Subject Description Form

Subject Code	EIE3331
Subject Title	Communication Fundamentals
Credit Value	3
Level	3
Pre-requisite	AMA2111 Mathematics I
Co-requisite/ Exclusion	Nil
Objectives	Telecommunication plays an important role in modern societies that rely heavily on a knowledge economy. Telecommunication systems enable the transfer and exchange of information over communication channels that are corrupted by disturbances and noises in a cost-effective manner. The major objectives of this subject are for the students to establish a firm foundation for the understanding of telecommunication systems, and the relationship among various technical and socio-economic factors when such systems are designed and operated.
Intended Subject Learning Outcomes	**Upon completion of the subject, students will be able to:** Category A: Professional/academic knowledge and skills 1. Identify various elements, processes, and parameters in telecommunication systems, and describe their functions, effects, and interrelationship. 2. Analyze, measure, and evaluate the performance of a telecommunication system against given criteria. 3. Design typical telecommunication systems that consist of basic and essential building blocks. Category B: Attributes for all-roundedness 4. Communicate effectively. 5. Think critically and creatively. 6. Assimilate new technological development in related field.
Subject Synopsis/ Indicative Syllabus	**Syllabus:** 1. Introduction (1 hour) 1.1 Introduction to telecommunication systems, their past and present development; elements of a basic communication system; examples of practical telecommunication systems. 2. Analog Communications (10 hours) 2.1 Amplitude Modulation (AM): double sideband, double sideband with suppressed carrier, single sideband, frequency spectrum and power of the AM signal, Frequency Division Multiplexing. 2.2 Demodulation of AM signals: coherent detector, direct demodulation 2.3 Frequency modulation: bandwidth of FM signals, Stereo FM. 2.4 Demodulation of FM signals: Phase-Locked Loop (PLL) detector. 2.5 Comparison of AM and FM performance: bandwidth, signal-to-noise ratio 3. Analog to Digital Conversion (4 hours) 3.1 Sampling theorem; pulse amplitude modulation 3.2 Quantizing: uniform quantization and quantization noise, SNR (e.g.: Audio CD standard), non-uniform quantization (e.g. A-law, u-law) 3.3 Pulse code modulation (PCM) 3.4 Time division multiplexing: T1 multiplexing system 4. Digital Modulation and Demodulation (9 hours)

4.1 ASK, FSK, PSK, DPSK, QPSK (e.g. satellite system), OQPSK, QAM (e.g. Microwave link applications), constellation diagram, bandwidth.
4.2 Coherent demodulation
4.3 Non-coherent demodulation (e.g. DPSK, OQPSK)
4.4 BER performance over Additive White Gaussian Noise (AWGN) channel
4.5 Effects of bandwidth, distortion, noise, timing error on detection, eye diagram

Practical:

- Analog communication experiments (6 hours)
- Matlab simulation/experiments in digital communication systems (6 hours)

Assignment:

- Reception survey of analog sound broadcast quality in Hong Kong

Teaching/ Learning Methodology

Teaching and Learning Method	Intended Subject Learning Outcome	Remarks
Lectures, supplemented with interactive questions and answers, and short quizzes	1,2,3,5,6	In lectures, students are introduced to the *knowledge* of the telecommunication field; *comprehension* of the knowledge is strengthened with interactive Q&A and short quizzes. The students will be able to *define* and *describe* key terms and concepts about telecommunication. They will also be able to *explain* and *generalize* knowledge about telecommunication (e.g. different modulation techniques and their performance, difference between analog and digital modulation techniques)
Tutorials where case studies are conducted, and problems are given to students for them to solve	1,2,3,4,5,6	In tutorials, students *apply* what they have learnt in analyzing cases (e.g. superheterodyne receiver structure) and solving problems (e.g. calculating the channel capacity of a given channel). They will *analyze* the given information, *compare* and *contrast* different scenarios and propose solutions or alternatives.
Laboratories, where students will conduct experiments on digital communication systems	2,3,4,5,6	By performing hands-on authentic tasks, the students will be able to *synthesize* a structure of knowledge by *designing* a solution to a communication problem. They will *relate* the observation to theories and principles. They will also *evaluate* outcomes of the tasks they perform and *interpret* the data they gather.
Assignment/ homework, online quizzes, tests, end-of-chapter problems	1,2,3,4,5,6	Through working assignment and homework, online quizzes, and end-of-chapter problems in text books, students will develop a firm understanding and *comprehension* of the *knowledge* taught. They will *analyze* given information and *apply* knowledge in solving problems. For some design type of questions (e.g. design a communication link with a given S/N ratio), they will have to *synthesize* solutions by *evaluating* different alternatives.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific Assessment Methods/Tasks	% Weighting	Intended Subject Learning Outcomes to be Assessed (Please tick as appropriate)					
		1	2	3	4	5	6
1. Continuous Assessment (total 50%)							
• Assignments	10%	✓	✓	✓	✓	✓	
• Laboratory report	10%		✓	✓	✓	✓	✓
• Quiz	10%	✓	✓	✓	✓	✓	
• Test	20%	✓	✓	✓	✓	✓	
2. Examination	50%	✓	✓	✓	✓	✓	
Total	100 %						

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

Specific Assessment Methods/Tasks	Remark
Assignment/ Homework/ tests/examination	Assignment/Homework, tests, and examinations are given to students to assess their competence level of *knowledge* and *comprehension*, ability to *analyze* given information, ability to *apply* knowledge and skills in new situation, ability to *synthesize* structure, and ability to evaluate given data to make judgment. The criteria (i.e. *what* to be demonstrated) and level (i.e. the *extent*) of achievement will be graded according to six levels: Excellent (A+ and A), Good (B+ and B), Satisfactory (C+ and C), Marginal (D) and Failure (F). These will be made known to the students before an assignment/homework is given. Feedback about their performance will be given promptly to students to help them improvement their learning.
Laboratory report	Students are required to conduct experiments in team of 2 students each in four laboratory sessions. The emphasis is on assessing their ability to *apply* knowledge and skills learned in *designing*, *synthesizing* and ev*aluating*, ability in working with other people, and ability to take data and relate the measurement results to theory. Expectation and grading criteria will be given as in the case of assignment/ homework.

Student Study Effort Expected	**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	**Recommended Textbook:** 1. J.G. Proakis and M. Salehi, *Communication Systems Engineering*, Prentice Hall, 2002. **Reference Books:** 1. R.E. Ziemer, W.H. Tranter, *Principles of Communications: Systems, Modulation and Noise*, 5th ed., New York : John Wiley & Sons, c2002. 2. A.B. Carlson, P.B. Crilly and J.C. Ruthledge, *Communication Systems: an introduction to signals and noise in electrical communication,* 4th ed., McGraw-Hill, 2002. 3. S. Haykin, *Communication Systems,* 4th ed., John Wiley & Sons, 2001. 4. W.D. Stanley and J.M. Jeffords, *Electronic Communications: Principles and Systems*, Thomson Delmar Lerning, 2006.	
Last Updated	March 2018	
Prepared by	Dr W.C. Lee	