Digital Communication System

1.1 Course Number: CS371

1.2 Contact Hours: 3-0-0 Credits: 9

1.3 Semester-offered: 3ed Year-Odd

1.4 Prerequisite: probability and linear systems

1.5 Syllabus Committee Member: Dr. Sushum Biswas, Dr. Daya Sagar Gupta & Dr. Gargi Srivastava

2. **Objective:** This course is intended to develop the skills to diagnose and rectify the errors occurring in digital communication systems. the concepts and principles of digital communication will also lay the foundation to understand the various modern communication systems.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Introduction	Introduction: A layered view of digital communication; Discrete source encoding; Memory-less sources, prefix free codes, and entropy; Entropy and asymptotic equipartition property; Markov sources and Lempel-Ziv universal codes	8
2	Quantization	Quantization; High rate quantizers and waveform encoding; Measure, fourier series, and fourier transforms; Discrete-time fourier transforms and sampling theorem; Degrees of freedom, orthonormal expansions, and aliasing	8
3	Signal space	Signal space, projection theorem, and modulation; Nyquist theory, pulse amplitude modulation (PAM), quadrature amplitude modulation (QAM), and frequency translation; Random processes; Jointly Gaussian random vectors and processes and white Gaussian noise (WGN); Linear functionals and filtering of random processes	8
4	Detection	introduction to detection; Detection for random vectors and processes; Theorem of irrelevance, M-ary detection, and coding; Baseband detection and complex Gaussian processes; Introduction of wireless communication	8
5	Doppler Spread	Doppler spread, time spread, coherence time, and coherence frequency; Discrete-time baseband models for wireless channels; Detection for flat rayleigh fading	8

		and incoherent channels, and rake receivers; Case study — code division multiple access (CDMA)	
		Total	**40**

4. Readings

4.1 Textbook:

- Proakis, John G. Digital Communications. 4th ed. New York, NY: McGraw-Hill, 2000. ISBN: 9780072321111.
- Proakis, John G., and Masoud Salehi. Communication Systems Engineering. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 2001. ISBN: 9780130617934.
- Wozencraft, John M., and Irwin Mark Jacobs. Principles of Communication Engineering. Reprint ed. Long Grove, IL: Waveland Press, 1990. ISBN: 9780881335545.
- Wilson, Stephen G. Digital Modulation and Coding. Upper Saddle River, NJ: Prentice Hall, 1996. ISBN: 9780132100717.
- Gallager, Robert G. Information Theory and Reliable Communication. New York, NY: John Wiley & Sons, 1968. ISBN: 9780471290483.

4.2 Reference books:

- Cover, Thomas M., and Joy A. Thomas. Elements of Information Theory. 2nd ed. New York, NY: Wiley Interscience, 2006. ISBN: 9780471241959.
- Tse, David, and Pramod Viswanath. Fundamentals of Wireless Communication. Cambridge, UK: Cambridge University Press, 2005. ISBN: 9780521845274.
- Goldsmith, Andrea. Wireless Communications. Cambridge, UK: Cambridge University Press, 2005. ISBN: 9780521837163.
- Strang, Gilbert. Introduction to Linear Algebra. 3rd ed. Wellesley, MA: Wellesley-Cambridge Press, 2003. ISBN: 9780961408893.

5 Outcome of the Course: After the completion of this course, the students will be able to:

- analyse various error detection and correction codes in digital communication systems
- use various pulse code modulation techniques
- maintain systems based on digital modulation techniques
- multiplex and demultiplex digital signals
- maintain spread spectrum based systems