Subject Description Form

Subject Code	EIE575
Subject Title	Vehicular Communications and Inter-Networking Technologies
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	The students are expected to have some basic knowledge about wireless communications, computer networks and mobile ad-hoc networks. 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 emerging technologies, standards and applications in vehicular communication systems. The students will study the design considerations and challenges of vehicle-to-infrastructure and vehicle-to-vehicle communications. Theories such as vehicular mobility modeling, and vehicular technologies and standards from the physical to network layers will be introduced in the course. Examples of emerging applications of vehicular communications in Intelligent Transportation Systems will also be studied and discussed.
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, technologies, standards, and system architecture of vehicular ad-hoc networks (VANET) or inter-vehicle communication networks. b. Analyze, design, and evaluate vehicular communication platforms for various kinds of safety and infotainment applications. **(2) Attributes for all-roundedness** c. Communicate effectively. d. Think critically and creatively. e. Assimilate new technological development in related fields.
Subject Synopsis/ Indicative Syllabus	1. Introduction Basic principles and challenges, past and ongoing VANET activities 2. Cooperative Vehicular Safety Applications Enabling technologies, cooperative system architecture, safety applications 3. Vehicular Mobility Modeling Random models, flow and traffic models, behavioral models, trace and survey-based models, joint transport and communication simulations 4. Physical Layer Considerations for Vehicular Communications Signal propagation, Doppler spread and its impact on OFDM systems 5. MAC Layer of Vehicular Communication Networks Proposed MAC approaches and standards, IEEE 802.11p 6. VANET Routing protocols Opportunistic packet forwarding, topology-based routing, geographic routing 7. Emerging VANET Applications Limitations, example applications, communication paradigms, message coding and composition, data aggregation 8. Standards and Regulations Regulations and Standards, DSRC Protocol Stack, Cellular V2X

Teaching/Learning Methodology

The theories and applications of VANET will be described and explained in lectures. Techniques and parameters for evaluating various vehicular communication platforms will be presented in tutorials. Students are requested to review latest research papers on VANET and study in detail some selected vehicular communication platforms and their potential applications. Finally, share their findings with other classmates through two presentations and write a report to summarize their findings.

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

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. Paper Review	10%	✓	✓	✓	✓	✓
2. Survey Report	15%	✓	✓	✓	✓	✓
3. Test/Quizzes	20%	✓	✓	✓		
4. Lab	5%	✓	✓	✓	✓	
5. Mini project	50%	✓	✓	✓	✓	✓
Total	100%					

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

Paper review, survey report, test/quizzes, and lab exercises let students review the taught materials, do further reading for deeper learning and apply the learnt materials to solving common vehicular communication network problems.

The mini project requires the student to do further reading, search for information, keep abreast of current development, give presentations and prepare written report.

Regarding the use of generative AI tools in the subject:

- Similar to the Internet and other web applications, Generative AI tools such as ChatGPT can be used for brainstorming and data collection in the subject. If used, the data sources should be cited properly.
- However, it is forbidden for essay-type assignments or reports (e.g., paper review, survey report, lab report, and project report). All written assignments will be submitted to Turnitin for plagiarism check and AI writing detection.

Student Study Effort Required

Class contact:	
▪ Lecture/Tutorial/Lab	33 Hrs.
▪ Presentation	6 Hrs.
Other student study effort:	
▪ Lecture: further reading, doing homework/ assignment	30 Hrs.
▪ Mini-project: studying, writing a report, preparing two presentations	40 Hrs.

	Total student study effort	109 Hrs.
Reading List and References	Text book: 1. H. Hartenstein and K. P. Laberteaux, *VANET: Vehicular Applications and Inter-Networking Technologies*, Wiley, 2010. Reference books: 1. P. H.-J. Chong, I. W.-H. Ho, *Vehicular Networks: Applications, Performance Analysis and Challenges*, Nova Science Publishers, 2019. 2. C. Sommer, F. Dressler, *Vehicular Networking*, Cambridge University Press, 2015. 3. M. Emmelmann, B. Bochow and C. C. Kellum, *Vehicular Networking: Automotive Applications and Beyond*, Wiley, 2010. 4. M. Watfa, *Advances in Vehicular Ad-Hoc Networks: Development and Challenges*, Information Science Reference, 2010. 5. H. Moustafa, Y. Zhang, *Vehicular Networks: Techniques, Standards, and Applications*, CRC Press, 2009. Others: 1. IEEE Transactions and other journals.	