Subject Description Form

Subject Code	EIE509
Subject Title	Satellite Communications – Technology and Applications
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	The students are expected to have some basic knowledge about digital communication systems. 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	This subject will introduce students with the conventional and advanced technologies used in satellite communication systems. The students will study the design parameters of the transceiver on the performance of the link quality. Various multiple access techniques and resource allocation strategies will be compared to point out their relative merits and demerits. The multibeam and regenerative satellites networks, which render the use of small size earth station terminals possible, will also be discussed. Examples on global mobile satellite services will be given.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **(1) Professional/academic knowledge and skills** a. Understand and describe the basic theories and principles in satellite communication systems. b. Analyze, design, and evaluate satellite communication systems. **(2) Attributes for all-roundedness** c. Communicate effectively. d. Think critically and creatively. e. Assimilate new technological development in related field.
Subject Synopsis/ Indicative Syllabus	1. Introduction Historical background of satellite technology development; organisation of a satellite communication system. 2. Orbits Overview of orbits; orbit dynamics and Keppler's laws; relative movement of two point bodies; orbital parameters; Earth-satellite geometry. 3. Link Analysis Basic satellite link analysis; effect of rain on link performance. 4. Multiple Access Traffic routing; frequency division multiple access; time division multiple access; code division multiple access; fixed and on-demand assignment. 5. Multibeam Satellite Networks Advantages and disadvantages; transponder hopping; on-board switching; beam scanning; intersatellite links. 6. Regenerative Satellite Networks Transparent and regenerative repeaters; comparison of link budgets; on-board processing; effect on Earth stations. 7. Global Mobile Satellite Services GEO mobile satellite systems, Inmarsat.

Teaching/Learning Methodology

The theories and applications of satellite communication systems will be described and explained in lectures. Techniques and parameters for evaluating satellite communication systems will be presented in tutorials. A site visit to a satellite earth station will further provide an opportunity for students to understand the various components of a commercial satellite communication system as well as the operations of the ground unit. Students will also be requested to study in detail some selected satellite communication or space exploration systems, share their findings with other classmates through one presentation summarizing their findings. Computer simulations will allow student to evaluate and compare the performance of different satellite communication systems.

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

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
1. Assignments	15%	✓	✓	✓	✓	
2. Test	10%	✓	✓	✓	✓	
3. Mini-project	15%			✓		✓
4. Simulation	10%		✓	✓	✓	
5. Final examination	50%	✓	✓	✓	✓	
Total	100%					

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

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

The simulation experiment provides a deeper understanding of a satellite communication system. Mini-project requires the student to do further reading, search for information, keep abreast of current development, and give a presentation.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	27 Hrs.
▪ Simulation/Case Study	9 hours
▪ Site visit	3 Hrs.
Other student study effort:	
▪ Lecture: further reading, doing homework/ assignment	30 Hrs.
▪ Mini-project: studying, preparing one presentation	25 Hrs.
▪ Simulation: further studying and writing a report	13 Hrs.

	Total student study effort	107 Hrs.
Reading List and References	Text book: 1. G. Maral, M. Bousquet and Zhili Sun, *Satellite Communications Systems*, 6th ed., John Wiley, 2020. Reference books: 1. Dennis Roddy, *Satellite Communications*, 4th ed., McGraw-Hill, 2006. 2. A.K. Maini and V. Agrawal, *Satellite Technology,* John Wiley and Sons, 2007. 3. B. Elbert, *Introduction to Satellite Communication,* 3rd ed., Artech House, 2008. 4. Daniel Minoli, *Innovations in Satellite Communications and Satellite Technology*, Wiley, 2015. 5. Louis J. Ippolito, *Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance*, 2nd ed., Wiley, 2017. Others: 1. *IEEE Transactions* and other journals.	

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