

# CT111 Introduction to Communication Systems

## Lecture 1: Introduction

Yash M. Vasavada

Associate Professor, DA-IICT, Gandhinagar

3rd January 2018



# Overview of Today's Talk

- 1 Introduction
- 2 Course Mechanics
- 3 Foundations
- 4 Course Overview
  - Road from 4G to 5G
  - Related Subjects



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# About Myself

- Instructor: Yash M. Vasavada

- B.E. in Electronics and Communications from L. D. Engineering College, Gujarat University, Ahmedabad, India
- M.S. and Ph.D. in Electrical Engineering from Virginia Polytechnic Institute and State University, Blacksburg, VA, USA
- I was with Hughes Network Systems in Germantown, MD, USA until 2016
- Beginning of the year 2016, I have been with DA-IICT



# My Research

I am interested in

- the confluence of Machine Learning with Digital and Wireless Communications
- development of new algorithms, a study of their properties, and a study of their applications in communications, signal processing and artificial intelligence



# Overview

- This is a L-T-P-Cr: 3 – 0 – 3 – 4.5 Course.
- Lecture venue: LT 3
- Lecture time: M, W, F, 9 to 9:55 am.
- Lab Sessions: eight weekly labs, followed by a project





# Textbook

**Main Textbook:** Electronic Communication Systems, Wayne Tomasi, Pearson Education, India, Fourth Reprint, 2003.

**Supporting Textbooks:**

- ① Digital and Analog Communication Systems, Leon Couch, Pearson Education, India, 6th Ed, 2001.
- ② Communication Electronics Principles and Applications, Louis E. Frenzel, Tata Mc-Graw Hill, India, Third Edition, 2002.
- ③ Modern Electronic Communication, Gary M. Miller and Jeffrey S. Beasley, Prentice- Hall India, Seventh Edition, 2002.
- ④ Electronic Communications, Dennis Roddy and John Coolen, Pearson Education, India, Fourth Edition, 2004.

**Software:** LTspice, Pspice, Matlab, Python (Jupyter iPython Notebook)



# Foundational Topics

## Things to Keep in Mind

- Some observations:
  - New Year Resolutions and Walter Maschel's experiment
  - Why did Apple succeed where the other, quite capable, companies failed?
  - How did Gandhiji manage to excite the passions of the entire nation in 1922 non-cooperation movement, and how did he manage to put a sudden stop to it after Chauri Chaura incident?
- ▷ **Start With Why** Simon Sinek on TED Talks
- Why to study CT-111?
  - Because it's an inherently beautiful subject that you can fall in love with.
  - Think of CT-111 not as a course, but instead as a sight-seeing tour (where I will be your tour guide)



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# Grading Categories

- Evaluation Modes:

- ▷ Individual

- Three Examinations: two mid-terms and one final
- In-class Interactions: students will be graded on the basis of the questions asked during the class
- Labs: students will be graded on the basis of the quality of the lab work done and lab attendance. The TAs will perform this grading.

- ▷ Group

- Final project: all students in a group will jointly work on a project and present their work
- In-class Quizzes: all students in a group will jointly prepare for the in-class quizzes. One student per group will be randomly selected for each quiz. His/her score will apply to the entire group.

- Relative weighting of the above grade items is to be finalized.

- Total marks out of 100 will be converted to a letter (performance) grade using a 10-point scale.



Road from 4G to 5G

# Why to Study CT111?

(4G and 5G are the reasons)

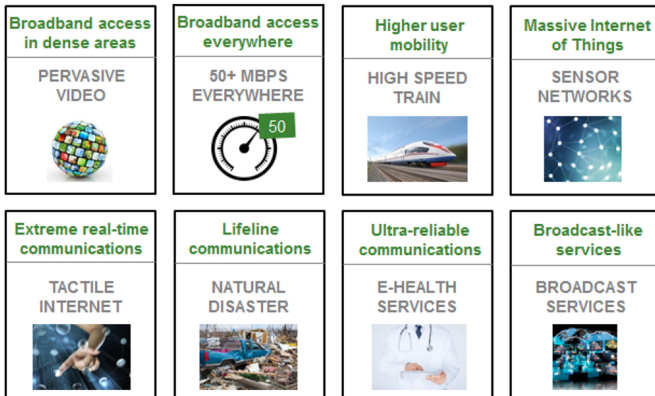
- The world is currently migrating from 3G to 4G
- However, the research and the advanced development in the industry is currently migrating from 4G to 5G
  - Perfect time to get on the board.
  - CT-111 would be the first step
- Let us see next what the research and the industry are targeting for



Road from 4G to 5G

# Why to Study CT111?

(5G Targets (by NGMN))



→ Reference: 5G White Paper, NGMN Alliance, Feb 2015



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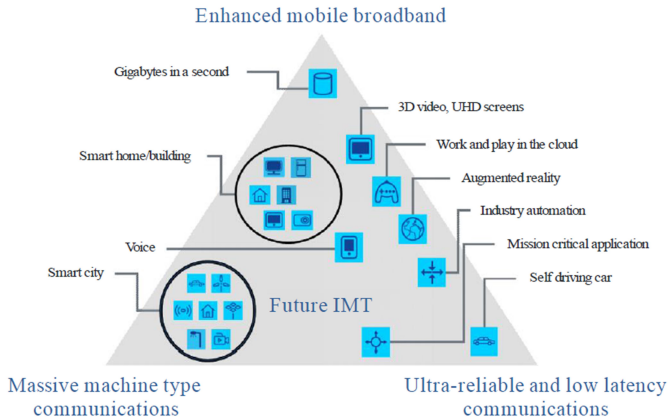
- Broadband Access in Dense Areas
  - Competitor to Cable TV
- Broadband Access Everywhere
  - Internet and phone calls in rural areas
- High Speed Mobility
  - Internet and phone calls in bullet trains and planes
- Massive Internet Of Things (IOT)
  - Connected devices that interact with each other
- Extreme Real Time Communications
  - Very fast, low latency, for autonomous vehicles, industrial automation, augmented reality
- Lifeline Communications
  - Mission critical applications, public safety
- Ultra Reliable Communications
  - Robotic surgery, surgeon located thousands of miles away, etc.



Road from 4G to 5G

# Why to Study CT111?

(5G Targets (by ITU))



→ Reference: ITU-R M.2083-0



Road from 4G to 5G

# Why to Study CT111?

(5G Targets (by ITU))

- Enhanced Mobile Broadband (hologram)
- Critical Communications (drones and robots)
- Massive MTC (inventory control, flexible manufacturing)
- Network Operation that save energy
- Enhancement of Vehicle to Everything (autonomous driving)



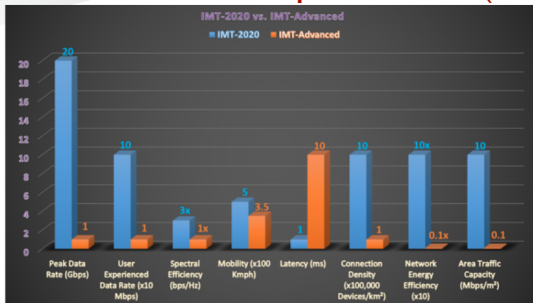


Road from 4G to 5G

# Why to Study CT111?

(5G Targets (by NGMN))

## 5G Performance Requirements (ITU)



# Relation to Other Courses

**Analog and Digital Communications:** Designed to be a precursor to A&D. Several lectures may have some overlap with A&D.

**Coding Theory:** cover block codes, convolutional codes, Turbo and LDPC codes. Describes the performance analysis and their application in the system design.

**Wireless Communications:** this course provides a detailed study on the statistical description of the wireless channel. The course also covers multiple wireless (2G/3G/4G) standards. CT-111 will provide an overview of the channel models, and will allow you to understand the basics of these various wireless standards.



# Relation to Other Courses

**Information Theory:** emphasizes the fundamental limits on the communications. In CT111, we will study the algorithms used at the transmitter and the receiver of the digital communication system that attempt to approach these limits.

**Estimation and Detection Theory:** provides a detailed mathematical background on the algorithms used at the receiver of a communication system. In this class, we will cover a part of this material.

**Probability and Statistics for Engineers:** this class serves as foundation course for all of the courses listed above. We will utilize some statistical concepts in CT111.

