupt		
0		
Zero		1 .
4. Which of	the following is not a machine control floop	1 point
which of	the following is not a machine control flag?	
Direction	flog	
Direction	liag	
Unterrunt t	nel	
Ö	lag	
Overflow	flag	
Ö	ing	
Trap flag		
5 Match e	ach animal with its classification	4 point
		1
CE		
CF		
IF		
	<b>v</b>	
SF		
~-		
OF	flag	
. overnow	nag	
. Sigii 11ag carry fla	Υ.	
interrunt	5	
<b>6</b> .		1 point
Direction	flag is used with	1 point
0		
String ins	tructions	
0		
Stack Inst	ructions	
0		
Arithmeti	c Instructions	
0		
Branch In	structions	
<u>S</u> ubmit		

Method: Flipped Classroom Name of the Faculty member: SOWMYA B Course: Embedded Real Time Operating Systems Topic: Software Performance Optimization Academic Year 2022-23 Time Allotted for the Activity: 60 Minutes

#### **Details of the Implementation:**

1. **Materials for the Activity:** The materials for the preparation of the students were shared one week before through LMS Canvas. Students were asked to refer to the webcontent also.

**2.Formation of Groups:** As per the number of sub-topics, student groups were created as below: Number of sub-topics: 06

Class Strength: 60 Number of groups: 10 Members per group: 06

#### 3. Topic Allocation:

For six sub-topics, students were divided into six groups, and topics were allotted in advance. The Students must prepare a 5-minute presentation, including the topic learned, 3 minutes for questions and answers, and a description of each member's participation

#### 4. Topic Delivery:

The main objective of the flipped classroom activity is that each group will learn one application, and the presentation helps the other members learn about the topic as well



Many students presented their slides with some examples without any stage fright. The activity helped the students do their roll belter and it includes interactions and discussions that helped students to understand the topics better.

Reflective Critique: Feedback from students on flipped class practise was taken

> The material shared with us helped a lot with slide preparation.

The choice of group formation given to the students provided an opportunityto pick their team member

*Method*: QUIZ method Name of the Staff: Mr. Rajkumar D Bhure Subject Satellite Communication AY 22-23 Duration:10 min

# **Satellite Communications Quiz-1**

\* Indicates required question

- 1. Email \*
- 2. Name \*
- 3. Roll Number \*
- 4. Section \*

*Check all that apply.* 

ECE A
ECE B

5. which of the band can not be used for Satellite Communications ? \*

1 point

Mark only one oval.

C Band

MF Band

<sup>–</sup> Ku Bamd

6. with reference to satellite orbit, Parigee is the $*$	1 point
Mark only one oval.	
<ul> <li>Point in an intermediate orbit</li> <li>Highest point in the orbit</li> <li>Lowest point in the orbit</li> </ul>	
7. The period of Satellite around the earth can be computed using	<b>]:</b> 1 point
Mark only one oval.	
<ul> <li>Newton's law of gravitation</li> <li>Kepler's Second law</li> <li>Kepler's Third law</li> </ul>	

8. The line joining the ascending and descending nodes through the center of the earth. Ipoint

Mark only one oval.

Descending node

→ Ascending node

\_\_\_\_ Line of nodes

Both (a) and (b

https://docs.google.com/forms/d/1zIO5JAH-0yueyYm2zAEftoU-0rdMUhCSorx9urXqsFg/edit

11/5

Method: Flipped classroom Name of the Staff: B. Shravan Kumar Subject: Internet of things Academic Year :22-23 Topic covered through activity: IOT in Domain Specific Application

Goals/objective of method: To evaluate the student's awareness of the course and their progress.



Video was played - on the topic IOT in Domain Specific Application discussed the topic and students were made to answer a few questions related to it. https://www.digimat.in/nptel/courses/video/106105166/L01.html

#### **Tutorial Sheet Based on Video Lecture:**

1.	. Key Elements of NFV Architecture are	[ ]
	a) VNF & NFVI b) NFV Managem	ent and Orchestration
	b) a&b d) None of the al	bove
2.	. MQTT stands for :	[ ]
	a) Message Query Telemetry Transport	) Meta Query Telemetry Transport
2	c) Multiple Query Telemetry Transport	) Multi-Queue Query Telemetry Transport
3.	. M2M stands for:	L J
	a) MAC to MAC communication b)	Machine to MAC communication
	c) Machine to machine communication d)	MAC to machine communication
4.	. SDN decouples from the	traditional devices: [ ]

a) Data Plane and Control Planeb) Data Plane and Application Planed) None of the above

5. Link Layer protocols determine how the data is \_\_\_\_\_

- 6. HTTP is a \_\_\_\_\_\_ and each request is independent
- 7. state full form of REST \_\_\_\_\_
- 8. \_\_\_\_\_\_ is a client-server protocol.
- 9. Data that does not conform to a data model or data schema is known as\_\_\_\_\_
- 10. M2M gateway acts as a \_\_\_\_\_\_ performing translations from / to native protocols to / from Internet Protocol
- 11. The unique Identifiers of the things are \_\_\_\_\_
- 12. IoT data collection is in \_\_\_\_\_

13. \_\_\_\_\_language preferred for IoT analytics.

14. The most commonly used protocols in IoT/M2M connections are \_\_\_\_\_

15. \_\_\_\_\_ is a collection of data that is used in volume, yet growing exponentially with time

- 16. Working Group of NFV is \_\_\_\_\_
- 17. Netopeer is set of open source \_\_\_\_\_\_ built on the Libnetconf library
- 18. \_\_\_\_\_ involves the simultaneous execution of multiple sub-tasks that collectively comprise a larger task.
- 19. YANG is a data modeling language used to \_\_\_\_\_\_manipulated by the NETCONF protocol.
- 20. VNC stands for \_\_\_\_\_

Method: Learning by doing Name of the Faculty: Ms. Jyothi Name of the Subject: BEEE Year & Semester: I Year I Sem Academic Year: 2023-34 Topic: Common Emitter configuration

Department has two dedicated labs for implementing "Learning by doing" methodology. In these labs, students are provided with hands-on training for the better learning experience. Labs and classes are held together to implement "Learning by doing".



**Process:** Students are performing the common emitter base configuration characteristics and observing how the operating point on the load line will affect the amplification factor.

Method: Learning by doing Name of the Faculty: Ms Samantha G

Name of the Subject: Microprocessor

Year & Semester: II Year I Sem, AY:2023-34

**IDEA:** To explain the application for a particular concept first and then the concept Implementation

Listing different peripherals (like keyboard, mouse, LEDs and switches) used for better operation of 8086 microprocessor. Discussion of interfacing them with 8086. Drawing the need of using 8255 for interfacing 8086 with peripherals by increasing the number of I/O ports then discuss the 8255 architecture.

- 1. Program to display alternate LEDs.
- 2. Diplay first four (1.2.3.4) LEDs ON and 5, 6, 7 and 8 LEDs OFF and repeat.



**OUTCOME:** Creating interest among the students in knowing the topic

#### Method: Learning by doing Name of the Faculty: Ms Supriya

Name of the Subject: Basic Electronics and Electrical Engineering

Year & Semester: I Year II Sem, AY:2023-34

To enhance collaborative and creative skills.

- 1. Design and observe the input and output waveforms of the Half-wave rectifier on CRO with and without filter for different load resistors.
- 2. Find load regulation and ripple factor of a half-wave rectifier both with and without filter.





**Implementation:** To involve students in 'experiential learning by doing and observing **Outcome:** Students will be able to learn core subjects in an elaborative and practical way.

Method: Learning by doing Name of the Faculty: Ms B Sowmya Name of the Subject: IC Applications Year & Semester: III Year I Sem, AY:2022-23

To Study the features of OP Amp 741 and design Adder, Subtractor and Comparator circuit



**Outcome:** The practical process has been coupled with theoretical aspects of the degree course and how transferable skills are incorporated into the design exercise. Furthermore, the students are introduced at an early stage to the key concepts of teamwork, exposure to real deadlines. This provides details of the teaching design exercise overview, design process, chip architecture, and test regime.

Method/activity: Active Learning Method Faculty/Inventor: Mrs. B. Supriya Designation: Asst. Prof, ECE Course Name: Probability Theory and stochastic process Academic Year: 2022-23

Goals/objective of method: To evaluate the student's awareness of the course and their progress.

#### Topic covered through activity: Random Variables

Active methods encourage students to discuss, contribute, participate, investigate, and create. Active learning challenges students by questioning them, requiring problem-solving and critical thinking. Most importantly, active learning engages students and requires them to be active in the classroom.

#### Teacher starts class by asking few questions like

What is a random variable and its types? How do you identify a random variable? What all the operations can be done on Random Variables?

The Students are posed with questions to think about the words which is coming across the topic and then co-relating the topics and explaining them in brief Outcome: Increased students engagement and preparation

Method/activity: Cooperative Learning Method Faculty/Inventor: Mrs. K. Shilpa Designation: Asst. Prof, ECE Course Name: Network Analysis Academic Year 2021-22 Goals/objective of method: To evaluate the student's awareness of the course and their progress. Topic covered through activity: Superposition Theorem and problems on it.

Description of method

Cooperative learning is an educational approach which aims to organize classroom activities into academic learning experiences.

To make students discuss on the given topic Superposition Theorem. Groups are made Topic is depicted by making each person in a group as one source acting and delivering the ideas by a leader finally which is equivalent of all the persons ideas summarizing which is called superposition theorem.

OUTCOME: Active participation of students and repetition will fix the topic in their memory

Faculty Name: G.Samatha Activity Name: Role Play Class: B. Tech III Year ECE Subject: Computer Networks Topic: OSI MODEL

Open System interconnection Model operation was played by the students. Few Students acted as layers, Sender, Receiver, router and anchors. Remaining students of the class observed the play. First the layers were drawn on the black board.





Outcome: Students were able to understand the concept of how information was transmitted by the play performed. It was easy to remember how communication moves downward through the layers on the sending device over the communication channel and upward to the receiving device.

Method/activity: Smart Classroom Faculty/Inventor: Mrs. Akula Jyothi Designation: Asst. Prof, ECE Course Name: Electromagnetic Wave & Transmission Lines AY- 2021-22

Topic covered through activity: FARADAY'S LAW OF ELECTRO MAGNETIC INDUCTION

The concept of "Smart Classroom" square measures a progressive methodology of education, that serves students to develop higher conceptions, educational achievements, improved reading skills, etc.

The traditional approach of giving lectures and taking notes have lost its effectiveness in the modern day around education. In efforts to grow academics, it must be considered that differentiated modalities of teaching and learning are necessary for better conceptual development.

Faraday's law of electromagnetic induction states that "whenever a conductor is placed in a varying magnetic field, an electromotive Force (EMF) is induced



Current induces in a coil when changing magnetic field lines passes to coil



If magnetic field Lines constant inside coil then no current will be induced

Method: Activity Based Learning Name of the Faculty: Mrs. K. Shilpa Name of the Subject: Signals & Systems Year & Semester: II Year I Semester

The activity method is a technique adopted by a teacher to emphasize his or her method of teaching through activity in which the students participate rigorously and bring about efficient learning experiences. Learning by doing is the main focus of this method. Learning by doing is imperative in successful learning since it is well proved that more the senses are stimulated, the more a person learns and longer he/she retains.

#### **Objectives:**

- 1. To enhance the creative aspect of the experience.
- 2. To build the student's self-confidence and to develop understanding through work in their group.

#### **Outcomes:**

1. Happy relationships between students and students, teachers and students will be developed.



Process: Shifting of impulse function

Shifting of Impulse signal is been explained with an activity, if original signal function of t at 0 on x-axis is been operated with t-1 then it will be shifted to the Right as shown similarly for t+1 operation signal will be shifted to the left as depicted in a picture.

Method: One Minute Paper Name of the Faculty member: Mrs.K. Sneha latha Branch: B.TECH, II-I Semester, ECE Academic Year: 2022- 2023 Topic: Classification of Signals and Systems Duration: 15 Minutes

#### **Description of One Minute Paper:**

Minute Paper is a very commonly used classroom assessment technique. It really does take about a minute and, while usually used at the end of class, it can be used at the end of any topic discussion. Its major advantage is that it provides rapid feedback on whether the professor's main idea and what the students perceived as the main idea are the same. Additionally, by asking students to add a question at the end, this assessment becomes an integrative task. Students must first organize their thinking to rank the major points and then decide upon a significant question.

#### **Implementation in the Classroom:**

The students were asked to recall the topic learnt in the classroom and they were asked to write what they have learnt during that class in a piece of paper.

#### **Effectiveness of conducting the activity:**

Due to this activity, the students were able to recall the topics they have learnt in the classroom, and they were also able to reproduce it in the exam. In the Internal Assessment Test- I most of the students attended the questions under this topic and scored good marks.

One Minute Paper				
k Veshnupriya <u>One Hindo Paper</u> . <u>I fenerosity:-</u> <u>Beighted Burn of Input = kleighted 9um of Output</u> <u>B</u> Trime variant:- <u>Triput solelay # Output solelay</u> <u>B</u> Courses:- <u>The output values only depends on present</u> <u>ornal point simput values.</u> <u>A</u> Static:- <u>The output values only depends on present</u> <u>unput values.</u> <u>B</u> Stable:- <u>J</u> retidt <u>X</u> co	Min Paper NVersensuchu Lineasity:- A shystem is abaid to be linean when the weighted dum of I/P = weighted dum of g/r. (i.e. I H [ax, [t] + b](2(4)] = a [HX, (4)] + b [HX2(4)] : ausality:- A duystem is david to be caused when the 0/P value to depends an present spass Vale of I/P. Then 'it is called causal. Static or Dynamic:- A System is david to be dynamic then the o/r value depends on Present only ther of I/P			
j unput values. 5. Stable:- ∫ r[t]dt × ∞	A system is daied to be system when the off value depends on Present only the			

Samples images:

The students will be able to Analyze the various properties of signals and systems.

#### **References:**

- 1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes
- 2. AllanV.Oppenheim, S.WilskyandS.H.Nawab, "SignalsandSystems

Method: Assignments Name of the Faculty member: Mrs. K. Shilpa Academic Year: 2023 -2024 Topic: Network Analysis

#### Assignment Marks:5

#### DOS: 13/11/2023

Q. No	Question	COs	Blooms Taxonomy
1	Define: Network Topology, Fundamental loop, Tie- set,cut-set matrix, Link Current,Planar graph, Non- planar graph,Mesh,Node,Tree ,Links & co-tree	CO1	Remembering
2	Determine the mesh currents in the circuit shown in figure. $ \begin{array}{c}                                     $	CO2	Understand
3	Find I of the circuit using nodal Analysis	CO3	Apply
4	Write the Cut-set matrix for the graph	CO2	Understand

#### Method: Assignments Name of the Faculty member: Mr. Rajkumar D Bhure Academic Year: 2023 -2024 Topic: Network Analysis

#### **Assignment Marks:5**

#### DOS: 15/11/2023

Q. No	Question	COs	Blooms Taxonomy
5.	What are design considerations of earth station?	CO1	Remembering
6.	Write the principle behind DTH and GPS	CO2	Understand
7.	Give the types of satellite services.	CO3	Apply
8.	An intelligent VSAT must use what type of networking to permit the maximum utilization of the satellite capacity?	CO2	Understand

#### Sample Assignment Sheet

2) Write the principle behind 07H and GPS. k- Sahithi that DTH (Drived - to-Home) and GPS (Global Positioning system) are satellite Communication he ECE - A 20671A0414 different technologies used for different applications, so the principles 15 Assignment -5 I what are design considerations of Earth station? behind them are also different. Here is a brief explanation of the that Dationing an Earth station involves several key considered including. \* leastion : choose a site with minimal radio frequency interference and good visibility of the sky to ensure optimal satellite communication. principle behind each technology: \* Artenna selection: select an appropriate artenna size and type DTH is a digital satellite tellision broadcarting technology that based on the required communication performance frequency bands, allows television channels to be transmitted directly to a subscribes's home wing a small dish anknna and a set-top box. The principle and coverage area. \* Frequency Bands : Determine the frequency bands for uplink and behind OTH is based on the concept of satellite transmission, where downlink communication, considering factors like regulatory restrictions the television signal is transmitted from the broad casting center to the satellite, which then beams it back to Earth. The DTH service and available spectrum. \* Equipment Redundancy: Implement redundancy in critical components, provides has a network of satellites in orbit that covers a specific such as power supplies, amplifiers, and tracking systems to enhance gragraphic area the subscriber's dish ankrina receives the signals from the satellity, which are then bransmitted to the set top-bax. The set top system reliability. to weather considerations: Account for weather conditions like rain box decedes the signals and displays the television channels on fade and wind loads, to ensure reliable communication during the subscribes's TV. adverse weather. 2. GPS : \* Security Measures : Incorporate security features to safiguord GPS is a satellite-based navigation system that allows user to against unauthorized access, data breaches and potential cyber threats. determine their exact location, speed and time using signals from + Grounding and lightning Brotichion = Implement proper grounding a network of satellite orbiting the Earth. The principle behind GPS and lightning protection measures to safeguard equipment and is based on the concept of trilatorition, which trivolves measuring the personnel from electrical surges. time it takes for signals from at least four GPS satellites to to Power supply: Ensure a stable and reliable power supply. transportability backup systems like generations or batteries to prevent reach the GPS receiver. Each satellite broadcasts a unique signal that contains information about its location and the time the signal service disruptions. was transmitted. The GPS receives the signals from the satellites and

ulakes the distance to each satellite based on the time it takes the signals to travel. By knowing the distance to atleast in satellities, the GPS receiver can calculate the user's location ing a process called trilateration. live the types of satellite services. here are several types of satellite services, including: Communication services : Satellites provides a means of communication though various forms such as voice, data and video example of communication satellity include INMARSAT, Indium, and Global star. \* Navigation services : satellites provide location and tracking information for a range of applications, including personal navigation devices, common shipping and air traffic central. Examples of navigation satellites include cps, alonnass and Galileo. \* Remote sensing services : satellites are used to called and transmit information about the Earth's surface such as weather patterns, agricultural exp yields one natural resource management. Examples of remote sensing satellites include Landrat, MODIS and GOES. a scientific Research services : satellites are used to conduct scientific research such as studying the Easth's atmosphere and space explored Examples of stimute sensing satellites include landsat. Middle space Telev chandra X-ray Observatory and fermi comma -ray space Telescope. A Military Services : satellites are used for military purposes such a reconnaissance communication and navigation. Examples of military satellites include the is Air Force's Defense satellite communications system (DSCS) and the National Reconnaissance office's (NRO) classified rmaging satellites.

3) An Intelligent user must use what type of networking to permi the maximum utilization of the satellite capacity? the An Intelligent VSAT (Vesy small Aperture Terminal) typically uses a TDUA (Time Division Multiple Access) networking approach to maximize satellite capacity utilization. This allows multiple visit terminals to share the satellike bandwidth efficiencily by dividing the available time slots. A satellite-switched TDMA system is an efficient TDMA system with multiple spot beam operation for the uplink and downlink transmissions The interconnection between the uplink and downlink beams is performed by a high speed switch matrix located at the heart of the satellite. An SS-TOMA scheme provides a full indexconnection of TOMA signals among various coverage regions by means of interconnecting the corresponding uptink and downlink becomes at a switching time. The advantages of SS-TDMA systems over TDMA systems are: \* The possibility of bequency recuse by spot-beam spatial discrimination. i.e. the same frequency band can be spatially re-used mony times. Hence, a considerable increase in satellite capacity can be made. \* The use of a norrow ardenna beam which provides a high gain for the coverage region. Hence, a power saving can be obtained in both the uplink and downlink. An SS-TOMA scheme has been planned for INTELSAT VI and Clympus satellite.

Method: Presentation by PPT's Faculty Name: Dr. Prasanta Kumar Pradhan Subject: Image and Computer Vission IV B.Tech I Sem AY 2023-24

# Transforms in Image Processing

Module II-Unit II

#### Discrete Fourier Transform

- DFT is a mathematical transformation used to analyze and manipulate discrete signals.
- It converts a signal from its time domain representation to its frequency domain representation.
- In the frequency domain, the signal is decomposed into its constituent frequencies.



- DFT is widely used in various fields, including image processing, audio signal analysis, communications, and more.
- It allows us to examine the spectral characteristics of a signal and extract meaningful information.
- DFT is based on the principles of complex numbers and Fourier series.
- It employs a set of complex exponential functions, known as basis functions or harmonics.
- These basis functions are used to decompose the signal into its frequency components.

$$\begin{split} K_k &= \sum_{n=0}^{N-1} x_n \cdot e^{-\frac{i2\pi}{N}kn} \\ &= \sum_{n=0}^{N-1} x_n \cdot \left[ \cos \! \left( \frac{2\pi}{N}kn \right) - i \cdot \sin \! \left( \frac{2\pi}{N}kn \right) \right], \end{split}$$

- By performing DFT, we obtain a spectrum that represents the amplitude and phase information of each frequency component in the signal.
- The magnitude of the spectrum represents the strength of each frequency component, while the phase represents the relative timing or alignment





Method: Presentation by PPT's Faculty Name: B Sowmya Subject: Embedded Real Time Operating Systems III B.Tech II Sem AY 2023-24





Method: Presentation by PPT's Name of the Faculty: K Shilpa Name of the Subject: Network Analysis Year & Semester: II Year I Sem, AY: 2023-34

## **Maximum Power Transfer Theorem**

What load should be applied to a system to ensure that the load is receiving maximum power from the system?

and, conversely:

For a particular load, what conditions should be imposed on the source to ensure that it will deliver the maximum power available?

A load will receive maximum power from a network when its resistance is exactly equal to the Thévenin resistance of the network applied to the load. That is,







## **Maximum Power Transfer Theorem**

	$H_{0}(\Omega)$	$P_{\pm}(\Theta)$	$I_{\downarrow}(\mathbf{A})$	$V_2(0)$
Why is it maximum at $R_{TH}$ ?	8.1 62 83	431 451 1934	4.60 4.52 4.52	8.96 1.30 3.38
$P_L = I_L^2 R_L$ , why not increase $R_L$ ?	1045	555 550 621 9.54	5.00 5.00 5.02 4.02	100 150 150 21.0
$P_L = V_L^2 / R_L$	8 7 8 (K <sub>10</sub> )	96,00 96,46 Jachuse 96,47 Machaner 96,77	405 335 Denuer 335 T 335 Conner 335 Conner	3.08 3.25 (annual 3.25 ( 3.26 (2 <sub>0</sub> ,0)
A balance must be made between the load	0	90,00 97,96 96,59	100 2.00 2.01 7.01	0.0 545 546
resistance and the resulting current or voltage.	03 36 17 36	10.33 12.36 10.53 前月日	130 141 231 122	23.00 33.40 35.20 46.00

maximum power transfer occurs when the load voltage and current are one-half of their maximum possible values.

### Maximum Power Transfer Theorem



Method: Presentation by PPT's Name of the Faculty:B Supriya Name of the Subject:PTSP Year & Semester: II Year I Sem, AY: 2023-34



Method: Presentation by PPT's Faculty Name: Dr. Himanshu Sharma Associate Professor Subject: EMI Year & Semester: :IV II SEM 2022-23



# Parameters for Capacitive Transducers Changing Area of the Plates of Capacitive Transducers

- Changing Distance between the Plates of Capacitive Transducers
- Changing Dielectric Constant type of Capacitive Transducers







Method: Presentation by PPT's Faculty Name: B. Shravan Kumar, Assistant Professor Subject: Internet of things Topic : IOT Application and Protocols **Year & Semester:III**/ II SEM AY-2022**-23** 



Method: Presentation by PPT's Faculty Name: Mrs. K. Snehalatha Subject: Signals and Systems Year & Semester:II/ I SEM AY-2022-23



Method: Presentation by PPT's Faculty Name: Ms. B Sowmya Subject: Signals and Systems Year & Semester: III/ II SEM AY-2022-23



### Course Objectives:

The Student will

- understand the characteristics of embedded systems and application areas.
- 2. explain the core of embedded system and gain the knowledge of ASICs, PLDs and communication interfaces.
- 3. understand Embedded firmware, RTC and design approaches.
- analyze RTOs based Embedded System Design and multiprocessing.

5. understand Task communication and task synchronization.

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## Introduction to Embedded Systems:

UNIT-I

- >Definition of Embedded System
- > Embedded Systems Vs General Computing Systems
- > History of Embedded Systems
- > Classification. Major Application Areas
- > Purpose of Embedded Systems
- Characteristics and Quality Attributes of Embedded Systems.

- Embedded System also contains I/O subsystem which facilitates the interfacing of sensors and actuators which acts as the messengers from and to the 'Real world' to which the embedded system is interacting
- Embedded System also contains on-board and external communication interfaces for communicating between the various on-board subsystems and chips
- Embedded System also contains other supervisory systems and support units like watchdog timers, reset circuits, brown-out protection circuits, regulated power supply unit, clock generation circuit etc.

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Method: Presentation by PPT's Faculty Name: Rajkumar D Bhure Subject: Radar System Year & Semester:IV/ I SEM AY-2021-22



Method: Presentation by PPT's Faculty Name: Rajkumar D Bhure Subject: Satellite Communication Year & Semester:IV / I SEM 2021-22



Method: Presentation by PPT's Faculty Name: Bijaya Kumar Muni Subject: Cellular and Mobile Communication Year & Semester: IV / I Sem, AY 2020-21



#### ✓ Reproducibility of Ph.D. Work

Ph.D. holders of the department motivate students and staff for brainstorming future ideas on the existing Ph.D. works.

Name of the Faculty: Dr. Anindya JanaDept.: Electronics & Communication EngineeringDesignation: Professor & Dean- IIICTitle: Modeling of Nanoscale Devices & Exploring their Applications

#### Abstract:

Since, the beginning of the seventies, the microelectronics industry has followed Moore's law, doubling processing power energy in every eighteen months. This performance increase has been achieved by improving the speed and decreasing both the power consumption and size of devices and circuits. Recent advances in crystal growth techniques like fine line lithography, metal organic chemical vapor deposition (MOCVD) and molecular beam epitaxy have made possible the fabrication of low dimensional semiconductor structures. The possibility of realization of high speed devices using such low-dimensional structures has stimulated active research in quasi-low dimensional structures. Continuous evolution in technology over the years has shrunk devices and systems so much that these dimensions are now less than a 1/10<sup>th</sup> of a micron. The term nano electronics is therefore used instead of microelectronics. The planar silicon metal-oxide semiconductor field-effect transistor (MOSFET) is perhaps the most important invention in the field of micro electronics.

MOSFET performance has been improved at a dramatic rate via gate length scaling and is the dominating technology for integrated circuits. For long channel devices, dimensions and supply voltages are scaled by the same factor in order to maintain a constant electric field to achieve the specifications. Modern short channel devices use both the supply voltage and device geometry scaling by different factors. Moore's prediction has held over the last four decades and will continue as long as the cost of a transistor continues to drop in price.

For more than two decades the rapid progress in complementary metal-oxide-semiconductor (MOS) technology has taken place through the tremendous pace of scaling, leading to an enormous increase in speed and functionality of electronic devices. It is becoming increasingly difficult to meet MOSFET performance gains with reasonable device leakage. Now the gate leakage current constitutes a major part of the power budget of microprocessors. Another critical scaling issue involves the increase of the source-drain resistance resulting from the need for ultra-shallow p-n junctions in the source-drain regions. To keep the source-drain series resistance at a reasonable fraction of the total channel resistance, several alternative MOSFET structures have been proposed, such as non-overlapped gate structures, which do not require ultrashallow source-drain functions or structures with metallic source and drain electrodes to minimize the series resistance. Continuous device performance improvement is possible only through a combination of device scaling, new device structures and material property improvement to its fundamental limits. Retaining the same functional efficiency and achieving further minimization only through device scaling, has become almost impossible for planar CMOS due to some internal physical limitations. However, there have been reports suggesting that the CMOS transistor cannot shrunk beyond certain limits dictated by its operating principle. Over recent years this realization has lead to exploration of possible successor technologies with greater scaling potential such as quantum and single electronics for the next generation VLSI/ULSI circuits.

The single electron tunneling (SET) technology is one of the most promising future technologies to meet the required increase in density, performance and decrease in power dissipation. While the prospect of CMOS devices being completely replaced by SET devices remains to be seen. SET devices and circuits have received tremendous attention in the research community. Hybridization of the SET with complementary MOS technology has attracted much attention in recent years since such integration offers new functionalities, which are very difficult to achieve either by pure CMOS or by pure SET approaches. Consequently, Silicon SETs are appearing to be more promising than metallic SETs for their possible integration with CMOS.

Spintronics is a spin based electronic device technology that combines several characteristics like low power consumption, high operating speed and high integration density, making it financially indispensable in modern electronics. Conventional electronics encode information using the electronic charge. But in Spintronics, the spin of electrons and charge are used together to represent binary data values, rather than charge alone. Because of several distinct features the possibility of developing devices that could be much smaller, consume less electricity and be more powerful for certain types of computation than is possible with system based on electronic charge transport based devices.

In view of the above declarations the candidate wants to study some nano device models and to explore some of their applications.



**Session for Faculty Members** 



**Session for Students** 

Name of the Faculty: Dr. Prsanta Kumar Pradhan Designation: Associate Professor Title: On efficient signal processing algorithms for signal detection and PAPR reduction in OFDM systems A Contributed Chapter: PAPR Reduction in OFDM Systems

#### Reproduced by R. Someshwar K. Sumith K. Abhinay Reddy BTech Thesis Title: PAPR Reduction Techniques in OFDM Systems

#### 1. Research Findings

The successful replication of the research findings from the Ph.D. work on "PAPR Reduction in OFDM System" by **Someshwar** and group in their major project serves as a compelling showcase of the direct applicability of advanced research in an undergraduate setting. This underscores the practical impact of the research. The abstract of the research paper provides insight into the complexity of the topic and the proposed method:

"In a communication system, the operation of the transmitter power amplifier is confined to its linear range. When the input signal surpasses the linear range, signal distortion occurs. Consequently, it is imperative to ensure that the input signal to the transmitter maintains a low peak-to-average power ratio (PAPR). This paper introduces a novel method for reducing the PAPR in an Orthogonal Frequency Division Multiplexing (OFDM) system. The proposed approach involves Discrete Cosine Transform (DCT)-aided successive addition and subtraction of OFDM symbols within a single OFDM frame. Through rigorous evaluation, the performance of the proposed method is found to be superior to existing techniques such as Partial Transmit Sequence (PTS) and Selected Mapping (SLM)."

By replicating these results in a major project, students demonstrate the practical implementation of advanced research concepts. This emphasizes on research with tangible impact, showcasing the application of sophisticated techniques in an undergraduate context. The successful reproduction not only validates the robustness of the Ph.D. research but also contributes to the institution's research culture and its commitment to providing students with hands-on, impactful learning experiences.

#### 2. Contributions to Student Learning

The reproducibility of the research outcomes from the Ph.D. work on "PAPR Reduction in OFDM System" significantly contributes to student learning, particularly at the undergraduate level. The successful implementation of the research findings in a major project offers students practical insights and hands-on experience, enriching their academic journey. Here's how this reproducibility enhances student learning:

The reproducibility of the research outcomes holds immense educational value by providing undergraduate students with a unique opportunity to translate theoretical knowledge into practical application. The Ph.D. work addresses a critical issue in communication systems— the reduction of the peak-to-average power ratio (PAPR) to prevent signal distortion in the transmitter power amplifier.

By successfully implementing the proposed method, which is based on Discrete Cosine

Transform (DCT) aided successive addition and subtraction of OFDM symbols within a single OFDM frame, students at the undergraduate level gain hands-on experience in tackling real- world challenges in communication systems. The practical application of advanced concepts enhances their understanding of the complexities involved in optimizing signal transmission.

Engaging in the major project allows students to explore the intricacies of the proposed method, understand its nuances, and witness first hand how it outperforms established techniques such as Partial Transmit Sequence (PTS) and Selected Mapping (SLM). This experiential learning not only deepens their comprehension of the subject matter but also cultivates critical thinking and problem-solving skills.

The successful reproduction of the research outcomes fosters a collaborative learning environment. Students can actively participate in discussions, share insights, and collectively address challenges encountered during the project. This collaborative aspect aligns with contemporary educational approaches that emphasize teamwork, communication, and the application of knowledge in practical scenarios.

The reproducibility of the research outcomes in a major project enriches the student learning experience by bridging the gap between theoretical concepts and real-world application. It instils a sense of confidence and competence, empowering students to approach complex problems in their academic and professional journeys with a practical mindset. This promotes experiential learning and the development of practical skills among students.

#### 3. Integration of Research into Curriculum

The seamless integration of the Ph.D. research topic on "PAPR Reduction in OFDM System" into the undergraduate curriculum is exemplified by Someswar and group successfully undertaking a major project on the same research topic. This integration highlights the relevance and applicability of advanced research at various academic levels. Here's an emphasis on the seamless integration:

The integration of the Ph.D. research topic into the undergraduate curriculum signifies a proactive approach to aligning academic content with real-world challenges. The research, focusing on the reduction of the peak-to-average power ratio (PAPR) in the communication system, addresses a critical issue relevant to modern communication technology.

The fact that a B.Tech student could undertake a major project based on the same research topic is a testament to the seamless integration of advanced research into the undergraduate curriculum. This integration is strategically designed to expose students to cutting-edge concepts and methodologies, fostering a learning environment that transcends traditional boundaries.

The research topic's applicability at various academic levels is underscored by the successful execution of a major project by an undergraduate student. The major project serves as a bridge between theoretical understanding and practical implementation, allowing students to navigate complex concepts and contribute meaningfully to the ongoing discourse in the field.

This integration enhances the educational experience by providing students with exposure to sophisticated research topics early in their academic journey. It encourages a spirit of inquiry, innovation, and curiosity in promoting a curriculum that is contemporary, industry-relevant, and dynamic.

The integration of advanced research into the undergraduate curriculum cultivates a culture of research and inquiry among students. It instils a sense of curiosity and motivates students to explore interdisciplinary connections, promoting a holistic understanding of the subject matter.

The seamless integration of the Ph.D. research topic into the undergraduate curriculum, as evidenced by the major project undertaken by a B.Tech student, exemplifies a forward-thinking approach to education. It underscores the relevance and applicability of advanced research at multiple academic levels, contributing to a curriculum that prepares students for the evolving demands of the industry and academia.

#### 4. Effective Knowledge Transfer

The successful reproduction of results, as evidenced by the implementation of the research findings in an undergraduate project, serves as compelling evidence of effective knowledge transfer from advanced research at the Ph.D. level to undergraduate projects. The abstract on "PAPR Reduction in OFDM System" outlines a sophisticated methodology, and its successful application in an undergraduate context showcases the seamless transfer of knowledge.

The effective transfer of knowledge from advanced research at the Ph.D. level to undergraduate projects is vividly demonstrated by the successful reproduction of results in the context of 'PAPR Reduction in OFDM System.' The research, focusing on mitigating signal distortion in communication systems caused by exceeding the linear range of the transmitter power amplifier, presented an innovative method based on Discrete Cosine Transform (DCT) aided successive addition and subtraction of OFDM symbols.

The implementation of this research methodology in an undergraduate project serves as a testament to the efficacy of knowledge transfer. The undergraduate project successfully replicated the advanced techniques introduced at the Ph.D. level, showcasing the adaptability of the research to different academic contexts.

This knowledge transfer is not only confined to theoretical concepts but extends to the practical application of advanced methodologies. Undergraduate students actively engaged with and implemented the proposed method, gaining hands-on experience in addressing real-world challenges in communication systems. This hands-on experience contributes to a profound understanding of the subject matter, aligning with contemporary educational approaches that prioritize experiential learning.

The successful reproduction of results underscores the clarity and effectiveness of the knowledge transfer process. The sophisticated methodology introduced at the Ph.D. level has been translated into practical application by undergraduate students, demonstrating the comprehensibility and applicability of advanced research concepts.

This knowledge transfer is not only valuable in enhancing the learning experience of

undergraduate students but also contributes to a dynamic and collaborative research culture within the academic institution. It fosters an environment where research findings are disseminated, adapted, and applied across different academic levels, reinforcing the institution's commitment to academic excellence and innovation.

The successful reproduction of results in an undergraduate project stands as a robust example of effective knowledge transfer from advanced research at the Ph.D. level. It not only empowers undergraduate students with practical insights but also enriches the academic culture with a collaborative spirit and a commitment to the seamless integration of advanced research into undergraduate education

#### ✓ Reproducibility & Reusability of Ph.D Work Name of the Faculty: Dr. Himanshu Sharma

**Dept.:** Electronics & Communication Engineering

Designation: Associate Professor, ECE & Dean Administration

Title: A Sturdy Security Framework for Security Challenges in Cognitive Radio Networks.

#### Abstract:

Spectrum scarcity is a major problem in current communication scenario, a report according to FCC describes that the actual problem of spectrum scarcity is not because of shortage of spectrum but it is underutilization of spectrum which makes the problem more severe. In order to make efficient utilization of available spectrum resources, several researches have been conducted since last decade. Dynamic Spectrum Access (DSA) is a popular topic of research among researchers to fulfil this purpose. Cognitive Radio technology is most popular dynamic spectrum access technique which enables opportunistic spectrum access in present communication scenario. The CRN technology permits non-legitimate users to operate in vacant frequency bands to improve the communication between a pair of cognitive users.

Securing cognitive radio network is a crucial research topic because of the importance of CRN reliability. Security issues are mainly related to cognitive capability and re-configurability of cognitive radio networks. This research work is based on analysis of security attack related to

cognitive radio network and to propose their optimal solution. Several security issues related to cognitive radio networks has been studied and an analytical model for detection of primary user emulation attack is presented. Latest research on cognitive radio networks demands a comprehensive framework for cognitive radio networks which is not only capable of ensuring security but also provides solutions to common



problems related to cognitive radio networks. Keeping this in mind, this research work is a focused towards the development of a cognitive radio security framework which can provide solution to all needs of cognitive radio networks.

The proposed research is a four phase framework with centralised cluster based architecture, novel spectrum sensing algorithm for resource collection, trust estimation, reward and penalty mechanism to work as an active attack defence mechanism and secrecy capacity enhancement for physical layer security in given architecture. A MATLAB based simulation setup is developed for each phase of proposed framework. Simulation results show the effectiveness of proposed system architecture in attack detection with more than 80% of detection rate. Novel spectrum sensing architecture is able to detect low SNRs up to -20 dB while the trust mechanism provides an active reward and penalty scheme. Finally physical layer security is ensured by secrecy capacity enhancement scheme.

#### Email: himanshu.ece@jbiet.edu.in

#### ✓ Reproducibility & Reusability of Ph.D. Work

# Name of the Faculty: Dr Towheed Sultana Designation: Professor

Title: Extraction Of Superficial and Volumetric Features In 3-D Digital Images Using Morphological

#### Abstract:

The purpose of the work intended for research is to formulate techniques and strategies for processing three dimensional digital images. Mathematical morphology plays an important role in such formulations. The structuring elements of various discrete structures are studied using the algebraic tool called 'Geometric Filters'.

The concept of 'Geometric Filters' was introduced by Rajan and others in 1995 as Geometric interpretation of 'Extended Filters', which were introduced by Preston Hammer and others in 1985.

Extended Filter is a set theoretic concept developed with the help of set-valued set-functions of extended topology (finite set topology). The traditional topology deals with infinite spaces and constructs. The concept of Topological Filter was introduced by Cartan during 1950s, which is defined as a set of subsets (elements) of a power set with the condition that the presence of an element in the filter ensures the presence of all its super sets. This concept is similar to that of fundamental frequency and harmonics. Basically a signal processing system checks the presence of harmonics and changes the shape of the signal based on the requirement by filtering out certain frequencies. Similarly, one can think of processing an image which is a construct made up of certain basis shapes by a filter of topological type. Geometric filter is precisely such a shape filter constructed over the set of certain basis shapes. A G-Filter is basically an ordered dichotomy which divides a domain of shapes into two sets, one consisting of accepted shapes and the other of rejected shapes.

The work reported in this thesis deals with defining the basis filter constructs over the Rectangular and Hexagonal grid spaces (2-D and 3-D), and formulation of a novel concept of what we call as *Geometric Filters* over the Rectangular and Hexagonal grid spaces (2-D and 3-D). In addition, the thesis describes in brief the algebra of G-Filters, with a special attention to the algebra of Hierarchical Geometric Filters (HG- Filters) and Linear Geometric Filters (LG- Filters), by formulating a lattice of convex polyhedrons (structuring elements) constructed in a 3X3X3 grid of pixels. The results are visualized as a distributive lattice. Mathematical morphology is an application of lattice theory.

Three dimensional (3-D) structuring elements play a vital role in the processing of three dimensional volumetric images such as 3-D medical images. These structuring elements are used in 3-D mathematical morphological operations such as erosion, dilation etc. There is no algebraic framework as such to systematically generate the 3-D structuring elements. The work discussed in this thesis is systematically generating the 3-D structuring elements by using geometric filters (G-Filters) for mathematical, morphological operations.

One can construct 16 convex polygons in a 3X3 two dimensional array of cells and 256 convex polyhedrons in a 3X3X3 three dimensional array of cells. These two arrays of cells are sub lattices of discrete infinite lattices  $Z^2$  and  $Z^3$  respectively. Similarly, one can construct  $2^{16}$  convex hyper polyhedrons in a sub lattice of the discrete infinite lattice  $Z^4$ . In the abstract sense, convex hyper polyhedrons could be constructed in a sub lattice of the discrete infinite lattice  $Z^n$ . Thus, given an n-dimensional discrete infinite lattice, one can build a finite or a potentially infinite set of convex geometric shapes which could be treated as the ground set of a *permutation group*. This thesis describes the results of a study carried out on permutations groups of convex geometric shapes defined over n-dimensional discrete lattices  $Z^n$ , where n varies from 2 to infinity.

These G-Filters and Three dimensional (3-D) structuring elements have potential applications to processing of volumetric images are applied to 3-D images for detecting superficial and volumetric features using morphological method.

This thesis introduces a novel algorithm for extracting volumetric edges from 3D medical images. The proposed *Opening based edge detection* (OBED) algorithm for 3D digital images are compared with a variety of existing methods in mathematical morphological algorithms.

A few sample MRI images are used as a test data for analysis purposes. A comparative study of the algorithm introduced in this thesis with already existing algorithms has been made and results reported here.

Experimental results are shown and comparisons with existing algorithms are made to emphasize the results of this edge detection method.



Sectioned view of 3D image Cerebrix

Its edge detected version

#### PERSPECTIVES

- Generation of convex polyhedrons can be further extended to 5x5x5, 7x7x7, 9x9x9.....
- 2D / 3D structuring elements are not confined to 3 X 3 neighbourhoods alone. One can visualize 2D / 3D structuring elements in various neighbourhoods of size 5 X 5 or 7 X 7 / 5 X 5 X 5 or 7 X 7 X 7. A Structuring element is essentially a digital image and so it admits the possibility of being represented in large neighbourhoods.