THE HONG KONG POLYTECHNIC UNIVERSITY

DEPARTMENT OF ELECTRICAL ENGINEERING

PROGRAMME DOCUMENT FOR RESEARCH DEGREE PROGRAMMES

(For 2015/16 Cohort of Students and thereafter)

Programme Titles

Full-time / Part-time/ of Doctor of Philosophy (PhD)
Full-time / Part-time/ of Master of Philosophy (MPhil)

Offering Department

Department of Electrical Engineering

Final Awards

Doctor of Philosophy (PhD)
Master of Philosophy (MPhil)

Programme Aims and Rationale

The research degree programmes are designed to enable the students to acquire competence in research methods and scholarship in the discipline of electrical engineering or other related disciplines; and display sustained independent effort and original thought, to become capable professionals, researchers or scholars.

Programmes' Intended Learning Outcomes (ILOs)

The programme of research is designed in such a way to enable students to:

a/ act with integrity, and in an ethical manner in conducting research and in publications;

b/ demonstrate the ability to read and evaluate the literatures in engineering;

c / acquire a solid theoretical background in his/ her research area;

d/ appreciate current research and developments in various areas of his/ her discipline and their challenges;

e/ publish in international Journals and present research outcomes in conferences

f/ formulate and solve advanced engineering problems;

g/ for MPhil students: design and conduct research projects;

for PhD students: design and conduct research projects independently;

h/ for PhD students: deal with multi-disciplinary approaches and translate knowledge, models, algorithms, processes, solutions from areas to his/her own

i/ for MPhil students, be competent teacher/ researcher, or pursue PhD studies in his/ her discipline; and

for PhD students, be competent teacher/ researcher, or industrial R&D professional in his/ her discipline.

Normal Period of Study

As specified in 9.1 of Regulations and Administrative Procedures for the Degrees of MPhil and PhD. (Appendix A of Research Student Handbook http://www.polyu.edu.hk/ro/STDHBK/)

Credit Requirement

Students are mainly conducting research study under the supervision of his/ her main supervisor's guidance. Different categories of students are needed to attain different credit requirements. The credit requirements should cover requirement on attending seminars and practicum with details as shown in 14.1 of Regulations and Administrative Procedures for the Degrees of MPhil and PhD. (Appendix A of Research Student Handbook http://www.polyu.edu.hk/ro/STDHBK/)

HTI6081 is a compulsory one-credit subject entitled Ethics: Research, Professional & Personal Perspectives. Students could also take one subject from among the Engineering Doctorate Guided-study subjects.

In terms of study effort, 1 credit on subject is approximately equal to 40 hours of study, including attending classes, private study and examination.

Curricula

University Coursework Requirements

All details as specified in 14.1.1 to 14.1.13 of Regulations and Administrative Procedures for the Degrees of MPhil and PhD. (Appendix A of Research Student Handbook http://www.polyu.edu.hk/ro/STDHBK/)

TPS Assistantship recipients (who will be required to undertake teaching assistant activities for 17 hours per week) are also allowed to fulfill part of their teaching assistant duties through the completion of these compulsory Practicum credits.

Credit transfer

As specified in 16 of Regulations and Administrative Procedures for the Degrees of MPhil and PhD. (Appendix A of Research Student Handbook http://www.polyu.edu.hk/ro/STDHBK/)

Subjects Support to Programme Outcomes

The following subjects support the programme outcomes through teaching activities, practice and examination.

HTI6081	Ethics: Research, Professional and Personal Perspectives
EE6521	Industrial Power Electronics
EE6530	Electrical Energy-saving Systems
EE6551	Principles of Photonics and Optical Systems
EE6811-EE6813	Special Topics in Advanced Power System I/II/III
EE6821-EE6823	Special Topics in Advanced Utilisation I/II/III
EE6831-EE6833	Special Topics in Advanced Control System I/II/III
EE6841-EE6843	Special Topics in Advanced Fiber Optic I/II/III
EE6851-EE6853	Special Topics in Advanced Smart Materials and Structures I/II/III

Other non-subject base training:

EE6001J- EE6001M Research seminars
EE6002 Practicum
Attendance and presentation in international conferences or workshops
Journal paper publications
Thesis write-up and oral defense

The curriculum map which indicates how each intended learning outcomes of the programme is addressed by the constituent subjects is shown in Appendix I.

This Programme Document is subject to review and changes which the programme offering Department can decide to make from time to time. Students will be informed of the changes as and when appropriate.

This Document should be read together with the "Regulations and Administrative Procedures for the Degrees of MPhil and PhD" and the "Research Student Handbook".

Appendix I Curriculum Map
Appendix II Subject Description Forms

Curriculum Map for Individual Research Degree Programme

Programme Title: Doctor of Philosophy (PhD)

Hosted by: Department of Electrical Engineering

Please put a " √ " in the relevant box where the subject helps to fulfill the specific programme outcome.

Programme Outcomes	Ethics: Research, Professional & Personal Perspectives HTI6081	Industrial Power Electronics EE6521	Electrical Energy-saving Systems EE6530	Principles of Photonics & Optical Systems EE6551	Special Topic Subjects EE6811-3 EE6821-3 EE6831-3 EE6841-3 EE6851-3	Research seminars EE6001J-M	Departmental training EE6002	International conference / workshop attendance and presentation	Journal paper publications	Thesis write-up and oral defense
a/ Act with integrity, and in an ethical manner in conducting research and in publications	√							√	√	
b/ Demonstrate the ability to read and evaluate the literatures in engineering		√	√	√	√			√	√	√
c/ Acquire a solid theoretical background in the his/her research area		√		√	√				√	√
d/ Appreciate current research and developments in various areas of his/her discipline and their challenges		√	√	√	√	√			√	√
e/ publish in international journals and present research outcomes in conferences								√	√	
f/ Formulate and solve advanced engineering problems		√		√					√	√
g/ Design and conduct research projects independently			√						√	√
h/ deal with multi-disciplinary approaches and translate								√	√	√

knowledge, models, algorithms, processes, solutions from areas to his/her own										
i/ Be a competent teacher, researcher, or industrial R&D professional in his/her discipline		√	√		√		√	√	√	√

Curriculum Map for Individual Research Degree Programme

Programme Title: **Master of Philosophy (MPhil)**

Hosted by: **Department of Electrical Engineering**

Please put a " √ " in the relevant box where the subject helps to fulfill the specific programme outcome.

Programme Outcomes	Ethics: Research, Professional & Personal Perspectives HTI6081	Industrial Power Electronics EE6521	Electrical Energy-saving Systems EE6530	Principles of Photonics & Optical Systems EE6551	Special Topic Subjects EE6811-3 EE6821-3 EE6831-3 EE6841-3 EE6851-3	Research seminars EE6001J-M	Departmental training EE6002	International conference / workshop attendance and presentation	Journal paper publications	Thesis write-up and oral defense
a/ Act with integrity, and in an ethical manner in conducting research and in publications	√							√	√	
b/ Demonstrate the ability to read and evaluate the literatures in engineering		√	√	√	√			√	√	√
c/ Acquire a solid theoretical background in the his/her research area		√		√	√				√	√
d/ Appreciate current research and developments in various areas of his/her discipline and their challenges		√	√	√	√	√			√	√
e/ publish in international journals and present research outcomes in conferences								√	√	
f/ Formulate and solve advanced engineering problems		√		√					√	√
g/ Design and conduct research projects			√						√	√
h/ Be a competent teacher, researcher, or industrial R&D professional in his/her discipline		√	√		√		√	√	√	√

Subject Description From

<table>
<tr><td>Subject Code</td><td>EE6001J, EE6001K, EE6001L, EE6001M</td></tr>
<tr><td>Subject Title</td><td>Research Seminar I/II/III/IV</td></tr>
<tr><td>Credit Value</td><td>1</td></tr>
<tr><td>Level</td><td>6</td></tr>
<tr><td>Pre-requisite/co-requisite/Exclusion</td><td>EE6001J Pre-requisite: Nil
EE6001K Pre-requisite: Nil
EE6001L Pre-requisite: EE6001J or EE6001K
EE6001M Pre-requisite: EE6001J and EE6001K</td></tr>
<tr><td>Objectives</td><td>To encourage students to appreciate the latest research and development in various areas of his/her discipline.</td></tr>
<tr><td>Subject Intended Learning Outcomes</td><td>Upon completion of the subject students will be able:
1. To appreciate the latest research and development in various research areas and disciplines.
2. To meet and discuss with experts and leaders in person in various research areas and disciplines.
3. To disseminate and promote research outputs in various research areas and disciplines through discussions and report.</td></tr>
<tr><td>Subject Synopsis / Indicative Syllabus</td><td>To attend research seminars in various research areas and disciplines.</td></tr>
<tr><td>Teaching / Learning Methodology</td><td>Students are required to attend at least 10 research seminars which may or may not be organized by the Department. The duration of each seminar should not be less than an hour. Students are required to submit a report with no less than 1500 words (excluding references) on one of the attended seminars to their Chief Supervisors. The topic of the seminar reported on should not be related directly to the thesis title of the student. Assessment of the report will be given with a pass or failure grade. Students who failed to submit a report to the satisfaction of their Chief Supervisors are required to make a re-submission until a pass grade is obtained.

<table>
<tr><td>Teaching/Learning Methodology</td><td colspan="3">Intended subject learning outcomes</td></tr>
<tr><td></td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Seminars</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Report</td><td>✓</td><td></td><td>✓</td></tr>
</table>
</td></tr>
<tr><td>Assessment Methods, its alignment of Intended Subject Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods</td><td rowspan="2">% weighting</td><td colspan="3">Intended subject learning outcomes to be assessed</td></tr>
<tr><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Attendance</td><td>50</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Report</td><td>50</td><td>✓</td><td></td><td>✓</td></tr>
<tr><td>Total</td><td>100</td><td colspan="3"></td></tr>
</table>
</td></tr>
<tr><td>Measurements of the Intended Subject Learning Outcomes</td><td>
<table>
<tr><td>Intended Subject Learning Outcomes</td><td>Related Programme Learning Outcome</td><td>Assessment Methods</td><td>Measurement Level</td><td>Assessment Standard</td></tr>
<tr><td>1</td><td rowspan="3">e</td><td rowspan="3">Attendance and report</td><td rowspan="3">Pass</td><td rowspan="3">Not less than 70% of students in the class achieving the Measurement Level</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
</table>
</td></tr>
</table>

Student Study Effort Expected	- Seminars	20 Hrs
	- Self-study and Preparation of report	15 Hrs
	Total student study effort	35 Hrs
Reading List and References	NA	

Subject Description From

<table>
<tr><td>Subject Code</td><td>EE6002</td></tr>
<tr><td>Subject Title</td><td>Practicum</td></tr>
<tr><td>Credit Value</td><td>2 training credits</td></tr>
<tr><td>Level</td><td>6</td></tr>
<tr><td>Pre-requisite/co-requisite/Exclusion</td><td>Nil</td></tr>
<tr><td>Objectives</td><td>To train student as a competent teacher, researcher, or industrial R& D professional in his/ her discipline.</td></tr>
<tr><td>Subject Intended Learning Outcomes</td><td>Upon completion of the subject students will be able:
1. To engage in teaching support activities.
2. To engage in departmental research support activities.</td></tr>
<tr><td>Subject Synopsis / Indicative Syllabus</td><td>To engage in teaching/research supporting activities.</td></tr>
<tr><td>Teaching / Learning Methodology</td><td>For 1 credit, students are required to engage in teaching / research supporting activities assigned by the Head of Department or his/her delegate for up to 6 hours per week in any 13-week semester. Before the commencement of any teaching supporting activities, students are required to complete the training programmes organized by the Education Development Centre. Students who are required to interact directly with students in English as a part of their duties in supporting teaching and learning must demonstrate their language competence to fulfill the intended duties to the satisfaction of the host department. All eligible students except those who are native English speakers will also be required to successfully complete a language training programme offered by the English Learning Centre before taking up any teaching supporting activities.
<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="2">Intended subject learning outcomes</td></tr>
<tr><td>1</td><td>2</td></tr>
<tr><td>Teaching support duties</td><td>✓</td><td></td></tr>
<tr><td>Research support duties</td><td></td><td>✓</td></tr>
</table></td></tr>
<tr><td>Assessment Methods, its alignment of Intended Subject Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods</td><td rowspan="2">% weighting</td><td colspan="2">Intended subject learning outcomes to be assessed</td></tr>
<tr><td>1</td><td>2</td></tr>
<tr><td>Student feedback</td><td>50</td><td>✓</td><td>✓</td></tr>
<tr><td>Lecturer evaluation</td><td>50</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100</td><td colspan="2"></td></tr>
</table></td></tr>
<tr><td>Measurements of the Intended Subject Learning Outcomes</td><td>
<table>
<tr><td>Intended Subject Learning Outcomes</td><td>Related Programme Learning Outcome</td><td>Assessment Methods</td><td>Measurement Level</td><td>Assessment Standard</td></tr>
<tr><td>1</td><td rowspan="2">h</td><td rowspan="2">Student feedback and lecturer evaluation</td><td rowspan="2">Pass</td><td rowspan="2">Not less than 70% of students in the class achieving the Measurement Level</td></tr>
<tr><td>2</td></tr>
</table></td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>- Teaching/research support activities</td><td>78 Hrs</td></tr>
<tr><td>Total student study effort</td><td>78 Hrs</td></tr>
</table></td></tr>
<tr><td>Reading List and References</td><td>NA</td></tr>
</table>

Subject Description Form

Subject Code	EE6521
Subject Title	Industrial Power Electronics
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To provide power electronics engineers with in depth knowledge of the industrial power electronics. 2. To provide latest development in power supplies, industrial power electronics system and switched-mode motor-drive. 3. To develop a skill in power electronics design including passive components, packaging and standards
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Acquire an in-depth understanding of power supply concept and design and be able to analyse the industrial needs for static power conversion. b. Apply the international standards to power electronics design. c. Have a global view on recent development on power electronics and facilitate applications of power electronics in various industries d. Work in teams and independently when conducting power electronics design and testing.
Subject Synopsis/ Indicative Syllabus	1. ***Industrial power systems:*** Static power systems, battery systems, AC systems, DC systems and AC-DC power conversion. 2. ***Power conversion:*** Soft-switching, power factor correction, inverter configurations and static converters. 3. ***Special environment power electronics:*** Power electronics distribution system, industrial guidelines, variable speed and constant frequency systems, actuation systems, brushless drives and other applications of power electronics in industry 4. ***Industrial power supplies:*** Converter topologies, decentralized power, power modules, electro-magnetic compatibility, international standards and reliability. 5. ***Devices and packaging:*** Hermetic and plastic packages, wire bonding, power devices, high temperature effect and substrates. 6. ***Magnetics and capacitors:*** High frequency inductors and transformers, winding techniques, core loss analysis, optimization of magnetics and power capacitors. **Laboratory Experiments:** Computer aided design for power electronics Power electronics for DC brushless motor Power Factor correction

Teaching/Learning Methodology

Lectures and tutorials are the primary means of conveying the basic concepts and theories. Experiences on design and practical applications are given through experiments and mini-projects, in which the students are expected to solve design problems with real-life constraints and to attain pragmatic solutions with critical and analytical thinking. Interactive laboratory sessions are introduced to encourage better preparation and hence understanding of the experiments. Experiments are designed to supplement the lecturing materials so that the students are encouraged to take extra readings and to look for relevant information.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
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						
1. Examination	60%	√	√	√							
2. Test	20%	√	√	√							
3. Laboratory performance/report	20%				√						
Total	100%										

One end-of-semester written examination; one mid-semester-test; laboratory performance evaluation (including initiative and technical reasoning); and laboratory report on a particular experiment.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	30 Hrs.
▪ Tutorial/Student presentation	3 Hrs.
▪ Laboratory	6 Hrs.
Other student study effort:	
▪ Laboratory and presentation preparation/report	15 Hrs.
▪ Self-study	66 Hrs.
Total student study effort	120 Hrs.

Reading List and References

Reference books:

1. A. M. Trzynadlowski, Introduction to Modern Power Electronics, Wiley, 2010.
2. M.Cirrincione, M. Pucci, G. Vitale, Power Converters and AC Electrical Drives with Linear Neural Networks, CRC Press, 2012.

	3. N. Mohan, Power Electronics: A First Course, John Wiley & Sons, 2012. 4. F.P. McCluskey, High temperature Electronics, CRC Press, 1997 5. K.W.E. Cheng, Classical Switched Mode and Resonant Power Converters, The Hong Kong Polytechnic University, 2002

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Subject Description Form

Subject Code	EE6530
Subject Title	Electrical Energy-saving Systems
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To enable students to establish a research skill on energy saving using techniques of electrical engineering. 2. To provide an in-depth knowledge on selected topics of energy-saving systems in electrical engineering. 3. To enable students to understand typical energy storage systems, its associated issues of grid connection and related technical considerations. 4. To enable students to understand the potential of solar energy and characteristics & performance of various kinds solar energy systems. 5. To enable students to understand various techniques and systems for control and monitoring of energy saving, as well as the related communication protocol and interfacing requirements. 6. To enable students to understand control gears for lighting systems and variable speed drives for HVAC systems & elevators.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Examine the operation principle & control strategy of various energy storage systems, compensation techniques, topologies of these systems and identify their benefits & impacts. b. Examine the principle and characteristics of various solar energy devices, and identify the potentials of solar energy. Calculate available solar irradiation for a given location. c. Understand the theory of energy saving and describe the operation principle and characteristics of typical control and monitoring systems for energy saving, including the communication protocols. d. Identify different energy saving control for industrial plants and multi-storey buildings, including giving examples. e. Examine the operation principle and characteristics of typical control gear for lighting and variables speed drives. f. Given a technical topic, carry out literature search and report the findings in a presentation and be able to work and communicate effectively in a team setting.
Subject Synopsis/ Indicative Syllabus	1. ***Energy storage systems:*** Local compensation, utility Load Factor, peak lopping and valley filling, energy storage systems, battery energy storage, supercapacitor, power electronics topologies, control strategy, grid connection, voltage support, power quality improvement, environmental impact, improvement of utility energy efficiencies. 2. ***Solar energy utilization:*** Solar irradiation on earth, potentials of solar energy, solar thermal system systems, photovoltaic systems, characteristics and performance of typical BIPV systems and estimation of its energy output, passive solar devices on buildings and mobility for energy saving, and case study. 3. ***Energy saving control and monitoring systems:*** Theory of energy saving, concept of building energy efficiency, control and monitoring systems and some of its related communication protocols. Application examples.

4. ***Lighting, ballast, and variable speed drives:*** Magnetic ballast, electronic ballast, lighting design, fluorescent, LED and HID lamps, variable speed drives for HVAC systems and elevators, harmonics implications.

Laboratory Experiments, Seminars, Site Visits:
Demonstration on operating principles of some selected energy-saving systems.

Case study:
Selections of practical real life energy-saving systems in Hong Kong.

Teaching/Learning Methodology

Lectures and tutorials are the primary means of conveying the basic concepts and theories. Practical experiences on power electronics design, energy saving and applications are given through mini-projects. Mini-projects are given in the beginning of the study. Students are encouraged to form group to jointly investigate an industrial problem and they have to present the projects in front of the class.

Teaching/Learning Methodology	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									
		a	b	c	d	e	f				
1. Examination	60%	√	√	√	√	√					
2. Class Test	30%	√	√	√	√	√					
3. Mini-project & Report	10%	√	√	√	√	√	√				
Total	100%										

It is a fundamental energy saving subject. The outcomes on concepts, design and applications are assessed by the usual means of examination and test whilst those on analytical skills, problem-solving techniques and practical considerations of circuit design, as well as technical reporting and teamwork, are evaluated by experiments, mini-project and the reports.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	30 Hrs.
▪ Seminar/Case study	9 Hrs.
Other student study effort:	
▪ Mini-project/report	15 Hrs.
▪ Self-study	66 Hrs.
Total student study effort	120 Hrs.

Reading List and References

Reference books:

Battery Storage Systems
1. D. Andrea, Battery Management Systems for Large Lithium Ion Battery Packs, Artech House, 2010.
2. P.W. Parfomak, Energy storage for Power Grids and Electric Transportation: A Technology Assessment, Congressional Research Service, 2012.
3. Y. Brunet, Energy storage, Wiley, 2010.
4. F. S. Barnes, J.G. Levine, Large Energy Storage Systems Handbook, CRC Press, 2011.

Solar Energy Utilisation
5. S. Yannas, Solar Energy and Housing Design, Architectural Association, 2005/2006.
6. R. Messenger, Photovoltaic Systems Engineering, CRC Press, 2000.
7. C. Prapanavarat, Investigation of the Performance of a Photovoltaic AC Module, Generation, Transmission and Distribution, IEE Proceedings, Vol: 149, Issue 4, Jul 2002.

	8. Web site of Energy Efficiency and Renewable Energy from the Dept. of Energy of USA, http://www.eere.energy.gov/ 9. Web site of the Key Centre of Photovoltaic Engineering in University of New South Wales, http://www.pv.unsw.edu.au/ Energy Saving Control and Monitoring Systems 10. EMSD of HKSAR Govt, Code of Practice for Energy Efficiency of Building Services Installation, 2012. 11. EMSD of HKSAR Govt, Code of Practice for Building Energy Audit, 2012. 12. M. Wiebe, A Guide to Utility Automation: AMR, SCADA, and IT Systems for Electric Power, c1999. 13. Bela Liptak, Instrument Engineers' Handbook, 4th Edition, Volume Two: Process Control and Optimization, CRC 2005. Lighting, Ballast, and Variable Speed Drives 14. J.R. Benya, D.J. Leban, Lighting Retrofit and Relighting: A Guide to Energy Efficient Lighting, John Wiley & Son, 2011. 15. M.H. Rashid, Power Electronics Handbook: Devices, Circuits and Applications, Academic Press, 2010. 16. Guidelines on Energy Efficiency of Lift and Escalator Installations, 2000 Edition, Electrical and Mechanical Services Department (EMSD), the Government of the HKSAR, Hong Kong. 17. K.W.E.Cheng, Design and Fabrication of Electronics and Optical Systems for Advanced Automotive Lighting Systems, The Hong Kong Polytechnic University, 2007.

Subject Description Form

Subject Code	EE6551
Subject Title	Principles of Photonics and Optical Systems
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	Recommended background: Undergraduate level calculus, linear algebra; signals and systems; Electromagnetic Theory; Introductory Optics *Note: This course is intended for students who are pursuing research or individuals who have strong interest in Photonics or related areas*
Objectives	1. To introduce ray optics and wave equations 2. To introduce electromagnetic (EM) and photon optics 3. To introduce Lasers and its operating principles 4. To characterize waveguides and modes of propagation 5. To describe EM signal propagation in optical fibers and associated propagation effects 6. To introduce fiber-optic communication systems
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Acquire a solid theoretical background in optics and photonics b. Appreciate current research and developments in various areas of photonics and their corresponding challenges c. Engage in self-learning and apply technical knowledge to research problems in engineering
Subject Synopsis/ Indicative Syllabus	1. ***Ray Optics and Wave Propagation (1 week)*****:** geometrical optics; curved mirrors and lenses; wave equation and its derivation; wave vector; plane wave; phase velocity and group velocity; Review of curl and divergence; Green's and Stokes Theorem 2. ***Electromagnetic and Photon Optics (3 weeks)*****:** Maxwell's Equations; Constitutive relations; Wave equation for EM waves; permittivity; permeability; dielectric media; electric susceptibility; polarization; Dispersion relation; absorption; the refractive index; Power and Poynting vector; linear polarization, circular polarization; polarization effects in optical fibers; Jones Space and Stokes space representation; photons quantum theory of light; the photoelectric effect; interaction of photons with atoms 3. ***Lasers (2 weeks)*****:** Spontaneous and stimulated emission; Cavity, gain medium; Rate Equations, pulsed lasers and Q-switching; Homogeneously broadened and Inhomogeneously broadened medium; mode locking 4. ***Waveguide Optics and coupled-mode theory (3 weeks)*****:** 1 dimensional slab waveguide; 2-dimensional; cylindrical waveguide and optical fibers; generalized linear operators from Maxwell's equations; propagating modes and radiating modes; single-mode fibers (SMF), multi-mode fibers (MMF); coupled-mode theory 5. ***Signal propagation in optical fibers (3 weeks)*****:** attenuation, chromatic dispersion (CD), polarization mode dispersion; Kerr Nonlinearity: self-phase modulation, cross-

phase modulation, four-wave mixing; The Nonlinear Schrodinger Equation; solitons and inverse scattering Transform; solitons; Stimulated Raman Scattering, Stimulated Brillouin Scattering; Fiber fabrication

6. ***Communication systems (2 weeks)*:** Elementary statistical signal processing and communication theory; IM/DD systems; optical amplifiers and optical signal-to-noise (OSNR) limitations; CD-induced limitations and compensation techniques; Modulation and detection; differentially-coherent and coherent systems; WDM systems; advanced modulation formats

Teaching/Learning Methodology

The students will gain an understanding of the various aspects of light and its applications in various engineering fields through regular lectures. Speakers (mostly other PolyU faculty members in Photonics) with relevant expertise will be invited to give short seminars on state-of-the-art research on particular aspects of the course materials.

The deliverables of the term project consists of a written report and an oral presentation. For students whose research advisor is also in the area of optics/photonics, the supervisor and the student will jointly come up with a topic to work on. Suggested depth of the project ranges from a thorough literature review of a particular research area to a publishable research paper.

Teaching/Learning Methodology	Outcomes		
	a	b	c
Lectures	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed									
		a	b	c							
1. Homeworks	40%	√	√								
2. Midterms	30%	√	√								
3. Term project	30%	√	√	√							
Total	100%										

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

Homeworks and midterms will be used to evaluate the student's knowledge on the basis and applications of photonics and optical systems

The term project requires the student to complete a thorough literature search and potentially generate new research ideas, which allow students to learn independently and apply technical concepts discussed in class to the research problem at hand.

Student Study Effort Expected

Class contact:	
▪ Lectures	39 Hrs.
Other student study effort:	
▪ Self/guided studies, group projects and	81 Hrs.

	assignments	
	Total student study effort	120 Hrs.
Reading List and References	1. Saleh and Teich, "Fundamentals of Photonics," John Wiley & Sons, 1991 2. E. Hecht, "Optics," Pearson Education, 6th edition, 2005 3. G.P. Agrawal, "Fiber-Optic Communication Systems," John Wiley & Sons, 4th edition, 2001 4. A. E. Siegman, "Lasers," University Science Books	

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Subject Description Form

Subject Code	EE6811 – EE6813
Subject Title	Special Topics in Advanced Power System I/II/III
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Recommended background knowledge: Knowledge of Power Systems equivalent to the final year of an Honours Degree in Electrical Engineering course. Preference will be given to those who has had research or working experience in the topic chosen.
Objectives	To provide practising electrical engineers with an opportunity to study in depth a topic in advanced power system engineering and management which are important to engineers and researchers.
Intended Learning Outcomes	Upon completion of the subject students will be able: 1. To acquire an understanding of a selected topic in this area, up to the expertise knowledge level, through self study and guidance by the supervisor. 2. To possess the ability of developing latest innovations and cutting edge technologies, through literature studies, simulation studies, and/or experimental studies. 3. To be able to report and explain the above selected area of knowledge, through written and oral means.
Subject Synopsis/ Indicative Syllabus	To conduct an in-depth study in a particular topic in Advanced Power System. The topic content will be fixed after mutual discussion with the prospective supervisor prior to the start of the module.
Teaching/Learning Methodology	The subject can be conducted via guided study in two modes for individual students. Mode I requires a student to take an MSc subject related to the topics of the guided study subject or a relevant short course as the basis of the guided study subject. The student will be required to participate fully in the MSc subject/relevant short course (i.e. attend all the lectures, complete both the coursework and examination requirements). To bring the subject up to the doctoral level, a student is required to submit further write-ups and presentations. An overall grade for the guided study subject is then derived from the result of the MSc subject as well as the extra writes-up and presentations. Mode II is operated for guided study subjects with no relevant MSc subject/short course available. A student is required, under the supervision of the subject supervisor, to read specified monographs, journal publications and/or a book. The student and the subject supervisor must meet once per week to discuss the progress made by the student in the subject. Courseworks in terms of literature survey reports and presentations should normally be included. At the end of the semester the student will be examined, normally both orally and in written form.

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Student Study Effort Expected **(Mode I)**	Class contact (time-tabled):
	▪ Lecture — 24 Hrs.
	▪ Tutorial/Laboratory/Practical Classes — 15 Hrs.
	Guided activities:
	▪ Meeting with the supervisor / Presentations/ Viva examination — 10 Hrs.
	▪ Self-study / Preparation of reports and presentation materials — 56 Hrs.
	Total student study effort — 105 Hrs.
(Mode II)	Guided activities:
	▪ Meeting with the supervisor / Presentations/ Viva examination — 20 Hrs.
	▪ Self-study / Preparation of reports and presentation materials — 85 Hrs.
	Total student study effort — 105 Hrs.
Reading List and References	To be assigned by the subject lecturer.

Subject Description Form

Subject Code	EE6821 – EE6823
Subject Title	Special Topics in Advanced Utilisation I/II/III
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Recommended background knowledge: Knowledge of Power Electronics and Drives equivalent to the final year of an Honours Degree in Electrical Engineering course. Preference will be given to those who has had research or working experience in the topic chosen.
Objectives	To provide practising electrical engineers with an opportunity to study in depth a topic in advanced utilisation engineering and management which are important to engineers and researchers.
Intended Learning Outcomes	Upon completion of the subject students will be able: 1. To acquire an understanding of a selected topic in this area, up to the expertise knowledge level, through self study and guidance by the supervisor. 2. To possess the ability of developing latest innovations and cutting edge technologies, through literature studies, simulation studies, and/or experimental studies. 3. To be able to report and explain the above selected area of knowledge, through written and oral means.
Subject Synopsis/ Indicative Syllabus	To conduct an in-depth study in a particular topic in Advanced Utilisation. The topic content will be fixed after mutual discussion with the prospective supervisor prior to the start of the module.
Teaching/Learning Methodology	The subject can be conducted via guided study in two modes for individual students. Mode I requires a student to take an MSc subject related to the topics of the guided study subject or a relevant short course as the basis of the guided study subject. The student will be required to participate fully in the MSc subject/relevant short course (i.e. attend all the lectures, complete both the coursework and examination requirements). To bring the subject up to the doctoral level, a student is required to submit further write-ups and presentations. An overall grade for the guided study subject is then derived from the result of the MSc subject as well as the extra writes-up and presentations. Mode II is operated for guided study subjects with no relevant MSc subject/short course available. A student is required, under the supervision of the subject supervisor, to read specified monographs, journal publications and/or a book. The student and the subject supervisor must meet once per week to discuss the progress made by the student in the subject. Courseworks in terms of literature survey reports and presentations should normally be included. At the end of the semester the student will be examined, normally both orally and in written form.

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Reading List and References	To be assigned by the subject lecturer.

Subject Description Form

Subject Code	EE6831 – EE6833
Subject Title	Special Topics in Advanced Control System I/II/III
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Recommended background knowledge: Knowledge of Control Systems equivalent to the final year of an Honours Degree in Electrical Engineering course. Preference will be given to those who has had research or working experience in the topic chosen.
Objectives	To provide practising electrical engineers with an opportunity to study in depth a topic in advanced control system engineering and management which are important to engineers and researchers.
Intended Learning Outcomes	Upon completion of the subject students will be able: 1. To acquire an understanding of a selected topic in this area, up to the expertise knowledge level, through self study and guidance by the supervisor. 2. To possess the ability of developing latest innovations and cutting edge technologies, through literature studies, simulation studies, and/or experimental studies. 3. To be able to report and explain the above selected area of knowledge, through written and oral means.
Subject Synopsis/ Indicative Syllabus	To conduct an in-depth study in a particular topic in Advanced Control System. The topic content will be fixed after mutual discussion with the prospective supervisor prior to the start of the module.
Teaching/Learning Methodology	The subject can be conducted via guided study in two modes for individual students. Mode I requires a student to take an MSc subject related to the topics of the guided study subject or a relevant short course as the basis of the guided study subject. The student will be required to participate fully in the MSc subject/relevant short course (i.e. attend all the lectures, complete both the coursework and examination requirements). To bring the subject up to the doctoral level, a student is required to submit further write-ups and presentations. An overall grade for the guided study subject is then derived from the result of the MSc subject as well as the extra writes-up and presentations. Mode II is operated for guided study subjects with no relevant MSc subject/short course available. A student is required, under the supervision of the subject supervisor, to read specified monographs, journal publications and/or a book. The student and the subject supervisor must meet once per week to discuss the progress made by the student in the subject. Courseworks in terms of literature survey reports and presentations should normally be included. At the end of the semester the student will be examined, normally both orally and in written form.

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Reading List and References	To be assigned by the subject lecturer.

Subject Description Form

Subject Code	EE6841 – EE6843
Subject Title	Special Topics in Advanced Fiber Optic I/II/III
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Recommended background knowledge: Knowledge of Fiber Optic equivalent to the final year of an Honours Degree in Electrical Engineering course. Preference will be given to those who has had research or working experience in the topic chosen.
Objectives	To provide practising electrical engineers with an opportunity to study in depth a topic in advanced fiber optic engineering and management which are important to engineers and managers.
Intended Learning Outcomes	Upon completion of the subject students will be able: 1. To acquire an understanding of a selected topic in this area, up to the expertise knowledge level, through self study and guidance by the supervisor. 2. To possess the ability of developing latest innovations and cutting edge technologies, through literature studies, simulation studies, and/or experimental studies. 3. To be able to report and explain the above selected area of knowledge, through written and oral means.
Subject Synopsis/ Indicative Syllabus	To conduct an in-depth study in a particular topic in Advanced Fiber Optic. The topic content will be fixed after mutual discussion with the prospective supervisor prior to the start of the module.
Teaching/Learning Methodology	The subject can be conducted via guided study in two modes for individual students. Mode I requires a student to take an MSc subject related to the topics of the guided study subject or a relevant short course as the basis of the guided study subject. The student will be required to participate fully in the MSc subject/relevant short course (i.e. attend all the lectures, complete both the coursework and examination requirements). To bring the subject up to the doctoral level, a student is required to submit further write-ups and presentations. An overall grade for the guided study subject is then derived from the result of the MSc subject as well as the extra writes-up and presentations. Mode II is operated for guided study subjects with no relevant MSc subject/short course available. A student is required, under the supervision of the subject supervisor, to read specified monographs, journal publications and/or a book. The student and the subject supervisor must meet once per week to discuss the progress made by the student in the subject. Courseworks in terms of literature survey reports and presentations should normally be included. At the end of the semester the student will be examined, normally both orally and in written form.

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Reading List and References	To be assigned by the subject lecturer.

Subject Description Form

Subject Code	EE6851 – EE6853
Subject Title	Special Topics in Smart Materials and Structures I/II/III
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Recommended background knowledge: Knowledge of Electrical Engineering equivalent to the final year of an Honours Degree in Electrical Engineering course. Preference will be given to those who have had research or working experience in the topic chosen.
Objectives	To provide practising engineers with an opportunity to study in depth a topic in smart materials and structures which are becoming increasingly important to engineers and researchers.
Intended Learning Outcomes	Upon completion of the subject students will be able: 4. To acquire an understanding of a selected topic in this area, up to the expertise knowledge level, through self study and guidance by the supervisor. 5. To possess the ability of developing latest innovations and cutting edge technologies, through literature studies, simulation studies, and/or experimental studies. 6. To be able to report and explain the above selected area of knowledge, through written and oral means.
Subject Synopsis/ Indicative Syllabus	To conduct an in-depth study in a particular topic in Smart Materials and Structures. The topic content will be fixed after mutual discussion with the prospective supervisor prior to the start of the module.
Teaching/Learning Methodology	The subject can be conducted via guided study in two modes for individual students. Mode I requires a student to take an MSc subject related to the topics of the guided study subject or a relevant short course as the basis of the guided study subject. The student will be required to participate fully in the MSc subject/relevant short course (i.e. attend all the lectures, complete both the coursework and examination requirements). To bring the subject up to the doctoral level, a student is required to submit further write-ups and presentations. An overall grade for the guided study subject is then derived from the result of the MSc subject as well as the extra writes-up and presentations. Mode II is operated for guided study subjects with no relevant MSc subject/short course available. A student is required, under the supervision of the subject supervisor, to read specified monographs, journal publications and/or a book. The student and the subject supervisor must meet once per week to discuss the progress made by the student in the subject. Courseworks in terms of literature survey reports and presentations should normally be included. At the end of the semester the student will be examined, normally both orally and in written form.

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Reading List and References	To be assigned by the subject lecturer.