# Subject Description Form

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|---|---|
| **Subject Code** | EE3008 / EE3008A / EE3008B |
| **Subject Title** | Linear Systems and Signal Processing |
| **Credit Value** | 3 |
| **Level** | 3 |
| **Pre-requisite/ Co-requisite/ Exclusion** | Exclusion of EE3008B: EE3011B |
| **Objectives** | To provide an introduction to the fundamentals of linear systems, frequency domain analysis with applications to telecommunication systems. |
| **Subject Intended Learning Outcomes** | Upon completion of the subject, students will be able to:<br>a. Understand the fundamentals of signals and linear systems.<br>b. Understand and analyze problems in different disciplines of engineering (with an emphasis on communication systems) under the framework of signals and linear systems<br>c. Understand the characteristics, operating principles, performance metrics and limitations of some typical telecommunication systems. |
| **Subject Synopsis/ Indicative Syllabus** | 1. ***Signal representation and analysis:*** Mathematical representation of a signal; time-domain representation. Classification of signal and systems; Special functions. Linear and Time-Invariant Systems; Convolution;<br>2. ***Fourier series and Fourier Transforms:*** Complex exponentials; Frequency domain representation of signals; Fourier Series; Fourier transform; Fourier Transform pairs; Fourier Transform properties; Parsavel's theorem; Transfer functions; filters. Applications to music, electromagnetic radiation and imaging;<br>3. ***Sinusoidal carrier modulation:*** Amplitude and frequency modulation; Operating principle; Double side-band suppressed carrier, single side-band; Frequency division multiplexing; generation and detection circuitry; Modulation system performance comparison.<br>4. ***Pulse modulation:*** Sampling theorem. Pulse amplitude modulation. Time division multiplexing. Pulse code modulation: quantization, encoding. Quantization noise. Differential pulse code modulation. Delta modulation. Pulse amplitude modulation; Pulse width modulation;<br>5. ***Digital communications:*** Digital transmission. Intersymbol interference; Eye diagram. Digital carrier modulation; Pulse shaping; modulation format and spectral efficiency; probability and random variables; bit error ratio (BER) characterization and system performance.<br>6. ***Introduction to copper-wire, wireless and optical fiber communications:***<br>channel characterization; Electromagnetic radiation in wireless systems; multi-path interference; Light sources in optical communication systems. Light transmission in optical fibers. Light detection. Communication networks; Current research trends and challenges.<br>**Laboratory Experiments:**<br>1) Transfer function characterization of copper wires<br>2) Matlab Exercise |

**Teaching/Learning Methodology**

The main teaching methods used to convey the basic concepts and fundamental theories are lectures and tutorials. The laboratory sessions are used to help the students to have an in-depth understanding of the fundamentals of telecommunication systems and apply the theory learned to practice.

| Teaching/Learning Methodology | Outcomes | | |
|---|---|---|---|
| | a | b | c |
| Lectures | ✓ | ✓ | |
| Tutorials | ✓ | ✓ | |
| Experiments | ✓ | | ✓ |

**Assessment Methods in Alignment with Intended Learning Outcomes**

| Specific assessment methods/tasks | % weighting | Intended subject learning outcomes to be assessed | | |
|---|---|---|---|---|
| | | a | b | c |
| 1. Examination | 50% | ✓ | ✓ | |
| 2. Class tests | 25% | ✓ | ✓ | |
| 3. Laboratory | 10% | ✓ | | ✓ |
| 4. Homeworks or in-class quizzes | 15% | ✓ | ✓ | |
| Total | 100% | | | |

The outcomes on understanding the fundamentals of telecommunication systems and their characteristics are mainly assessed by examination, test and exercises, whilst the capability of applying theory to practice is evaluated through the laboratory work.

**Student Study Effort Expected**

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|---|---|
| Class contact: | |
| ▪ Lecture/Tutorial | 33 Hrs. |
| ▪ Laboratory | 6 Hrs. |
| Other student study effort: | |
| ▪ Laboratory preparation/report | 6 Hrs. |
| ▪ Self-study | 60 Hrs. |
| Total student study effort | 105 Hrs. |

**Reading List and References**

**Reference books:**


1. A.V. Oppenheim and A. S. Willsky, "Signals and systems," 2nd Edition, Prentice Hall, 2014.
2. B.P. Lathi and Zhi Ding, Modern Digital and Analogue Communication Systems, 4th Edition, Oxford University Express, 2009.
3. J.M. Senior, Optical Fiber Communications: Principle and Practice, 3rd Edition, Prentice Hall, 2009
4. J. G. Proakis and M. Salehi, "Digital Communications," 5th Edition, McGraw-Hill, 2007.