Subject Description Form

Subject Code	AAE6102
Subject Title	Satellite Communication and Navigation
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	N/A
Objectives	To provide students with fundamental scientific aspects of satellite communication and navigation, including signal processing, position, velocity and timing estimation, and future development of satellite navigation.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) Understand the scientific theoretical aspects in satellite navigation and communication. b) Conduct the positioning estimation using raw data provided by a receiver of global positioning system GPS. c) Conduct analysis of the signal processing used in the receiver for satellite navigation and communication. d) Apply the satellite navigation solutions to different situations of engineering context and professional practice.
Subject Synopsis/ Indicative Syllabus	**Introduction of Guidance, Navigation, and Control –** the role of GNC in autonomous systems, the relationship between navigation, and guidance and control, positioning to navigation. **Introduction of GNSS –** system architecture, global coordinate systems, time reference and GPS time system, radio frequency spectrum of GNSS signal, future plan of GNSS. **Receiver signal processing –** Digtal signal processing, GPS signal acquisition, GPS Signal tracking, delay lock loop and phase lock loop, decode GPS navigation data. **Position, velocity and timing estimation** – pseudo range, linear estimation for GPS position, weighted least square, dilution of precision, velocity estimation, carrier smoothing. **GNSS measurement and error source** – control segment error, signal propagation modeling errors, measurement error, user range error URE. **Improved GNSS navigation** – differential GNSS, real-time kinematics RTK, GPS/INS integration, Kalman filter, multipath mitigation. **GNSS navigation in civil aviation use** – accuracy and integrity, receiver autonomous integrity monitoring RAIM, satellite based augmentation system

SBAS, ground based augmentation system GBAS.

Challenges and threats of GNSS receiver – Radio frequency interference spoofing, none-light-of-sight (NLOS) reception

Teaching/Learning Methodology

1. The teaching and learning methods include lecture/tutorial/laboratory sessions, homework assignments and mini research project.
2. Technical/scientific examples and problems are raised and discussed in class/tutorial sessions.
3. The mini research project which includes literature review, research methodology, and experimental/numerical data analysis is used to provide students a guided study with the basic research elements.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	
3. Homework assignment	√	√	√	√
4. Laboratory	√	√		√
5. Mini research 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
1. Homework assignment	20%	√	√	√	√
2. Test	10%	√	√	√	
3. Mini research project report	20%	√	√	√	√
4. Laboratory report	10%	√	√		√
5. Examination	40%	√	√	√	√
Total	100 %				

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

Overall Assessment:

0.40 x End of Subject Examination + 0.6 x Continuous Assessment

The continuous assessment and examination are aimed at providing students with integrated knowledge required for satellite navigation and

	communication. The continuous assessment consists of four components: homework assignments, test, mini research project report and laboratory report. They are aimed at evaluating the progress of students' study, assisting them in self-monitoring of fulfilling the respective subject learning outcomes, and enhancing the integration of the knowledge learnt. In particular, the mini research project can provide students a guided study with the basic research elements. The examination is used to assess the knowledge acquired by the students for understanding and analyzing the problems critically and independently; as well as to determine the degree of achieving the subject learning outcomes.	
Student Study Effort Expected	Class contact:	
	▪ Lecture	33 Hrs.
	▪ Tutorials and Laboratory Works	6 Hrs.
	Other student study effort:	
	▪ Literature Review and Self-learning	30 Hrs.
	▪ Assignments	20 Hrs.
	▪ Mini-project and Laboratory Reports	22 Hrs.
	Total student study effort	111 Hrs.
Reading List and References	1. Misra, P. and P. Enge, *Global Positioning System: Signals, Measurements, and Performance*. Lincoln, MA 01773 Ganga-Jamuna Press, Latest Edition. 2. Kaplan, E. and C. Hegarty, *Understanding GPS: principles and applications*. Artech House Publishers, Latest Edition. 3. Groves, P.D., *Principles of GNSS, Inertial, and Multi-Sensor Integrated Navigation Systems (GNSS Technology and Applications)*, Artech House Publishers, Latest Edition.	

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