

# Advanced Topics in Coding Theory

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## Overview

Error control coding is an indispensable part of any digital communication system. Since Shannon's landmark paper in 1948, coding theorists have been trying to develop practical error correcting codes that can achieve channel capacity. In the last two decades, with the discovery of turbo codes and the re-discovery of capacity approaching low density parity check codes, there has been new excitement in the area of coding theory. Spatially coupled codes and polar codes are two examples of low complexity codes with excellent performance.

Spatially coupled codes have the property that their decoding threshold under low-complexity iterative decoding is essentially equal to the decoding threshold of high-complexity (optimal) maximum-likelihood (ML) of the underlying sparse graph code. While spatially coupled codes, which can be viewed as low density parity check convolutional codes, are typically constructed randomly, polar codes, introduced by Arikan in 2007, have an explicit construction to achieve channel capacity for symmetric binary-input discrete memoryless channels.

<b>Course Information</b>	<b>Duration:</b> October 13 <sup>th</sup> -October 22 <sup>nd</sup> 2016 <b>Total Contact Hours:</b> 30 hours in 10 days <b>Course Website:</b> <a href="http://www.iitk.ac.in/ee/wireless/">http://www.iitk.ac.in/ee/wireless/</a>
<b>Modules</b>	<b>A: Introduction to coding theory : Oct 13 - Oct 15, 2016</b> <b>B: LDPC &amp; Spatially coupled codes: Oct 16 - Oct 18, 2016</b> <b>C: Polar codes : Oct 20 – Oct 22, 2016</b>
<b>You Should Attend if</b>	<ul style="list-style-type: none"><li>▪ you are a industry professional interested in designing and implementing state of the art error control coding techniques</li><li>▪ you are a student or faculty from academic institution interested in knowing the latest happening in the area of coding theory</li></ul> <b>Pre-requisite:</b> Prior knowledge in Probability Theory, Linear Algebra and Digital Communications is needed.
<b>Fees</b>	The participation fees for taking the course is as follows: <b>Industry/ Research Organizations: Rs. 10000 + 15% service tax (Total: Rs. 11500)</b> <b>Academic Institutions (Faculty): Rs. 5000 + 15% service tax (Total: Rs. 5750)</b> <b>Academic Institutions (Students): Rs. 2000 + 15% service tax (Total: Rs. 2300)</b> <b>Academic Institutions (SC/ST Students) : Rs. 1000 + 15% service tax (Total: Rs. 1150)</b>  Students have to submit a letter from their institute as proof of full time student enrollment. SC/ST students will have to submit a valid Caste/Tribe Certificate.  The above fee entitles participants to attend all the lectures. Boarding, lodging and meal charges are not included in the fees. The participants will be provided shared accommodation in Visitor's Hostel/Visitor's Hostel Extension on payment basis.

## The Faculty



**Daniel J. Costello, Jr.**, is the Leonard Bettex Professor Emeritus of Electrical Engineering at the University of Notre Dame. He is a Fellow of IEEE. In 2000, he received an IEEE Third Millennium Medal, in 2009 he was co-recipient of the IEEE Donald G. Fink Prize Paper Award, in 2012 he was co-recipient of the joint IEEE Information Theory Society/Communications Society Prize Paper Award, and in 2013 he received the Aaron D. Wyner Distinguished Service Award from the IEEE Information Theory Society. In 2014 he received the Vice President's Recognition Award from the Educational Activities Board (EAB) of the IEEE. He is also the recipient of the 2015 Leon K. Kirchmayer Graduate Teaching Award by the IEEE. In 1983 he coauthored a textbook entitled "Error Control Coding: Fundamentals and Applications", the 2nd edition of which was published in 2004.



**Emre Telatar** received the S.M. and Ph.D. degrees in electrical engineering and computer science from the Massachusetts Institute of Technology, Cambridge, in 1988 and 1992 respectively. He is a professor at EPFL, Lausanne. Emre Telatar was the recipient of the IEEE Information Theory Society Paper Award in 2001. He was a program co-chair for the IEEE International Symposium on Information Theory in 2002, and associate editor for Shannon Theory for the IEEE Information Theory Transactions from 2001 to 2004. He was awarded the EPFL Agepoly teaching prize in 2005. Emre Telatar's research interests are in communication and information theories.



**Ajit Chaturvedi** received his Bachelors, Masters and Ph.D. degrees from Indian Institute of Technology, Kanpur. Currently he is a professor in the department of electrical engineering at IIT Kanpur. He is a recipient of Distinguished Teacher's award from IIT Kanpur and Tan Chin Tuan fellowship from Nanyang Technical University, Singapore. His research interests are in the areas of communications theory, and mobile communications.



**Adrish Banerjee** received his Bachelors degree from Indian Institute of Technology, Kharagpur and Masters and Ph.D. degree from University of Notre Dame, Indiana. He is currently an Associate Professor in the Department of Electrical Engineering at Indian Institute of Technology, Kanpur. He is a recipient of Microsoft Research India young faculty award, Institute of Engineers India young engineer award, and IETE-Prof. Sreenivasan Memorial Award-2016. His research interests are in the physical layer aspects of wireless communications, particularly error control coding, cognitive radio and green communications.

## Course Co-ordinators:

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<http://www.iitk.ac.in/ee/wireless>