ALVA'S
Education Foundation

ALVA'S INSTITUTE OF ENGINEERING & TECHNOLOGY

(Unit of Alva's Education Foundation (R), Moodbidri)

Affiliated to Visvesvaraya Technological University, Belagavi &

Approved by AICTE, New Delhi. Recognized by Government of Karnataka.

Accredited with A+ by NACC & NBA (ECE & CSE)

STUDENTS SEMINAR

STUDENTS SEMIAR REPORT – 2023-24

Alva's Institute of Engineering & Technology
Shobhavana Campus, Mijar, Moodbidri, D.K – 574225
Phone: 08258-262725, Fax: 08258-262726

Department of Electronics and Communication Engineering

EM SEMINAR 5th SEM A SECTION -2023-24

BATCH.No	USN	NAME	TOPIC
B1	4AL21EC031	Hemanth R	**Torque in electric and magnetic field**
	4AL21EC039	Keerthan S	
	4AL21EC046	Mahantesh ShidarayTanvashi	
B2	4AL21EC015	Bhavana.B	**Lorentenz Transformation**
	4AL21EC025	Deeksha S	
	4AL21EC030	Harshitha B S	
	4AL21EC033	HuriyaSanadi	
B3	4AL21EC007	Anchita	**Antenna design and optimization for wireless communication**
	4AL21EC024	Darshana Basavaraj Bandi.	
	4AL21EC034	Inchara S Shetty	
	4AL21EC043	Lakshmi Keerthana B	
B4	4AL21EC002	Abhishek S	**Gama rays on wireless communication**
	4AL21EC003	Akash A H	
	4AL21EC036	Jeevan V	
	4AL21EC053	Nagabhushan H K	
B5	4AL21EC032	Hemashri H N	**Doppler Effect**
	4AL21EC049	Manupriya Y	
	4AL21EC068	Ramya R	
B6	4AL21EC014	Bhaskar T	**EM Properties of Conductors, semi conductors and insulators**
	4AL21EC018	Charan Raj R V	
	4AL21EC045	Madugonde Sandeep	

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Department of Electronics and Communication Engineering

EM SEMINAR 5th SEM A SECTION -2023-24

	4AL21EC054	Naveen Kumar H S	
B7	4AL21EC026	Deekshith D Shetty	**Histroy of Maxwell Equations**
	4AL21EC029	Gowtham M A	
	4AL21EC040	Kiran Kashyap M	
	4AL21EC042	Lakshan	
B8	4AL21EC001	A. S. Pavithra	**EM waves in Radar**
	4AL21EC009	B.Vennela	
	4AL21EC050	Meghana L	
	4AL21EC104	Vaishnavi S	
B9	4AL22EC400	Abhishek P T	**Electromagnetic spectrum**
	4AL21EC013	Bharath N	
	4AL22EC402	Chetan G Kur Gouda	
	4AL22EC406	Shamshuddin	
B10	4AL22EC401	Chethana A B	**Intensity of an EM waves**
	4AL22EC405	Pallavi B	
	4AL22EC407	Suhani R J	
B11	4AL21EC016	ChakravarthyJaipalTeredal	**Magnetic field for different current configurations**
	4AL21EC023	Darshan T S	
	4AL21EC018	Charan Raj R V	
	4AL22EC408	Veeresh S V	
B12	4AL21EC028	Gagan H S	**Properties of electric Material**
	4AL21EC062	Prajwal S Das	

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Department of Electronics and Communication Engineering

EM SEMINAR 5thSEM A SECTION -2023-24

	4AL21EC020	Chethan K.M	
	4AL21EC035	Jeevan K G	
B13	4AL21EC005	Akshay Kumar H	**Electric diploe**
	4AL21EC021	Chiranjeevi U B	
	4AL21EC041	Kishor U	
	4AL21EC044	Lekhan T	
B14	4AL21EC037	Kalmesh G Galigoudra	**Remote Sensing**
	4AL21EC038	KaluvaChandrashekar	
	4AL21EC047	Mailaragouda N P	
	4AL21EC006	Amaresha M	
15	4AL21EC008	Anush S Amargol	**Applications of Gauss Law in Communication**
	4AL21EC010	Basangouda Patil	
	4AL21EC011	Basavakiran	

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Department of Electronics and Communication Engineering

DC MINI PROJECT 5th SEM B SECTION -2023-24

BATCH.No	USN	NAME	TOPIC
B1	4AL21EC066	Raksha	Modren Communication System Using Maxwell's Equation
	4AL21EC063	Prakruthi K P	
	4AL21EC070	Sahana	
	4AL21EC091	Sindhu S Patil	
B2	4AL22EC404	Navaneeth	Evolution of Biot savarts Law
	4AL21EC099	Thejas J Kotian	
	4AL21EC067	Rakshith	
B3	4AL21EC074	Santhosha A S	EM In Defense
	4AL21EC098	Tej Ashok	
	4AL21EC083	Shreyas S Naik	
	4AL21EC069	Ravi Kovi	
B4	4AL21EC059	Pooja Venkatesh Naik	Wave Behavior of EM
	4AL21EC092	Sonali	
	4AL21EC093	Srishti S Shetty	
	4AL21EC106	Varshini Shetty	
B5	4AL21EC061	Prajwal Malabagi	Permittivity and permeability in different media
	4AL21EC079	Shivakumar K V	
	4AL21EC095	Sumith N	
B7	4AL21EC084	Shruthi	Uniform Plane Waves & Helmholtz Wave equation
	4AL21EC088	Sinchana RD	

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Department of Electronics and Communication Engineering

BE MINI-PROJECT 5th SEM B SECTION -2023-24

	4AL21EC090	Sindhu KS	
	4AL21EC102	Usha Rani.N	
B8	4AL21EC082	Shreya K R	**Applications of Laplace equations**
	4AL21EC086	Sinchana C K	
	4AL21EC109	Veena Basavaraj Rachappanavar	
	4AL21EC113	Yashaswini T R	
B9	4AL20EC009	C. Navajeevan	**Applications of Gauss law in communication**
	4AL21EC071	Saikumar	
	4AL21EC085	Siddharoodh B Durgipujeri	
	4AL21EC103	V Venkta Sainihith Mullapudi	
B10	4AL21EC101	Thrisha P Hegde	**Poisson's Distribution**
	4AL21EC081	Shreya Chandrahasa Shetty	
	4AL21EC097	Tanishka	
	4AL21EC089	Sinchana.S.D	
B11	4AL21EC056	Nivedita T Patil	**Wireless Power Transmission**
	4AL21EC073	Sanjana Shrikant Havanoor	
	4AL21EC087	Sinchana R	
	4AL21EC096	Sushrutha N	
B12	4AL21EC080	Shravya Shetty	**Television Radio Waves**
	4AL21EC094	Suma K G	
	4AL21EC100	Thejashwi P Acharya	

...UJECT 5th SEM B SECTION -2023-24 ...unication Engineerin...

13	4AL21EC065	Rakesh	**Satellite Communication**
	4AL21EC058	Pavan	
	4AL21EC110	Videesh D Shetty	
	4AL21EC111	Vishal	
14	4AL21EC076	Shashank C Soppannavar	**Biot Savarts Law in communication**
	4AL21EC077	Shashank Swami	
	4AL21EC078	Shashank Viresh Shetti	
	4AL21EC108	Varun Devaramani	
B15	4AL21EC060	Prajwal L R	**Electric dipole**
	4AL21EC064	Prasanna Kumar B I	
	4AL21EC107	Varun Kumar R	
	4AL21EC057	Prajyot Rajgonda Patil	**EM in Space**
	4AL21EC112	Vishwanath HB	

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ALVA`S INSTITUTE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND COMMUNICATION

SEMINAR REPORT IN ELECTROMAGNETIC WAVES

TOPIC: LORENTZ TRANSFORMATION

ACADEMIC YEAR : 2023-24

SUBJECT CODE: 21EC54

SUBJECT: ELECTROMAGNETIC WAVES

CLASS: III YEAR

SEMESTER: 5^{TH} SEM

SECTION: A

SUBMITTED BY:	
USN	NAME
4AL21EC015	BHAVANA B
4AL21EC025	DEEKSHA S
4AL21EC030	HARSHITHA B S
4AL21EC033	HURIYA SANADI

CERTIFICATION OF EVALUATION

COLLEGE NAME	ALVA'S INSTITUTE OF ENGINEERING & TECHNOLOGY	
DEGREE	B. E	
BRANCH	ELECTRONICS AND COMMUNICATION ENGINEERING	
CLASS	III YEAR	
SEMESTER	V	
SECTION	A	
USN & NAME OF STUDENTS	4AL21EC015	BHAVANA B
	4AL21EC025	DEEKSHA S
	4AL21EC030	HARSHITHA B S
	4AL21EC033	HURIYA SANADI
SEMINAR TOPIC	LORENTZ TRANSFORMATION	
FACULTY NAME	PROF. VIJETHA T S	
DESIGNATION	ASSISTANT PROFESSOR	
DATE OF SUBMISSION	~~24-01-2024~~ 7/2/24	
TOTAL MARKS	10	
MARKS SCORED		

7/2/24

FACULTY INCHARGE
PROF VIJETHA T S

Siddesh
ECE HOD
DR SIDDESH G K

Table of Contents:

LORENTZ TRANSFORMATION

Introduction:

The Lorentz transformation is a fundamental concept in physics, particularly in the theory of special relativity. It describes how coordinates of events in spacetime change under a change of inertial frame. This transformation was first introduced by the Dutch physicist Hendrik Lorentz in 1904 and later independently by Albert Einstein in 1905 as part of his theory of special relativity. The Lorentz transformation is crucial in understanding phenomena such as time dilation, length contraction, and the relativistic addition of velocities.

What is Lorentz Transformation?

Lorentz transformation refers to the relationship between two coordinate frames that move at a constant speed and are relative to one another. It is named after a Dutch physicist, Hendrik Lorentz.

The Lorentz transformation is a mathematical description of how space and time coordinates are transformed between different inertial frames of reference that are moving relative to each other with constant velocity. It was developed to make the equations of electromagnetism compatible with the theory of relativity. Lorentz proposed "contracting" lengths in the direction of motion in order to explain the Michelson-Morley experiment.

It involves scaling space and time coordinates by a factor that depends on velocity, known as the Lorentz factor. This results in length contraction and time dilation between frames. Lorentz transformations are related to only the inertial frame of reference and coordinate a relationship between two frames in linear motion that move at a constant velocity with respect to each other, in the context of special theory of relativity.

Each coordinate in one frame is a linear function to the other frame and each parameter describes the direction, speed and orientation of the equations.

We can divide reference frames into two categories:

CONCLUSION:

To sum up, the Lorentz Transformation is a fundamental concept in contemporary physics, especially in the field of special relativity. Its foundation is in Hendrik Lorentz's work bringing the equations of electromagnetism and the laws of relativity together. Since then, it has grown to be essential to comprehending phenomena like relativistic kinematics, time dilation, and length contraction. The Lorentz Transformation gracefully explains how space and time coordinates alter between various inertial frames moving at constant velocities relative to one another through its mathematical framework. The concept of the speed of light as a universal constant offers a framework for comprehending spacetime's composition and the interactions between time and space. Beyond theoretical physics, Lorentz Transformation has far-reaching ramifications. Applications include the behavior of subatomic particles in particle accelerators and the accurate synchronization of global positioning systems. Its theoretical elegance and practical utility, which allow us to make precise forecasts and improve technology, are equally important. The Lorentz Transformation continues to be a reliable guide as we explore farther into the secrets of the universe. It serves as a constant reminder of the interconnectivity of space and time as well as the underlying ideas that shape our reality.

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➢ Lorentz Transformation in Inertial Frame:

A Lorentz transformation can only be used in the context of inertial frames, so it is usually a special relativity transformation. During the linear transformation, a mapping occurs between 2 modules that include vector spaces. The multiplication and addition operations on scalars are preserved when using a linear transformation. As a result of this transformation, the observer who is moving at different speeds will be able to measure different elapsed times, different distances, and order of events, but it is important to follow the condition that the speed of light should be equivalent across all frames of reference.

Lorentz Boost:

It is also possible to apply the Lorentz transform to rotate space. A rotation free of this transformation is called Lorentz boost. This transformation preserves the space-time interval between two events.

The Statement of the Principle:
The transformation equations of Hendrik Lorentz relate two different coordinate systems in an inertial reference frame. There are two laws behind Lorentz transformations:

->Relativity Principle
->Light's constant speed

➢ Space-Time:

The concept of Lorentz transformation requires us to first understand spacetime and its coordinate system.

As opposed to three-dimensional coordinate systems having x, y, and z axes, space-time coordinates specify both space and time (four-dimensional coordinate system). The coordinates of each point in four-dimensional spacetime consist of three spatial and one temporal characteristic.

Need of a Spacetime Coordinate System:

Earlier, time was viewed as an absolute quantity. Since space is not an absolute quantity, observers would disagree about the distance (thus, the observers would not agree about the speed of the light) even though they agree on the time it takes for the light to travel. Consequently, time is no longer considered an absolute quantity due to the Theory of Relativity.

As a result, the distance between events can now be calculated as a function of time.
$d = (1/2)c$

Where,
-> d-distance of the event
->t-time was taken by a pulse to reach the event and reflect back
-> c-speed of light

➢ Application of Lorentz Transformation;

The following are the applications of Lorentz transformation:

>Helps us to understand the concept of space-time and its required coordinates.
>To understand the space-time diagrams and world lines.
>The speed of light is invariant in Lorentz transformations under inertial frames.
>Can observe muons on the surface of the Earth which originate from cosmic rays, proved by Lorentz transformation.

Lorentz's Transformation has two consequences:
>Length Contraction
> Time Dilation

Lorentz-Fitzgerald proposed for the first time that when a body moves at a rate comparable to the velocity of light relative to a stationary observer, the length of the body decreases along the direction of velocity. This reduction in length in the direction of motion is known as 'Length Contraction.'

Time dilation is the elongation of the time gap between two occurrences for an observer in an inertial frame moving relative to the events' rest frame.

➢ Significance of Lorentz Transformation:

The Lorentz transformation has been created in order to make predictions that could be confirmed by emprical mathematics. The Lorentz transformation is applicable to all physics events. Because of its left-fixed origin, a Lorentz transformation is also known as a hyperbolic rotation.

In the Lorentz transformation's relative time formula, c represents the velocity of light, as well as the relativistic invariant. The Lorentz boost has no effect on the velocity of light c, which remains constant regardless of the velocity linked to the Lorentz boost. Lorentz boost is essentially a Lorentz transformation without rotation. That explains why c is identical in all frames of reference.

The Lorentz transformation embodies the fundamental truth of the Universe. Every event is determined by the observer's reference frame. As a result, the Lorentz transform has an effect on every possible event. Because of its hyperbolic rotation, the Lorentz transformation is simply another arithmetical application in special relativity theory.

➢ CONCLUSION:

To sum up, the Lorentz Transformation is a fundamental concept in contemporary physics, especially in the field of special relativity. Its foundation is in Hendrik Lorent's work bringing the equations of electromagnetism and the laws of relativity together. Since then, it has grown to be essential to comprehending phenomena like relativistic kinematics, time dilation, and length contraction. The Lorentz Transformation gracefully explains how space and time coordinates alter between various inertial frames moving at constant velocities relative to one another through its mathematical framework. The concept of the speed of light as a universal constant offers a framework for comprehending spacetime's composition and the interactions between time and space. Beyond theoretical physics, Lorentz Transformation has far-reaching ramifications. Applications include the behavior of subatomic particles in particle accelerators and the accurate synchronization of global positioning systems. Its theoretical elegance and practical utility, which allow us to make precise forecasts and improve technology, are equally important. The Lorentz Transformation continues to be a reliable guide as we explore farther into the secrets of the universe. It serves as a constant reminder of the interconnectivity of space and time as well as the underlying ideas that shape our reality.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
Academic Year 2023-24

Subject Name: Digital Communication **Subject Code:** 21EC51 **Semester:** 5th 'A'

Subject Seminar GroupWise Topics

#	Group Number	USN	Student Name	Seminar Topic
1	Group-1	4AL21EC001	A. S. Pavithra	Kraft–McMillan inequality
2		4AL21EC002	ABHISHEK S	
3		4AL21EC003	AKASH A H	
4		4AL21EC005	Akshay Kumar h	
5	Group-2	4AL21EC006	Amaresha M	Binary Erasure Channel, Muroga's Theorem.
6		4AL21EC007	Anchita	
7		4AL21EC008	Anush S Amargol	
8		4AL21EC009	B.VENNELA	
9	Group-3	4AL21EC010	Basangouda patil	Convolution Codes
10		4AL21EC011	Basavakiran	
11		4AL21EC013	Bharath N	
12		4AL21EC014	Bhaskar T	
13	Group-4	4AL21EC015	Bhavana.B	Noisy Channel Coding Theorem
14		4AL21EC016	Chakravarty Jaipal T	
15		4AL21EC018	CHARAN RAJ RV	
16		4AL21EC019	Chetan M	
17	Group-5	4AL21EC020	Chethan K.M	Gaussian Channel and Information Capacity Theorem
18		4AL21EC021	Chiranjeevi U B	
19		4AL21EC022	Chithra L	
20		4AL21EC023	Darshan T S	

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Academic Year 2023-24

#	Group Number	USN	Student Name	Seminar Topic
21	Group-6	4AL21EC024	Darshana Basavaraj B	Generator Matrix and Parity Check Matrix
22		4AL21EC025	Deeksha S	
23		4AL21EC026	Deekshith D Shetty	
24		4AL21EC027	Diya	
25	Group-7	4AL21EC028	Gagan H S	Systematic Codes, Error Detections and Correction
26		4AL21EC029	Gowthama M A	
27		4AL21EC030	Harshitha B.S	
28		4AL21EC031	Hemanth R	
29	Group-8	4AL21EC032	Hemashri H N	Fire Code, Golay Code, CRC Codes and Circuit Implementation of Cyclic Codes
30		4AL21EC033	Huriya Sanadi	
31		4AL21EC034	Inchara S Shetty	
32		4AL21EC035	Jeevan K G	
33	Group-9	4AL21EC036	Jeevan V	Reed Solomon (RS) Codes
34		4AL21EC037	Kalmesh G G	
35		4AL21EC038	Kaluva Chandrashekar	
36		4AL21EC039	Keerthan S	
37	Group-10	4AL21EC040	Kiran Kashyap M	Hamming and Hadamard Codes
38		4AL21EC041	Kishor U	
39		4AL21EC042	Lakshan	
40		4AL21EC043	Lakshmi Keerthana B	
41	Group-11	4AL21EC044	Lekhan T	Probability Rules and Baye's Theorem
42		4AL21EC045	Madugonde Sandeep	
43		4AL21EC046	Mahantesh Shidaray T	
44		4AL21EC047	Mailaragouda N P	

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
Academic Year 2023-24

#	Group Number	USN	Student Name	Seminar Topic
45	Group-12 ✓	4AL21EC049	Manupriya Y	Information theory in Cryptography and Cryptanalysis
46		4AL21EC050	Meghana L	
47		4AL21EC051	Mohammed Iqbal	
48		4AL21EC052	Muhammad Razi	
49	Group-13 ✓	4AL21EC053	Nagabhushan H K	Optimum Quantizer, Practical Application of Source Coding: JPEG Compression
50		4AL21EC054	Naveen Kumar H S	
51		4AL21EC062	Prajwal s das	
52		4AL21EC068	Ramya .R	
53	Group-14 ✓	4AL21EC104	Vaishnavi S	Noisy Channel Coding Theorem
54		4AL22EC402	G Chethan Kumar G	
55		4AL22EC408	Veeresh S V	
56		4AL22EC406	Shamshuddin	
57	Group-15 ✓	4AL22EC400	Abhishek P Tatuskar	Markov statistical model of information sources
58		4AL22EC401	Chetana A Burud	
59		4AL22EC403	Lakshmi B	
60		4AL22EC405	Pallavi A B	
61		4AL22EC407	Suhani R Jadhav	

Faculty Incharge

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
Academic Year 2023-24

Subject Name: Digital Communication **Subject Code:** 21EC51 **Semester:** 5th 'B'

Subject Seminar Groupwise Topics

#	Group Number	USN	Student Name	Seminar Topic
1	Group-1	4AL21EC056	Nivedita T Patil	Kraft–McMillan inequality
2		4AL21EC057	Prajyot Rajgonda Patil	
3		4AL21EC058	Pavan	
4		4AL21EC059	Pooja Venkatesh Naik	
5	Group-2	4AL21EC060	Prajwal L R	Binary Erasure Channel, Muroga's Theorem.
6		4AL21EC061	Prajwal Malabagi	
7		4AL21EC063	Prakruthi K P	
8		4AL21EC064	Prasanna kumar B I	
9	Group-3	4AL21EC065	Rakesh	Convolution Codes
10		4AL21EC066	Raksha	
11		4AL21EC067	Rakshith	
12		4AL21EC069	Ravi Kovi	
13	Group-4	4AL21EC070	sahana	Noisy Channel Coding Theorem
14		4AL21EC071	Saikumar	
15		4AL21EC073	sanjana shrikant H	
16		4AL21EC074	Santhosha S	
17	Group-5	4AL21EC076	Shashank C S	Gaussian Channel and Information Capacity Theorem
18		4AL21EC077	Shashank Swami	
19		4AL21EC078	Shashank V Shetti	
20		4AL21EC079	Shivakumar K V	

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Academic Year 2023-24

#	Group Number	USN	Student Name	Seminar Topic
21	Group-6	4AL21EC080	Shravya shetty	Generator Matrix and Parity Check Matrix
22		4AL21EC081	Shreya C Shetty	
23		4AL21EC082	Shreya K R	
24		4AL21EC083	Shreyas S Naik	
25	Group-7	4AL21EC084	Shruthi	Systematic Codes, Error Detections and Correction
26		4AL21EC085	Siddharoodh B D	
27		4AL21EC086	Sinchana C K	
28		4AL21EC087	sinchana R	
29	Group-8	4AL21EC088	Sinchana RD	Fire Code, Golay Code, CRC Codes and Circuit Implementation of Cyclic Codes
30		4AL21EC089	Sinchana.S.D	
31		4AL21EC090	Sindhu KS	
32		4AL21EC091	Sindhu S Patil	
33	Group-9	4AL21EC092	Sonali	Reed Solomon (RS) Codes
34		4AL21EC093	Srishti S Shetty	
35		4AL21EC094	Suma K G	
36		4AL21EC095	Sumith N	
37	Group-10	4AL21EC096	Sushrutha N	Hamming and Hadamard Codes
38		4AL21EC097	Tanishka	
39		4AL21EC098	Tej Ashok	
40		4AL21EC099	Thejas J Kotian	
41	Group-11	4AL21EC100	Thejashwi P Acharya	Probability Rules and Baye's Theorem
42		4AL21EC101	Thrisha P Hegde	
43		4AL21EC102	Usha Rani.N	
44		4AL21EC103	V Venkta Sainihith M	

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
Academic Year 2023-24

#	Group Number	USN	Student Name	Seminar Topic
45	Group-12	4AL21EC105	Vaishnavi Vithal Naik	Information theory in Cryptography and Cryptanalysis
46		4AL21EC106	Varshini Shetty	
47		4AL21EC107	Varun Kumar R	
48		4AL21EC108	Varun Devaramani	
49	Group-13	4AL21EC109	Veena Basavaraj R	Optimum Quantizer, Practical Application of Source Coding: JPEG Compression
50		4AL21EC110	Videesh D Shetty	
51		4AL21EC111	Vishal	
52		4AL21EC112	Vishwanath HB	
53	Group-14	4AL21EC113	Yashaswini T R	Noisy Channel Coding Theorem
54		4AL21EC114	Yashwanth GT	
55		4AL21EC115	Yogeshwar M	
56		4AL20EC009	C.Navajeevan	
57		4AL22EC404	Navaneeth	

Faculty Incharge

G-6(B)

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ALVA'S INSTITUTE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SEMINAR REPORT

on

Generator Matrix and Parity Check Matrix

ACADEMIC YEAR: 2023-2024

SUBJECT CODE : 21EC51

SUBJECT : Digital communication

CLASS : 3rd Year

SEMESTER : 5th Semester

SECTION : 'B' Section

SUBMITTED BY:		
Sl.no	**USN**	**NAME**
1	4AL21EC080	Shravya Shetty
2	4AL21EC081	Shreya C Shetty
3	4AL21EC082	Shreya K R
4	4AL21EC083	Shreya S Naik

CERTIFICATE OF EVALUATION

College Name	Alva's Institute of Engineering & Technology	
Degree	B. E.	
Branch	Electronics and Communication Engineering	
Semester	5th Semester	
Section	B	
USN & Name of theStudents	4AL21EC080	Shravya Shetty
	4AL21EC081	Shreya C Shetty
	4AL21EC082	Shreya K R
	4AL21EC083	Shreya S Naik
Subject & Subject Code	Digital Communication (21EC51)	
Faculty Name	Mrs. Bhagyashree K	
Designation	Assistant Professor	
Date of Submission	25-01-2024	
Total Marks	10	
Marks Scored	10	

Mrs. Bhagyashree K
Faculty Incharge

Dr. Siddesh G K
HoD

Table of Contents

Generator Matrix and Parity Check Matrix

Introduction:

1.Generator Matrix:

Generator Matrix and Parity Check Matrix are fundamental concepts in the field of coding theory, a branch of information theory that deals with the transmission and storage of information in a reliable and efficient manner. These matrices play a crucial role in the design and implementation of error-correcting codes, which are essential for ensuring accurate data transmission in communication systems and data storage devices.

Generator matrix of a non-systematic (n,k) cyclic codes

- The generator matrix will be in this form:

$$
\mathbf{G} = \begin{bmatrix}
g_0 & g_1 & \cdots & g_{n-k-1} & g_{n-k} & 0 & 0 & \cdots & 0 \\
0 & g_0 & g_1 & \cdots & g_{n-k-1} & g_{n-k} & 0 & \cdots & 0 \\
0 & 0 & g_0 & g_1 & \cdots & g_{n-k-1} & g_{n-k} & 0 & 0 \\
 & \vdots & & & & & & & \\
0 & 0 & 0 & \cdots & 0 & g_0 & \cdots & g_{n-k-1} & g_{n-k}
\end{bmatrix}_{r \times n}
$$

notice that the row are merely cyclic shifts of the basis vector $\bar{g} = [g_0 g_1 \cdots g_{n-k-1} g_{n-k} 00\ldots0]$

- A Generator Matrix is a matrix used to generate codewords in a systematic linear block code.
- Linear block codes are a type of error-correcting code where each codeword is a linear combination of the original message vectors.
- The primary purpose of the Generator Matrix is to facilitate the systematic encoding of information for transmission or storage.
- It defines the linear transformation that converts an input message vector into a corresponding codeword.
- In a systematic linear block code, a portion of the codeword directly represents the original message, making it easy to identify and extract the message at the receiver's end.
- If G is the Generator Matrix and m is a message vector, then the codeword c is obtained by multiplying the message vector by the generator matrix: c=m×G.

- The Generator Matrix allows for the creation of systematic codes, where a part of the codeword remains unchanged and represents the original message, making the decoding process more straightforward.
- If G is an $k \times n$ matrix (where k is the dimension of the message vector and n is the length of the codeword), it defines a linear mapping from the k-dimensional message space to the n-dimensional codeword space.

2. Parity Check Matrix:

A Parity Check Matrix is a fundamental concept in coding theory, a field of study within information theory that focuses on the design and analysis of error-detecting and error-correcting codes. Parity Check Matrices are particularly important in the context of linear block codes, providing a mechanism for detecting and sometimes correcting errors that may occur during the transmission or storage of data. In coding theory, a parity-check matrix of a linear block code C is a matrix which describes the linear relations that the components of a codeword must satisfy. It can be used to decide whether a particular vector is a codeword and is also used in decoding algorithms. Formally, a parity check matrix H of a linear code C is a generator matrix of the dual code, $C^{\perp}$. This means that a codeword $\mathbf{c}$ is in C if and only if the matrix-vector product $H\mathbf{c}^{\top} = \mathbf{0}$ (some authors[1] would write this in an equivalent form, $\mathbf{c}H^{\top} = \mathbf{0}$.)

The rows of a parity check matrix are the coefficients of the parity check equations. That is, they show how linear combinations of certain digits (components) of each codeword equal zero. For example, the parity check matrix

$$H = \begin{bmatrix} 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 \end{bmatrix},$$

compactly represents the parity check equations,

$$c_3 + c_4 = 0$$
$$c_1 + c_2 = 0,$$

that must be satisfied for the (c_1, c_2, c_3, c_4) vector to be a codeword of C

From the definition of the parity-check matrix it directly follows the minimum distance of the code is the minimum number d such that every $d - 1$ columns of a parity-check matrix H are linearly independent while there exist d columns of H that are linearly dependent.

Creating a parity check matrix

The parity check matrix for a given code can be derived from its generator matrix (and vice versa). If the generator matrix for an $[n,k]$-code is in standard form

$$G = [I_k | P],$$

then the parity check matrix is given by

$$H = [-P^{\top} | I_{n-k}].$$

Because

$$GH^{\top} = P - P = 0.$$

Negation is performed in the finite field F_q. Note that if the characteristic of the underlying field is 2 (i.e., 1 + 1 = 0 in that field), as in binary codes, then $-P = P$, so the negation is unnecessary.

For example, if a binary code has the generator matrix

$$G = \left[\begin{array}{cc|ccc} 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \end{array}\right]$$

then its parity check matrix is

$$H = \left[\begin{array}{cc|ccc} 1 & 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 \end{array}\right].$$

It can be verified that G is a k x n matrix, while H is a (n-k) matrix.

- A Parity Check Matrix is a mathematical construct used to perform error checking in linear block codes.
- Linear block codes are a type of error-correcting code where codewords are generated through linear combinations of message vectors.
- The primary purpose of a Parity Check Matrix is to check the validity of received codewords.
- If H is the Parity Check Matrix and c is a received codeword, the product c×HT (where HT is the transpose of H) results in a vector known as the syndrome.
- The syndrome is a crucial indicator of errors in the received codeword.
- A non-zero syndrome signals the presence of errors, and the specific pattern of the syndrome helps identify the location and nature of these errors.
- If H is an (n−k)×n matrix (where n is the length of the codeword and k is the dimension of the message vector), it defines linear relationships among the elements of a codeword.
- The Parity Check Matrix H is carefully designed to ensure that any valid codeword satisfies certain parity-check equations, making it a powerful tool for error detection.
- While Parity Check Matrices are primarily used for error detection, they can also be employed in certain cases for error correction, especially in codes that support error correction.

Types of Generator Matrix:

In coding theory, Generator Matrices play a crucial role in defining linear block codes. The types of Generator Matrices depend on specific properties and structures. Here are a few types along with brief explanations:

1.Systematic Generator Matrix:

A systematic generator matrix is designed to create systematic linear block codes. In a systematic code, a part of the codeword directly represents the original message, making the encoding and decoding processes more straightforward. The leftmost submatrix of a systematic generator matrix is typically an identity matrix.

2.Non-Systematic Generator Matrix:

Unlike a systematic generator matrix, a non-systematic generator matrix does not guarantee that a portion of the codeword corresponds directly to the message. While it is still valid for encoding, the absence of a systematic structure may complicate decoding.

3.Standard Form Generator Matrix:

A generator matrix is in standard form if it has an identity matrix as its leftmost submatrix. This form simplifies the encoding process and is often preferred for its ease of use in systematic codes.

4.Canonical Generator Matrix:

A canonical generator matrix is one that is structured to create codes with specific mathematical properties. The choice of a canonical form may depend on the desired characteristics of the code, such as performance in error correction or detection.

5.Sparse Generator Matrix:

A sparse generator matrix is characterized by having a small number of non-zero entries. Sparse matrices can be advantageous in terms of storage and computation efficiency, especially in situations where resources are limited.

6.Cyclic Generator Matrix:

Cyclic codes have a special property where cyclically shifting a codeword results in another valid codeword. A cyclic generator matrix is structured to create cyclic codes, simplifying the encoding and decoding processes for such codes.

7.Orthogonal Generator Matrix:

An orthogonal generator matrix is associated with codes that exhibit orthogonal properties. These codes may have applications in communication systems where interference is a concern.

Conclusion:

In information theory and coding, Generator Matrices and Parity Check Matrices are indispensable tools for ensuring reliable data transmission and storage. The Generator Matrix, with its linear transformation properties, plays a pivotal role in encoding information systematically into codewords, simplifying the process of data transmission and storage. Its systematic structure facilitates efficient decoding, allowing for the direct extraction of the original message from a portion of the codeword. On the other hand, the Parity Check Matrix serves as a critical component in error detection, providing a means to verify the integrity of received codewords. The orthogonality between the rows of the Generator and Parity Check Matrices, along with their relationship G×HT=0, ensures that errors can be efficiently identified through the syndrome. These matrices are essential in the design of error-correcting codes, contributing to the robustness of communication systems and the integrity of stored data. Their properties and relationships lay the foundation for creating codes that withstand the challenges posed by noise and interference, ultimately enhancing the reliability and accuracy of information transmission in diverse applications.


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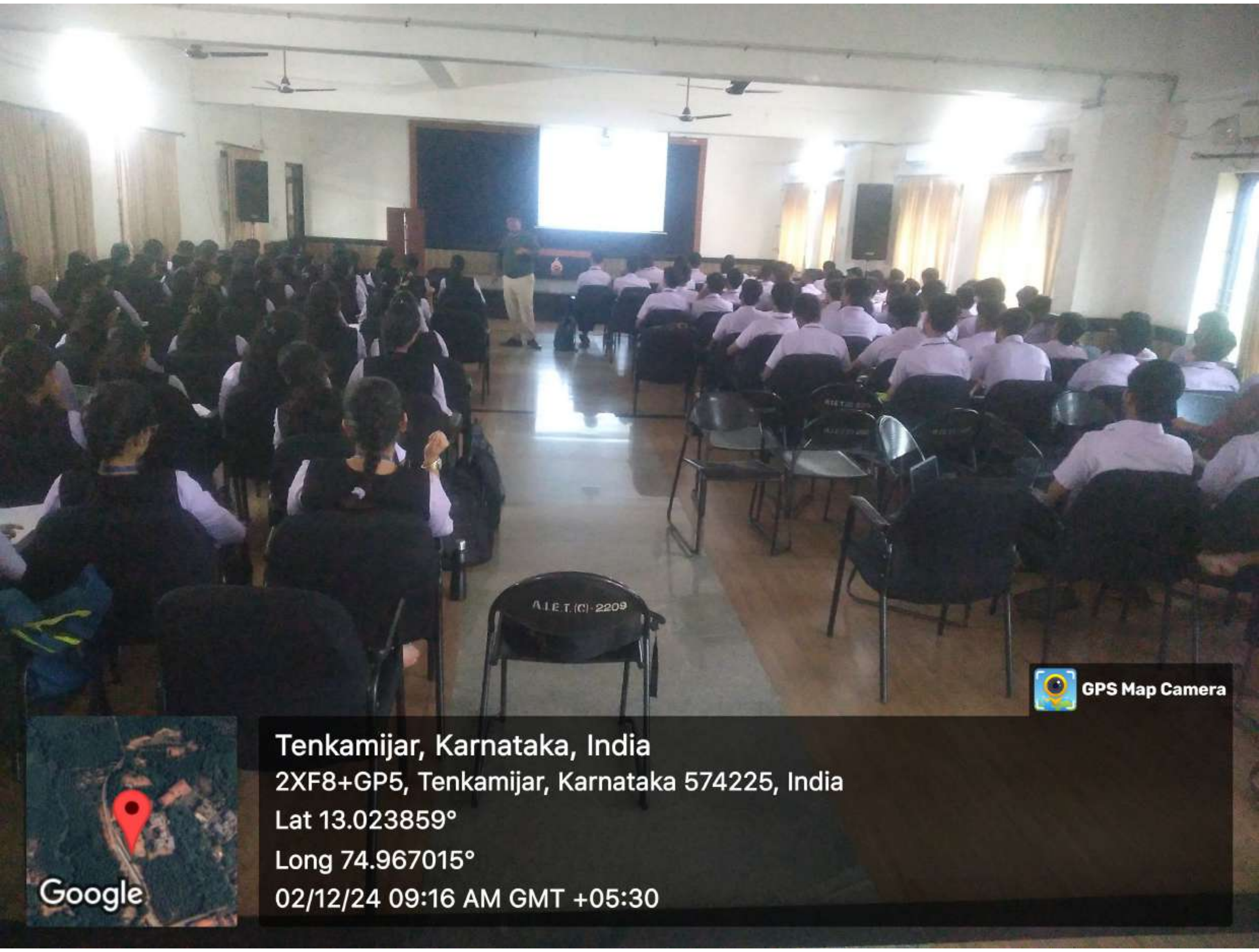
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