Subject Description Form

Subject Code	EIE566
Subject Title	Wireless Communications
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	The students are expected to have some basic knowledge about digital communications. Extra materials will be provided for self-learning before the commencement of the course on request for those who do not have the appropriate knowledge. Please contact the subject lecturer for details.
Objectives	1. To introduce the fundamental issues, concepts, and design principles in cellular and wireless communications. 2. To model how various channel-fading phenomena degrades a transmitted wireless signal. 3. To introduce various wireless standards and their potential applications to Internet of things.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: <u>Category A: Professional/academic knowledge and skills</u> a. Understand and describe the physical-layer features of wireless communication systems and their potential applications to Internet of things. b. Understand the frequency-reuse concept in cellular communications, and to analyze its effects on interference and system capacity. c. Understand large-scale and small-scale fading-channel models, and to analyze their influence on the performance of a wireless communication system. <u>Category B: Attributes for all-roundedness</u> d. Communicate effectively. e. Think critically and creatively. f. Assimilate new technological development in related field.
Subject Synopsis/ Indicative Syllabus	1. Digital modulation schemes, multiplexing and multiple access schemes, duplexing Analog versus digital modulations. Phase shift keying (BPSK), frequency shift keying (FSK), amplitude shift keying (ASK), quadrature amplitude modulation (QAM). Frequency-division multiplexing (FDM) and multiple-access (FDMA), time-division multiplexing (TDM) and multiple-access (TDMA), code-division multiplexing (CDM) and multiple-access (CDMA), frequency hopping (FH) and direct sequence (DS) spreading, hybrid schemes. Simplex, half-duplex and full duplex, time division duplexing (TDD) and frequency division duplexing (FDD). 2. Cellular communication systems Cellular structure, frequency reuse, cell splitting, macrocell, microcell, picocell and femtocell. Channel assignment. Co-channel interference, adjacent-channel interference, system capacity, power control, call handoffs. 3. Macroscopic fading models for radiowave propagation Free-space radio-wave propagation. Reflection, diffraction, and scattering. Various path-loss models such as ground-reflection, log-distance, lognormal. 4. Microscopic fading models for radiowave propagation Rician and Rayleigh fading models. Doppler frequency, delay spread, coherence bandwidth, level crossing rate. Characterization of multipath phenomena. Fading effects due to multi-path time delay spread. Fading effects due to Doppler spread.

5. Wireless standards, advanced modulation schemes, and Internet of Things (IoT)

Global Mobile Communication (GSM), 3G, 4G Long-Term Evolution (LTE), Wi-fi, Zigbee, narrow-band IoT, LoRa technology, orthogonal frequency-division multiplexing (OFDM), orthogonal frequency-division multiple access (OFDMA), single-carrier FDMA (SC-FDMA), multiple antenna operation, multiple-input multiple-output (MIMO) transceiver.

Teaching/Learning Methodology

The physical-layer characteristics of a digital communication system will be described and explained in lectures. Channel characteristics will be presented in lectures and tutorials. Performance of a digital communication system under different channel conditions will be simulated with Matlab programs. Students will also be required to study one or more wireless communication systems, share their findings with other classmates through presentations and write a report summarizing their findings.

Teaching/Learning Methodology	Intended Subject Learning Outcomes					
	a	b	c	d	e	f
Lectures / Tutorials	✓	✓	✓		✓	
Mini-project	✓			✓		✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d	e	f
1. Assignments	30%	✓	✓	✓		✓	✓
2. Test	40%	✓	✓	✓			
3. Mini-project	30%			✓	✓		
Total	100%						

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

Assignments and tests let students review the taught materials, do further reading for deeper learning and apply the learnt materials to solving common communication system problems.

Mini-project requires the student to do further reading, search for information, keep abreast of current development, give presentations and write a report.

Student Study Effort Expected

Class contact:	
▪ Lectures/Test	33 Hrs.
▪ Presentation	6 Hrs.
Other student study effort:	
▪ Further reading, doing homework/assignment and preparing for tests	30 Hrs.
▪ Mini-project: studying, writing a report, and preparing presentations	40 Hrs.
Total student study effort	109 Hrs.

Reading List and References

1. A. Goldsmith, *Wireless Communications*, Cambridge University Press, 2005.
2. Andreas F. Molisch, *Wireless Communications,* Wiley – IEEE, 2nd ed., 2010.
3. A. Ghosh, J. Zhang, J. G. Andrews, and R. Muhamed, *Fundamentals of LTE*, Prentice-Hall, 2010.

	4. IEEE and other publications.