Uka Tarsadia University

B. Tech.

Semester IV

CODING THEORY
IT4023

EFFECTIVE FROM July-2022

Syllabus version: 1.00

Subject Code	Subject Title	Teaching Scheme			
		Hours		Credits	
		Theory	Practical	Theory	Practical
IT4023	Coding Theory	3	2	3	1

Subject Code	Subject Title	Theory Examination Marks		Practical Examination Marks	Total Marks
		Internal	External	CIE	
IT4023	Coding Theory	40	60	50	150

Objectives of the course:

- To expose student with the foundation of digital communication.
- To demonstrate various codes, algorithms and their structures.

Course outcomes:

Upon completion of the course, the student shall be able to,

CO1: Explain communication systems.
CO2: Understand and apply algebraic coding theory.
CO3: Understand and apply convolutional codes.
CO4: Understand and apply turbo codes.
CO5: Illustrate and compute space-time codes.
CO6: Comprehend and execute algebraic structures.

Sr. No.	Topics	Hours
	Unit – I	
1	**Introduction to Communication Systems:** Communication systems, Information Theory – Entropy, Channel capacity, Binary symmetric channel, AWGN channel A simple channel code.	6
	Unit – II	
2	**Algebraic Coding Theory:** Fundamentals of block codes, Linear block codes – Generator matrix, Parity check matrix, Syndrome and Cosets, Dual code, Bounds for linear block codes, and Code construction, Cyclic codes – Generator polynomial, Parity-check polynomial, Dual codes,	9

	Linear feedback shift registers, BCH codes, Reed-solomon codes.	
Unit – III		
3	**Convolutional Codes:** Encoding of Convolutional codes, Trellis diagram and the Viterbi algorithm, Distance properties and Error bounds, Soft-input decoding, Soft-output decoding, Convolutional coding in mobile communications.	8
Unit – IV		
4	**Turbo Codes:** LDPC codes, Code concatenation, Concatenated Convolutional codes, EXIT charts, Weight distribution, Woven Convolutional codes.	8
Unit – V		
5	**Space-Time Codes:** Introduction, Spatial channels, Performance measures, Orthogonal space–time block codes, Spatial multiplexing.	8
Unit – VI		
6	**Algebraic Structures:** Group, Rings, and Finite fields, Vector spaces, Polynomial fields, Extension fields, Discrete Fourier transform.	6

Sr. No.	Coding Theory (Practicals)	Hours
1	To prove bounds for linear block codes.	4
2	To prove Gilbert–Varshamov Bound.	4
3	To prove Griesmer Bound.	4
4	To study Asymptotic bounds for linear binary block codes.	4
5	To implement e Viterbi Algorithm.	6
6	To study and implement SR-ARQ block-wise ACK/NACK signaling.	8

Text book:

1. Andre Neubauer, Jurgen Freudenberger, and Volker Kuhn, “Docing Theory – Algorithms, Architectures and Applications”, Wiley Publications.

Reference books:

1. Chaoping Xing San Ling, ”Coding Theory: A First Course”, Cambridge Publication.
2. J. Das, P K Chatterjee and S. K. Mullick, Principles of Digital Communication, Wiley Publciation.

Course objectives and Course outcomes mapping:

- To expose student with the foundation of digital communication: CO1 and CO6.
- To demonstrate various codes, algorithms and their structures: CO2, CO3, CO4, and CO5.

Course units and Course outcomes mapping:

Unit No.	Unit Name	Course Outcomes					
		CO1	CO2	CO3	CO4	CO5	CO6
1	Introduction to Communication Systems	✓					
2	Algebraic Coding Theory		✓				
3	Convolutional Codes			✓			
4	Turbo Codes				✓		
5	Space-Time Codes					✓	
6	Algebraic Structures						✓

Programme outcomes:

PO 1: Engineering knowledge: An ability to apply knowledge of mathematics, science, and engineering.

PO 2: Problem analysis: An ability to identify, formulates, and solves engineering problems.

PO 3: Design/development of solutions: An ability to design a system, component, or process to meet desired needs within realistic constraints.

PO 4: Conduct investigations of complex problems: An ability to use the techniques, skills, and modern engineering tools necessary for solving engineering problems.

PO 5: Modern tool usage: The broad education and understanding of new engineering techniques necessary to solve engineering problems.

PO 6: The engineer and society: Achieve professional success with an understanding and appreciation of ethical behavior, social responsibility, and diversity, both as individuals and in team environments.

PO 7: Environment and sustainability: Articulate a comprehensive world view that integrates diverse approaches to sustainability.

PO 8: Ethics: Identify and demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work.

PO 9: Individual and team work: An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give/receive clear instructions.

PO 11: Project management and finance: An ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: A recognition of the need for, and an ability to engage in life-long learning.

Programme outcomes and Course outcomes mapping:

Programme Outcomes	Course Outcomes					
	CO1	CO2	CO3	CO4	CO5	CO6
PO1						
PO2		✓	✓	✓	✓	
PO3		✓	✓	✓	✓	
PO4						
PO5						
PO6						
PO7						
PO8						
PO9						
PO10						
PO11						
PO12	✓					