University of Tehran
School of Electrical and Computer Engineering

Course:	**8101172 – Coding Theory**		
Course type:	Elective	EE*	Credit: 3
Level:	Graduate		
Co-requisite(s):	None		
Prerequisite(s):	None		
Prerequisite by topic:	Concepts of digital communications		
Textbook(s):	S. Lin and D. J. Costello, Jr., *Error Control Coding: Fundamentals and Applications*, Prentice Hall, 2nd Edition, 2004		
Coordinator:	Farshad Lahouti, Associate Professor		
Goals:	The students, upon completion of this course, will acquire knowledge on mathematical background of coding theory, linear block and convolutional codes, as well as Turbo codes. They will also be introduced to LDPC codes. They will understand how to design and implement encoders and decoders for different classes of coding schemes. Also, the student will be able to evaluate the performance of coded systems in BSC and AWGN channels. Taking the research oriented course projects, the students are enabled to conduct further research in coding theory.		
Outcome:	Upon successful completion of the course, students will be able to 1. Understand the role of channel coding in communications systems 2. Acquire basic knowledge on linear algebra for coding theory 3. Acquire fundamental knowledge on binary and non-binary linear block codes and their decoding techniques 4. Acquire fundamental knowledge on convolutional codes and their decoding schemes 5. Understand Turbo codes structures and iterative decoding 6. Acquire basic knowledge on Low Density Parity Check codes and their decoding schemes 7. Implement different coding and decoding schemes and evaluate the performance over a binary symmetric channel or an additive white Gaussian noise channel 8. Gain the scientific essentials and experience to conduct research in coding theory and related areas		
Topics:	1. Linear algebra for coding theory: Groups, Fields, Vector Spaces 2. Linear block codes 3. Cyclic codes 4. Linear convolutional codes, Viterbi decoding		

	5. BCH codes 6. Non-binary BCH & Reed Solomon codes 7. Concatenated Codes 8. Turbo codes, BCJR decoding and Turbo (iterative) decoding 9. Low density parity check codes and message passing decoding
Computer usage:	Matlab for implementing coding algorithms in assignments
Assignments:	The course includes assignments, computer assignments as midterm exam, and a research-based course project.
Projects:	
Grading:	Assignments: 10% Project: 20% Computer Assignments: 20% Exams: 50%
Further readings:	1. T. K. Moon, *Error Correction Coding Mathematical Methods and Algortihms,*Wiley, 2005 2. T. Richardson, R. Urbanke, *Modern Coding Theory*, Cambridge University Press, 2007. 3. D. J. C. MacKay, *Information Theory, Inference, and Learning Algorithms*, Cambridge University Press, 2003 4. S. J. Johnson, *Iterative Error Correction: Turbo, Low-Density Parity-Check and Repeat-Accumulate Codes,* Cambridge University Press, 2009. 5. S. B. Wicker, *Error Control Systems for Digital Communication and Storage*, Prentice Hall, 1995 6. F.J. MacWilliams and N. J. A. Sloane, *The Theory of Error-Correcting Codes*, North-Holland, 1978 7. E. R. Berlekamp, *Algebraic Coding Theory*, McGraw-Hill, New York, 1968 8. R. E. Blahut, *Theory and Practice of Error Control Codes*, Addison-Wesley, 1983 9. V. Pless and W. C. Huffman, Eds., *Handbook of Coding Theory*, Elsevier, 1998 10. D. J. C. MacKay, *Information Theory, Inference, and Learning Algorithms*, Cambridge University Press, 2003
Prepared by:	Farshad Lahouti
Date:	January 8, 2012

*EE: Electrical Engineering CE: Computer Engineering IT: Information Technology