Subject Description Form

Subject Code	EIE3312
Subject Title	Linear Systems
Credit Value	3
Level	3
Pre-requisite	AMA2111 Mathematics I
Co-requisite/ Exclusion	Nil
Objectives	1. To provide students with basic concepts and techniques for the modelling and analysis of linear continuous-time and discrete-time signals and systems. 2. To provide students with an analytical foundation for further studies in Communication Engineering and Digital Signal Processing.
Intended Subject Learning Outcomes	**Upon completion of the subject, students will be able to:** Category A: Professional/academic knowledge and skills 1. Understand the representations and classifications of the signals and systems. 2. Understand the modelling of linear systems. 3. Use different techniques to analyze and design systems. 4. Apply software tools to laboratory exercises for experimenting with theories, and to the analysis and design of signals and systems. 5. Appreciate the advantages and disadvantages of using the different representations and modeling approaches. Category B: Attributes for all-roundedness 6. Present ideas and findings effectively. 7. Think critically and learn independently. 8. Work in a team and collaborate effectively with others.
Subject Synopsis/ Indicative Syllabus	**Syllabus:** 1. Signal Representation Signal Classification, Continuous and Discrete-Time Signals, Random Signals. Time-Domain and Frequency-Domain Representations. 2. Continuous-Time and Discrete-Time Systems Impulse Representation and Convolution, Linear Time-Invariant Systems. Properties of Systems: Causality, Time Invariance, Linearity, Systems with Memory, Inverse of a System, Stability. LTI Systems: Differential and Difference Equation Representation, Block Diagram Representations. 3. Fourier Representations for Signals Reviews on Periodic and Nonperiodic Signals, Continuous and Discrete Signal, Fourier Series and Transform, Frequency Spectra. Properties of Fourier Representations, Time Functions, Applications on System Frequency Response and Signal Frequency Spectrum. Frequency Response of LTI Systems, Sampling. Discrete-Time Fourier Transform, 4. Laplace Transform Definition and Properties of Laplace Transform, Inversion of Laplace Transform, Bilateral Laplace Transform. Transform Analysis of LTI Systems, Poles and Zeros. Relationship of Laplace Transform and Fourier Transform.

5. Analogue Filters
   Ideal Filters, Bode Plots. Filter Design: Butterworth Filters, Chebyshev Filters, Frequency Transformations.

Laboratory Experiments:

1. Fundamentals of Signals
2. Linear Time-Invariant Systems
3. Fourier Analysis of Continuous-time Signals
4. Sampling
5. Fourier Analysis of Discrete-time Signals

Teaching/ Learning Methodology

Teaching and Learning Method	**Intended Subject Learning Outcome**	**Remarks**
Lectures	1, 2, 3, 5, 7	Fundamental principles and key concepts of the subject are delivered to students.
Tutorials	1, 2, 3, 5, 7	These are supplementary to lectures and are conducted with smaller class sizes; students will be able to clarify concepts and to gain a deeper understanding of the lecture material; problems and application examples are given and discussed.
Laboratory sessions	4, 6, 7, 8	Students will make use of the software MATLAB to simulate the various theories and visualize the results.

Assessment Methods in Alignment with Intended Subject Learning Outcomes

Specific Assessment Methods/ Task	**% Weighting**	**Intended Subject Learning Outcomes to be Assessed (Please tick as appropriate)**							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Continuous Assessment	40%								
• Assignments	10%	✓	✓	✓		✓	✓	✓	
• Laboratory sessions	10%				✓		✓		✓
• Tests	20%	✓	✓	✓		✓	✓	✓	
2. Examination	60%	✓	✓	✓		✓	✓	✓	
Total	100%								

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Specific Assessment Methods/Tasks	Remark
Short quizzes	These can measure the students' understanding of the theories and concepts as well as their comprehension of subject materials.
Assignments, tests and examination	End-of-chapter-type problems are used to evaluate the students' ability in applying concepts and skills learnt in the classroom; students need to think critically and to learn independently in order to come up with an alternative solution to an existing problem.
Laboratory sessions	Each student is required to produce a written report; the accuracy and presentation of the report will be assessed; oral examination based on the laboratory exercises will be conducted for each student to evaluate his/her technical knowledge and communication skills.

Student Study Effort Required	**Class contact (time-tabled):**	
	• Lecture	24 Hours
	• Tutorial/Laboratory/Practice Classes	15 hours
	Other student study effort:	
	• Lecture: preview/review of notes; homework/assignment; preparation for test/quizzes/examination	36 Hours
	• Tutorial/Laboratory/Practice Classes: preview of materials, revision and/or reports writing	30 Hours
	Total student study effort:	**105 Hours**

Reading List and References

Reference Books:

1. Ed. Kamen and Bonnie Heck, *Fundamentals of Signals and Systems Using the Web and Matlab*, 3/e, Prentice-Hall, 2007.
2. M.J. Roberts, *Fundamentals of Signals & Systems,* McGraw-Hill, 2008
3. Simon Haykin and Barry Van Veen, *Signals and Systems*, Wiley, 2003.
4. Charles L. Phillips, et al., *Signals, Systems, and Transforms,* 3/e, Prentice-Hall, 2003.

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Prepared by	Prof. Kenneth Lam