

## Department of Electrical Engineering, IIT Madras

ESB-207B, E-Slot

July-Nov., 2019

### **EE 5151: Communication Techniques**

*Motivation:* This course is to introduce students to several design problems in communication systems where the solution can be obtained by a combination of intuitive reasoning and “fairly simple” numerical techniques. We take examples from the classical public switched telephone network, modern wireless cellular communications, and data networks, to bring out the elegance of several engineering solutions which have been designed, developed and commercially deployed over the last 60 years of telecommunications.

**Part-1:** From “*Digital Telephony*”, J.C.Bellamy, 3<sup>rd</sup> Ed (John Wiley)

1.1 Chapter 1 – Introduction: reading

1.2 Chapter 2 – Why digital representation and transmission? reading

1.3 Signal representation, Sampling of band-pass signals (Notes)

1.4 Chapter 4 – Digital transmission & multiplexing of digital streams – examples from elastic buffers, bit-stuffing, and marker detection for framing

1.5 Chapter 5 – Digital switching for Voice -- Multistage switches, Non-blocking and Blocking switches, Blocking Probability versus Complexity, (5.1--5.4; excluding 5.2.3 to 5.2.6), Digital Trunking for Voice – interpretation from Erlang-B formula (Notes)

**Part-2:** From “*Wireless Communications*”, T.S.Rappaport, (Pearson Ed.)

2.1 Chapter 1 – Introduction to wireless communications: reading

2.2 RF Principles, Path Loss, Receiver Sensitivity, Wireless Communication Link Budget, Analog repeater (relay) design, BER of Analog Repeater and Regenerative Repeater (Notes)

2.3 Chapter 2 – Cellular concept – System design fundamentals

(emphasis on co-channel interference and system capacity, and trunking efficiency), user capacity of cellular TDMA and DS-CDMA systems (also from Chapter 8)

2.4 Introduction to symbol-by-symbol modulation and motivation for block modulation – basics of pulse-shaping for band-limited channels and equalization for distorting channels

**2.5 Optional Lab Component – Bonus Marks!**

**Part-3:** From “*Data Networks*”, Bertsekas and Gallager, 2<sup>nd</sup> Ed, (Prentice Hall India)

3.1 Elements of Packet Switching – Motivation, CRC and matrix-parity check codes, ARQ Protocols, **Pipelining, Flow Control; What is hybrid ARQ (HARQ) in 4G LTE systems?**

Assessment Method:

Quiz1 – 20; Quiz2 – 20; End Sem – 40; The remaining 20 marks will be awarded to take-home assignments and/or “short quizzes” for 15mins-30mins duration. The optional lab component followed by demo+viva can yield up to 10 bonus marks on top of this. The TAs for this course will be Abhay Mohan, Sweta Singh, and Sairaj Desai. Contact me at ESB-334B, x4420, [giri@ee.iitm.ac.in](mailto:giri@ee.iitm.ac.in), for more details. Soft-copies of additional material will be made available at [www.ee.iitm.ac.in/~giri](http://www.ee.iitm.ac.in/~giri) and/or on Moodle.