Subject Description Form

Subject Code	EE4007 / EE4007A / EE4007B
Subject Title	Advanced Power Electronics
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite for EE4007: EE3003 Pre-requisite for EE4007A: EE3003A Pre-requisite for EE4007B: EE3003B Exclusion: EE521
Objectives	1. To provide the students with the knowledge of advanced power electronic conversion. 2. To ensure the students having an in-depth understanding of the design and control of various power electronics converters. 3. To give the knowledge of AC switched-mode conversion. 4. To provide a concept of impact of power electronics on power quality.
Subject Intended Learning Outcomes	Upon completion of the subject, students will: a. Have acquired a good understanding of basic switched-mode DC/DC topologies, operation, performance and modelling. b. Have acquired a basic understanding of resonant converters and its method of loss reduction. c. Be able to apply switched-mode techniques to inverters (DC/AC converters). d. Be able to perform study on power electronics circuit simulation. e. Be aware of impacts of electromagnetic interference (EMI) and reduction of EMI using power electronics techniques. f. Be able to present results of study in the form of computer simulation, design equations and basic models, working independently and in teams when conducting power electronics circuit design.
Subject Synopsis/ Indicative Syllabus	1. ***Pulse-width-modulated DC/DC Converters*****:** Basic topologies and higher order converters, transformer-isolated topologies, snubber circuits, continuous and discontinuous conduction modes of operation, ripple analysis. 2. ***Resonant-mode DC/DC Converters*****:** Classification, zero-current switching and zero-voltage switching techniques, quasi-resonant converters, resonant transition converters. 3. ***Switched-mode Inverters*****:** Single-phase and three-phase voltage-source inverters, AC/AC conversion, resonant inverters. 4. ***Modelling and* Control of *Power Converters:*** Small-signal modelling, traditional PID control method, modern control techniques, analogue and digital circuit simulation for power electronics, simulation techniques. 5. ***Electromagnetic Interference*****:** Generation of EMI, power factor, switched-mode EMI filter, International Standards, reduction of EMI. **Laboratory Experiments** Conduct hardware experiments on DC-DC converters and Resonant converters, computer simulations on DC-DC converter.

Teaching/Learning Methodology

Lectures and tutorials are effective teaching methods:

1. To provide an overview or outline of recent development of power electronics.
2. To introduce new concepts and knowledge in advantage power electronic converter design, soft switching techniques, control methods and electromagnetic interference (EMI) aspects.
3. To explain difficult ideas and concepts.
4. To provide students feedback in relation to their learning.
5. To encourage students' responsibility for their learning by extra reference books reading and computer-based circuit simulations.

Laboratory works is an essential ingredient of this subject:

1. To supplement the lecturing materials.
2. To provide power converter design experience for the students.
3. To provide deep understanding of various power converter design aspects.
4. To enable students to organise principles and challenge ideas.

Teaching/Learning methodology	Outcomes					
	a	b	c	d	e	f
Lectures	✓	✓	✓		✓	
Tutorials	✓	✓	✓		✓	
Experiments	✓	✓	✓	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed					
		a	b	c	d	e	f
1. Examination	60%	✓	✓	✓		✓	
2. Tests	20%	✓	✓	✓		✓	
3. Laboratory reports	10%	✓	✓	✓	✓	✓	✓
4. Assignments	10%	✓	✓	✓		✓	
Total	100%						

The understanding on theoretical principle and practical considerations, analytical skills and problem solving techniques will be evaluated. Examination, class tests, laboratory sections and reports are an integrated approach to validly assess students' performance with respect to the intended subject learning outcomes.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	33 Hrs.
▪ Laboratory	6 Hrs.
Other student study effort:	
▪ Laboratory preparation/report/assignment	12 Hrs.
▪ Self-study	54 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Textbooks:

1. Ned. Mohan, Power Electronics: Converters, Applications & Design, Wiley, 2007
2. K.W.E.Cheng, Classical Switched Mode and Resonant Power Converters, The Hong Kong Polytechnic University, 2002
3. G. M. Masters, Renewable and efficient electric power systems, John Wiley & Sons, 2004.

Reference books:

1. N. Mohan, Power Electronics: A First Course, John Wiley & Sons, 2012.
2. A.M. Trzynadlowski, Introduction to Modern Power Electronics, Third Edition, John Wiley & Sons, 2015.

	3, Muhammad H. Rashid, Power Electronics: Devices, Circuits and Applications 4th ed, Pearson India, 2017. 3. Robert W. Erickson, Dragan Maksimović, Fundamentals of Power Electronics, Springer; 3rd ed. 2020 4. Farzin Asadi, Simulation of Power Electronics Circuits with MATLAB®/Simulink®: Design, Analyze, and Prototype Power Electronics, Apress, 1st ed, 2022.

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