

## Modern Coding Theory

1.1 Course Number: ECE318

1.2 Contact Hours: 3-0-0 Credits: 9

1.3 Semester-offered: 4<sup>th</sup> Year-Even

1.4 Prerequisite:

1.5 Syllabus Committee Member: Dr. Umakant Dhar Dwivedi, Dr. Shivanshu Shrivastava, Dr. Sajal Agarwal, and Dr. Abhishek Kumar Singh.

2. **Objective:**

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Introduction	Communication Problem, Coding Trial and Error, Codes and Ensembles, MAP and ML Decoding and APP Processing, Channel Coding and Complexity, Linear Codes and Complexity, Rate, Probability, Complexity and Length	5
2	Factor Graphs	2.1. Distributive Law 2.2. Graphical Representation of Factorization 2.3. Recursive Determination of Marginals 2.4. Marginalization via Message Passing	5
3	Binary Erasure Channel	3.1. Channel Model 3.2. Transmission via Linear Codes 3.3. Tanner Graphs 3.4. Low-Density Parity-Check Codes 3.5. Message-Passing Decoder 3.6. Two Basic Simplifications 3.7. Computation Graph and Tree Ensemble 3.8. Tree Channel and Convergence to Tree Channel 3.9. Density Evolution 3.10. Monotonicity 3.11. Threshold 3.12. Fixed Point Characterization of Threshold 3.13. Stability 3.14. EXIT Chart	10
4	Binary Memoryless Symmetric Channels	4.1. Basic Definitions and Examples 4.2. Message-Passing Decoder 4.3. Two Basic Simplification 4.4. Tree Channel and Convergence to Tree Channel	10

		4.5.Density Evolution 4.6.Monotonicity 4.7.Threshold 4.8.Fixed Point Characterization of Threshold 4.9.Stability 4.10.EXIT Chart	
5	Turbo Codes and	5.1.Convolution Codes 5.2.Structure and Encoding 5.3.Decoding	5
6	General Ensembles	6.1.Multi-Edge-Type LDPC Code Ensembles 6.2. Multi-Edge-Type LDPC Code Analysis 6.3.Structure Codes	5
		<b>Total</b>	<b>40</b>

#### 4. Readings

##### 4.1 Textbook:

1. “Modern Coding Theory”, T. Richardson and R. Urbanke, Cambridge University Press, 2008.