



DIGITAL COMMUNICATIONS (EE 420)

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| Lecture Schedule | Tuesday and Thursday(12:30-13:45) | Semester | Fall2015 |
| Pre-requisite | Signals and Systems (EE312) Communication Sytems (EE410) | Credit Hours | 3+1 |
| Instructors | Dr.Muhammad Adnan | Contact | muhammad.adnan@umt.edu.pk , +92.321.5086744 |
| Office Hours | Monday to Thursday and Saturday (9:00-17:00) | | |
| Office | Cabin 6, Room 501 , SEN | Counseling Hours | Monday to Thursday(15:00-17:00) |
| Course Objectives | The objective of this course is to provide a deep level of understanding to undergraduate students about a Digital Transceiver. The several blocks including formatting, channel coding/decoding ,base-band and band-pass modulation/demodulation (detection) will be discussed. | | |
| Learning Outcomes | <ul style="list-style-type: none">• First part, focused on formatting and baseband modulation.• Secondly, we learn about channel impairments ,affect of noise and InterSymbol Interference, and methods to overcome these impairments (like pulse-shapping filters and Equalization Techniques).• Thirdly, we develop the understanding of band-pass modulation including coherent and non-coherent detection.• Fourth, the most essential part of synchronization is introduced.• Fifth, we learn channel coding and decoding techniques . | | |
| Textbook(s) | Required Text: Digital Communications by Bernard Sklar second Edition ,Publisher Prentice Hall. Reference Books: (1) Communication Systems, 3rd or 4th Ed., Simon Haykin, John Wiley & Sons, (Available in the book stores) (2) Communication Systems Engineering, 2nd Edition, Prentice Hall, 2001. (3) Digital Communications, Fourth Edition, J.G. Proakis, McGraw Hill, 2000. (4) Analog and Digital Communication Systems, Leacon W. Couch II, 6th edition, Prentice Hall, 2001. (5) Modern Digital and Analog Communication Systems, B. P. Lathi, 3rd Ed. Oxford Univ. Press 1998. (6) Digital Communication, Edward. A. Lee and David G. Messerschmitt, 2nd Ed. Kluwer Acad. | | |
| Grading Policy | Quizzes & Assignments: 20% Term Project: 5% Mid Term: 25% Final : 50% | | |

Course Plan

| Lectures | Topics | Readings |
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| 1-2 | Introduction <ul style="list-style-type: none"> • Main Blocks of Digital Communication System • Performance criterion in Communication System (Analog vs Digital) • Merits and De-merits of Digital Communication. • Classification of Signals. | Chapter1.Text Book |
| 3-4 | Autocorrelation and Random Processes. <ul style="list-style-type: none"> • Random variable and Random processes. • Ensemble averages • Ergodic and WSS processes. • Autocorrelation and spectral densities. | Chapter1.Text Book |
| 5-6 | Sampling and Quantization <ul style="list-style-type: none"> • Nyquist Sampling Theorem and Aliasing. • Types of Sampling • Linear and Non-linear quantization. | Chapter2.Text Book |
| 7-8 | Pulse Modulation(base-band modulation) <ul style="list-style-type: none"> • Types of pulse modulation • PCM waveforms/Line codes and their comparison • Correlative coding. • Delta Modulation and adaptive delta modulation (Ref.) | Chapter2.Text Book Ref. reference material |
| 9-10 | Detection/Demodulation <ul style="list-style-type: none"> • Maximum likelihood detection for binary signaling. • Probability of Error for binary signaling. • Matched Filter and correlation realization of matched filter. | Chapter3.Text Book |
| 11-12 | InterSymbol Interference and Pulse shapping. <ul style="list-style-type: none"> • Intersymbol interference • Pulse shapping Filters. • Eye-Pattern • Detection of pulse shapped signals | Chapter3.Text Book |
| 13-14 | Channel Equalization. <ul style="list-style-type: none"> • Preset and Adaptive Equalization • Types of Equalizers (ZFE and DFE) • Filter update Rate. | Chapter3.Text Book |
| Mid-Term | | |
| 15-16 | Band-Pass modulation and Demodulation/Detection <ul style="list-style-type: none"> • Representation of signals (I-Q form, complex envelop) • Constellation Diagram. • ASK,PSK,FSK and APSK ($M>2$) • Coherent and Non-coherent ASK receiver. | Chapter4.Text Book |
| 17-18 | Band-Pass modulation and Demodulation/Detection <ul style="list-style-type: none"> • Coherent Detection of PSK • Sampled matched Filter. • Coherent Detection of FSK | Chapter4.Text Book |

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| 19-20 | Band-Pass modulation and Demodulation/Detection <ul style="list-style-type: none"> • Differential Phase shift keying and Non-coherent detection of PSK • Non-coherent Detection of FSK • M-APSK/M-QAM, MSK ,GMSK • Performance comparison of different modulation techniques. | Chapter4.Text Book |
| 21-22 | Introduction to Channel coding and Linear Block Codes. <ul style="list-style-type: none"> • Generator Matrix, error-pattern and syndrome testing. • Parity-Check Matrix • Systematic and Non-Systematic Linear Block codes. • Error Detection and Correction • Erasure correction and capability of codes. • Practical Linear Block codes i.e. Hamming, Golay & BCH codes. | Chapter6.Text Book |
| 23-24 | Cyclic Codes. <ul style="list-style-type: none"> • Algebraic structured of Cyclic codes. • Systematic and Non-systematic cyclic codes. • Circuit for dividing polynomials. • Systematic Encoding with (n-k)stage shift registers. • Error Detection with (n-k) stage shift registers. | Chapter6.Text Book |
| 25-26 | Convolutional Codes and Decoding Algorithms <ul style="list-style-type: none"> • Structure of convolutional codes. • Well-known representation like tree, trellis and state diagram • Viterbi decoding and sequential decoding algorithms | Chapter7.Text Book |
| 27-28 | Turbo Codes. <ul style="list-style-type: none"> • Soft vs Hard decoding • Iterative structure of Turbo codes | Chapter8.Text Book |
| 29-30 | Modulation and Coding Tradeoffs. <ul style="list-style-type: none"> • Trellis coded modulation • Performance gains of coded system Synchronization <ul style="list-style-type: none"> • Phase Locked Loops • Bit and Frame Synchronization | Chapter9.Text Book (selected topics) Chapter10.Text Book (selected topics) |