THE HONG KONG
POLYTECHNIC UNIVERSITY
香港理工大學

FACULTY OF
ENGINEERING
工程學院
WHERE CONCEPTS BECOME REALITY

Postgraduate Scheme In
Engineering

Programme Requirement Document

September 2022

Postgraduate Scheme In Engineering 2022

Postgraduate Scheme In Engineering 2022

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This Programme Requirement Document is applicable for 2022-23 intakes. It is subject to review and changes which the Programme Host Faculty/Department can decide to make from time to time. Students will be informed of the changes as and when appropriate.
[This Programme Requirement Document is posted at https://www.polyu.edu.hk/feng/05002/]

For ease of reading only the masculine pronoun has been used throughout this booklet. Women staff members and students should not take the omission of 'she', 'her' or 'hers' as being other than an editorial convenience.

1. General Information

1.1 Programme Title

Postgraduate Scheme in Engineering

1.2 Programme Code

05002

1.3 Mode of Study

Mixed-Mode

This programme of study provides an option for students to engage in a full-time (9 credits or more per semester) or part-time study load (less than 9 credits per semester). Full-time students normally take 3 to 5 subjects in a semester, and part-time students usually take 2 subjects. Students may have their study load vary from semester to semester which will accordingly affect their entitlement to University's services.

Note
The MSc Aviation Engineering programme also offers a 100% online study mode. These students are registered as part-time students.

1.4 Host and Contributing Departments

The Postgraduate Scheme in Engineering *(Pg Scheme)* is hosted by the Faculty of Engineering(FENG). Contributing departments include:

- Aeronautical and Aviation Engineering (AAE)
- Electrical Engineering(EE)
- Electronic and Information Engineering(EIE)
- Mechanical Engineering(ME)

1.5 Normal Duration

Award	*Full-time*	*Part-time*
Master of Science (MSc)	1.5 years (3 semesters)	2.5 years (5 semesters)

For students admitted in or after 2020/21, they should complete the programme within the normal duration of the programme. Those who exceed the normal duration of the programme will be de-registered from the programme unless prior approval has been obtained from relevant authorities. Refer to Section 6 of the Appendix on Scheme Regulations for details.

1.6 Fund Type

Self-financed

1.7 Final Awards

Upon successful completion of the required content of the respective awards, students will graduate with a Master of Science Degree (MSc). The Scheme currently offers the following awards *(specialism study options in brackets):*

- MSc in Aviation Engineering
- MSc in Aviation Engineering *(Aviation Operations and Management)*
- MSc in Aviation Engineering *(Aeronautical Engineering)*

- MSc in Electrical Engineering
- MSc in Electrical Engineering *(Electrical Power Systems)*
- MSc in Electrical Engineering *(Electric Vehicles and Power Electronics)*[1]
- MSc-in Electrical Engineering *(Railway Systems)*

- MSc-in Electronic and Information Engineering
- MSc in Electronic and Information Engineering *(Internet of Things)*
- MSc in Electronic and Information Engineering *(Multimedia Signal Processing and Communications)*

- MSc in Mechanical Engineering
- MSc in Mechanical Engineering *(Aerospace Engineering)*[2]
- MSc in Mechanical Engineering *(Air/Noise Pollution Management)*
- MSc in Mechanical Engineering *(Product Development and Analysis)*

Note: Students may apply to exit the MSc programme with a Postgraduate Diploma (PgD), subject to meeting the specified requirements.

1.8. Entrance Requirements

General Entrance Requirements

For admission to a Master's degree, the basic requirement is a Bachelor's degree from an institution that is recognised by PolyU. In addition, applicants must meet the entrance requirements as specified by individual programmes on *P.7 - 25*.

English Language Requirement

Applicants who are not native speakers of English, and the Bachelor's degree or equivalent qualification is awarded by institutions where the medium of instruction is not English, they are expected to fulfil the following minimum English language requirement:

(a) A Test of English as a Foreign Language (TOEFL) score of 80 for the Internet-based test or 550 for the paper-based test; OR

(b) An overall Band Score of at least 6 in the International English Language Testing System (IELTS).

Individual cases will be considered on their own merit by the departments concerned. Applicants may be required to attend interviews or tests to further demonstrate their language proficiency.

1.9 Graduation Requirements

A student would be eligible for award if he satisfies all the conditions listed below:

(a) Accumulation of the requisite number of credits – 30 for MSc; 18 for PgD exit award; and

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[1] Retitled from the specialism of *'Power Electronics and Drives'* offered to students admitted in 2021-22 and before, this specialism is applicable for 2022-23 intake and beyond.

[2] Retitled from the specialism of *'Aeronautical Engineering'* offered to students admitted in 2021-22 and before, this specialism is applicable for 2022-23 intake and beyond.

(b) Satisfying the residential requirement for at least 1/3 of the credits to be completed for the award he is currently enrolled, unless the professional bodies stipulate otherwise; and

(c) Satisfying all requirements as defined for the respective awards and as specified by the University; and

(d) Having a Grade Point Average (GPA) of 1.70 or above at the end of the programme;

(e) Having successfully completed the Online Tutorial on Academic Integrity (see below); and

(f) Having fulfilled the National Education (NE) Requirement (see below).

Online Tutorial on Academic Integrity – A mandatory requirement for graduation

To help students understand the importance of academic honesty and learn ways to ensure that their work and behaviour at PolyU are acceptable in this regard, students admitted to the Scheme in 2014/15 and beyond will be required to complete an Online Tutorial on Academic Integrity on a mandatory basis. Students need to complete the Tutorial preferably by Week 5 and the latest by end of the first semester they are admitted to the programme. Students without completing the Tutorial successfully will not be considered for graduation.

The Online Tutorial can be accessed on LEARN@PolyU (理學網). It takes approximately two hours to complete. Detailed information and instructions about the tutorial are posted at *"Student Guide on Online Tutorial on Academic Integrity".*
https://www.polyu.edu.hk/ogur/docdrive/Academic_Integrity/Student_Guide.pdf

National Education (NE) Requirement - A mandatory requirement for graduation for students admitted in or after 2022/23

Students enrolled on taught postgraduate programmes are required to complete the National Education (NE) Requirement. It is a 3-hour online module plus 7 hours of self-study on 'National Education' at their own pace, and pass the assessment (multiple attempts allowed) in the form of multiple-choice questions online as a graduation requirement. Except for students who have been granted an exemption, students without completing the module successfully will not be considered for graduation. Details are posted at https://www.polyu.edu.hk/ous/nationaleducation/understanding-china-and-hongkong/.

1.10 Application for Graduation

Application for Postgraduate Diploma exit award

Students who wish to exit the programme with a PgD should submit an application via Form AR84c in the semester they want to do so.

Application to graduate with a specialism

Students who wish to graduate from the MSc award with a specialism *(the specialism study options currently offered are listed under Section 1.7 above)* should apply for graduation via Form AR84c in the semester they deem having satisfied the award requirements concerned.

Students should refer to the Student Handbook for the application deadline stipulated for each semester. Applications for graduation will be considered by the Scheme's Board of Examiners in each semester and the results will be conveyed to students via eStudent (Examination Result Notification). Students will NOT be informed separately of the application results. Students who are unsuccessful in the application should submit another application for graduation in subsequent semester/academic year.

Students can download Form AR84c at
https://www.polyu.edu.hk/ar/web/en/for-polyu-students/application-forms/index.html

1.11 Credit Fee

HK$4,700 (local students) / $5,465 (non-local students)

1.12 Summer Term Teaching

The Scheme does not have a mandatory Summer Term.

1.13 Daytime and Evening Teaching

Subjects will be offered predominately in the evenings. Some subjects may be made available in daytime. In general, each subject requires a 3-hour class per week over a 13-week semester.

2. <u>Aims and Outcomes</u>

2.1 University Mission

The Scheme is able to fufil the University mission of:

2.1.1 To pursue impactful research that benefits the world.

2.1.2 To nurture critical thinkers, effective communicators, innovative problem solvers and socially responsible global citizens.

2.1.3 To foster a University community in which all members can excel in their aspirations with a strong sense of belonging and pride.

2.2 Programme Aims

Depending on needs, a student's selected programme of study can be designed for one or more of the following:

2.2.1 an in-depth treatment of an area beyond the student's first degree level in the same area;

2.2.2 updating of the knowledge of those engaged in a field especially where the discipline at undergraduate level is subject to rapid expansion or change;

2.2.3 a re-orientation or conversion to areas new to the student (in that it is in an area not directly related to the student's first degree); and

2.2.4 a synthesis and integration of a number of disciplines or subjects, particularly if the combination cannot be pursued adequately at undergraduate level.

Each programme offered within the Pg Scheme addresses the needs of its own profession. Please refer to the respective programme entries on *P.7 - 25* for details.

2.3 Programme Outcomes

Programme outcomes refer to the intellectual abilities, knowledge, skills and attributes that a graduate from the programme should possess. Each programme offered within the Pg Scheme has its unique learning outcomes. Please refer to the respective programme entries on *P.7 – 25* for details.

2.4 Relationship between University Mission and Programme Aims/Outcomes

Please refer to the respective programme entries on *P.7 - 25* for details.

2.5 Relationship between Programme Outcomes and Subjects

Please refer to the respective programme entries on *P.7 - 25* for details.

3. Curriculum Structure

3.1 To be eligible for the award of an MSc, students need to successfully complete 30 credits. To be eligible for the exit award of a PgD, students need to successfully complete 18 credits.

3.2 Each award has stipulated the requisite number of *compulsory* and/or *core* subjects, as detailed on *P.26 – 28*. For *elective* subjects, they are subjects that students may choose from the available subjects within this Scheme, or outside this Scheme (also see remarks below). Students would be informed of the choices during the online subject registration exercise of each semester. Please refer to the respective programme entries on *P.7 - 25* for the pool of stipulated *compulsory* and/or *core* subjects. Not all subjects as listed are offered each year. The subject offering departments have the complete discretion in determining the offer schedule.

Remarks: Students of MSc Aviation Engineering who opt for the 100% online mode can only choose elective subjects from the list of AAE Core Subjects, unless there are online subjects offered by other programmes within the Scheme.

3.3 Subject syllabi for compulsory and core subjects are given in *Part II.*

4. Assessment Regulations

Academic regulations governing the Scheme are given in *Appendix*.

5. Student Counselling

The Chairman of Award Committees are available to answer questions and provide advice. Their contact numbers and email addresses are given below.

6. Staff of the Scheme

Scheme Chairman: Prof. Francis LAU
Professor
Department of Electronic and Information Engineering
Tel. 2766 6206
Email: francis-cm.lau@polyu.edu.hk

Chairman of Award Committee:

MSc in	Award Chairman
Aviation Engineering	Dr Jiaao HAO Assistant Professor Department of Aeronautical and Aviation Engineering *Tel. 3400 8060 Email: jiaao.hao@polyu.edu.hk*
Electrical Engineering	Dr Shuangxia NIU Associate Professor Department of Electrical Engineering *Tel. 2766 6183 Email: eesxniu@polyu.edu.hk*
Electronic and Information Engineering	Prof. Changyuan YU Professor Department of Electronic and Information Engineering *Tel. 2766 6258 Email: changyuan.yu@polyu.edu.hk*
Mechanical Engineering	Dr JIAO Zengbao Associate Professor Department of Mechanical Engineering *Tel. 2766 6665 Email: zbjiao@polyu.edu.hk*

Master of Science in Aviation Engineering

The programme also provides two specialisms of study option:

- MSc in Aviation Engineering (Aviation Operations and Management)
- MSc in Aviation Engineering (Aeronautical Engineering)

1. Programme Aims

(a) To provide advanced education and training for students who intend to upgrade their knowledge and to seek a higher level career in the area of Aviation and Aeronautical Engineering;

(b) To enable students to develop their competence to increase their competitiveness in the job market and become the backbone in aviation industry;

(c) To enable students to have good understanding and mastering of the most up-to-date advanced technologies in the area of Aviation and Aeronautical Engineering; and

(d) To enable students to apply their learned knowledge and skills to solve problems encountered in practice.

2. Relationship of Programme Aims to University Mission

The University has the following mission:

(a) To pursue impactful research that benefits the world.

(b) To nurture critical thinkers, effective communicators, innovative problem solvers and socially responsible global citizens.

(c) To foster a University community in which all members can excel in their aspirations with a strong sense of belonging and pride.

The following table illustrates the relationship between programme aims and University mission:

Programme Aims	University Mission		
	(a)	(b)	(c)
(a)		√	√
(b)		√	√
(c)	√	√	√
(d)	√	√	√

3. Institutional Learning Outcomes

The institutional learning outcomes for taught postgraduate programmes are:

(a) **Professional competence of specialists/leaders of a discipline/profession:** Graduates of PolyU taught postgraduate programmes will possess in-depth knowledge and skills in their area of study and be able to apply their knowledge and contribute to professional leadership;

(b) **Strategic thinking:** Graduates of PolyU taught postgraduate programmes will be able to think holistically and analytically in dealing with complex problems and situations pertinent to their professional practice. They will be versatile problem solvers with good mastery of critical and creative thinking skills, who can generate practical and innovative solutions; and

(c) **Lifelong learning capability**: Graduates of PolyU taught postgraduate programmes will have an enhanced capability for continual professional development through inquiry and reflection on professional practice.

4. Intended Learning Outcomes of the Programme

The programme has the following intended learning outcomes:

(a) **Professional competence of specialists/leaders of a discipline/profession:** Graduates will possess state-of-the-art knowledge and skills in the area of Aviation and Aeronautical Engineering and be able to apply their knowledge and contribute to professional competence, including ability to manage maintenance/repair/overhaul business and airline/airport operation, perform aircraft design and engineering to meet desired needs. They will have the readiness for assuming a leadership role in their field of practice;

(b) **Critical and creative thinking:** Graduates will be able to think holistically, critically, strategically and creatively in dealing with complex problems and situations pertinent to their professional practice. They will be versatile problem solvers with good mastery of critical and creative thinking skills, who can generate practical and innovative solutions to novel problems; and

(c) **Lifelong learning capability:** Graduates will have recognition of the need for, and an ability to engage in life-long learning.

5. Relationship of Intended Learning Outcomes to Programme Aims

The following table illustrates the relationship between intended learning outcomes and programme aims of the programme:

Intended Learning Outcomes	Programme Aims			
	(a)	(b)	(c)	(d)
(a)	√	√	√	√
(b)	√	√	√	√
(c)		√		√

6. Relationship of Intended Learning Outcomes of the Programme to Institutional Learning Outcomes

The following table illustrates the relationship between intended learning outcomes of the programme to Institutional learning outcomes:

Intended Learning Outcomes	Institutional Learning Outcomes		
	(a)	(b)	(c)
(a)	√		
(b)		√	
(c)			√

7. Curriculum Map

The curriculum map shown below indicates how each intended learning outcomes of the programme is addressed by the constituent subjects.

Compulsory/Core Subjects	Intended Learning Outcomes		
	(a) Professional competence	(b) Critical & creative thinking	(c) Lifelong learning capability
AAE5001 Guidance, Navigation and Advanced Avionics System	√	√	√
AAE5002 Human Factors, Accident Prevention and Aircraft Maintenance	√	√	√
AAE5101 Next Generation Air Traffic Control and Air Traffic Flow Management	√	√	√
AAE5102 Operations Research, Resource Planning and Engineering Management in Aviation	√	√	√
AAE5103 Artificial Intelligence in Aviation Industry	√	√	√
AAE5104 Aviation Technical Services and Aircraft Leasing Management	√	√	√
AAE5105 Fleet Management and Aviation Sustainability	√	√	√
AAE5106 Flight Standards and Airworthiness	√	√	√
AAE5201 Aerodynamics and Computational Fluid Dynamics	√	√	√
AAE5202 Advanced Aircraft Structures and Materials	√	√	√
AAE5203 Aircraft Design and Certification	√	√	√
AAE5204 Autonomous Flight - Mechanics and Control	√	√	√
AAE5205 Aircraft Engine Systems and Combustion	√	√	√

8. Entrance Requirements

A Bachelor's degree with Honours in engineering, science or technology, or qualifications that satisfy the academic requirements for Corporate Membership of the Hong Kong Institution of Engineers (HKIE), or the equivalent.

Consideration will also be given to candidates without Honours degrees who have other relevant qualifications and/or appropriate working experience.

9. Programme Contents

Award Title	Core Subjects
MSc in Aviation Engineering	AAE5001 AAE5002 AAE5101 AAE5102 AAE5103 AAE5104 AAE5105 AAE5106 AAE5201 AAE5202 AAE5203 AAE5204 AAE5205
MSc in Aviation Engineering (Aviation Operations and Management)	AAE5001 AAE5002 AAE5101 AAE5102 AAE5103 AAE5104 AAE5105 AAE5106
MSc in Aviation Engineering (Aeronautical Engineering)	AAE5001 AAE5002 AAE5201 AAE5202 AAE5203 AAE5204 AAE5205

Master of Science in Electrical Engineering

The programme also provides three specialisms of study option:

- MSc in Electrical Engineering (Electrical Power Systems)
- MSc in Electrical Engineering (Electric Vehicles and Power Electronics) [3]
- MSc in Electrical Engineering (Railway Systems)

1. Programme Aims

(a) To strengthen the professional knowledge of electrical engineers involved in engineering activities in the power utilities, electricity utilization industries, railway systems, government organizations and consultancy companies;

(b) To provide in-depth study of the state-of-the-art developments in specialist areas of electrical engineering: power systems engineering; industrial utilization and power electronics; railway system; energy sources and planning; control and automation; and optoelectronics;

(c) To develop an understanding of the integration between advanced technologies (such as computer technology and communications) and the traditional branches of electrical engineering; and

(d) To provide an opportunity for supplementing the core areas of electrical engineering study with topics in management, information science and related engineering fields.

2. Relationship of Programme Aims to University Mission

The University has the following mission:

(a) To pursue impactful research that benefits the world.

(b) To nurture critical thinkers, effective communicators, innovative problem solvers and socially responsible global citizens.

(c) To foster a University community in which all members can excel in their aspirations with a strong sense of belonging and pride.

The following table illustrates the relationship between programme aims and University mission:

Programme Aims	University Mission		
	(a)	(b)	(c)
(a)	√	√	
(b)	√	√	
(c)	√	√	√
(d)	√	√	√

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[3] Retitled from the specialism of *'Power Electronics and Drives'* offered to students admitted in 2021-22 and before, this specialism is applicable for 2022-23 intake and beyond.

3. Institutional Learning Outcomes

The institutional learning outcomes for taught postgraduate programmes are:

(a) **Professional competence of specialists/leaders of a discipline/profession:** Graduates of PolyU taught postgraduate programmes will possess in-depth knowledge and skills in their area of study and be able to apply their knowledge and contribute to professional leadership.

(b) **Strategic thinking:** Graduates of PolyU taught postgraduate programmes will be able to think holistically and analytically in dealing with complex problems and situations pertinent to their professional practice. They will be versatile problem solvers with good mastery of critical and creative thinking skills, who can generate practical and innovative solutions.

(c) Lifelong learning capability: Graduates of PolyU taught postgraduate programmes will have an enhanced capability for continual professional development through inquiry and reflection on professional practice.

4. Intended Learning Outcomes of the Programme

The programme has the following intended learning outcomes:

(a) **Professional competence of specialists/leaders of a discipline/profession:** Graduates will possess state-of-the-art knowledge and skills in the areas within electrical engineering and be able to apply their knowledge. They will have the readiness for assuming a leadership role in their field of practice.

(b) **Design capability:** Graduates will develop an ability to design an electrical system, component, or process to meet desired needs within realistic constraints such as technical, economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

(c) **Critical and creative thinking:** Graduates will be able to think holistically and/or strategically in dealing with complex problems and situations pertinent to their professional practice. They will be versatile problem solvers with good mastery of critical and creative thinking skills, who can generate practical and innovative solutions to novel problems.

(d) **Lifelong learning capability:** Graduates will develop recognition of the need for, and an ability to engage in life-long learning.

5. Relationship of Intended Learning Outcomes to Programme Aims

The following table illustrates the relationship between intended learning outcomes and programme aims:

Intended Learning Outcomes	Programme Aims			
	(a)	(b)	(c)	(d)
(a)	√	√	√	√
(b)	√	√		
(c)	√	√		
(d)	√			√

6. Relationship of Intended Learning Outcomes of the Programme to Institutional Learning Outcomes

Intended Learning Outcomes	Institutional Learning Outcomes		
	(a)	(b)	(c)
(a)	√		
(b)	√		
(c)		√	
(d)			√

7. Curriculum Map

The curriculum map shown below indicates how each intended learning outcomes of the programme is addressed by the constituent subjects.

Core Subjects	Intended Learning Outcomes			
	(a) Professional competence	(b) Design capability	(c) Critical & creative thinking	(d) Lifelong learning capability
EE501 Alternative Energy Technologies	√		√	√
EE502 Modern Protection Methods	√	√	√	√
EE505 Power System Control and Operation	√	√	√	√
EE509 High Voltage Engineering	√		√	√
EE510 Electrical Traction Engineering	√		√	√
EE512 Electric Vehicles	√		√	√
EE514 Real Time Computing	√		√	√
EE520 Intelligent Motion Systems	√	√	√	√
EE521 Industrial Power Electronics	√	√	√	√
EE522 Optical Fibre Systems	√	√	√	√
EE524 Open Electricity Market Operation	√		√	√
EE526 Power System Analysis and Dynamics	√	√	√	√
EE528 System Modelling and Optimal Control	√	√	√	√
EE530 Electrical Energy Saving Systems	√	√	√	√
EE533 Railway Power Supply Systems	√	√	√	√
EE535 Maintenance and Reliability Engineering	√		√	√
EE536 Signalling and Train Control Systems	√	√	√	√
EE537 Railway Vehicles	√	√	√	√
EE5381System Assurance and Safety in Railways	√	√	√	√

Core Subjects	Intended Learning Outcomes			
	(a) Professional competence	(b) Design capability	(c) Critical & creative thinking	(d) Lifelong learning capability
EE539 Aerospace Power Electronics and Actuation Systems	√		√	√
EE545 Modern Generation and Grid Integration Technologies	√	√	√	√
EE546 Electric Energy Storage and New Energy Sources for Electric Vehicles	√		√	√
EE547 Electric Vehicle Charging Systems	√		√	√
EE548 Advanced Electric Vehicle Technology	√		√	√
EE549 Modern Sensor Technologies	√	√	√	√
EE550 Enterprise Risk and Asset Management	√		√	√
EE552 High Speed Rail	√	√	√	√
EE553 Railway Electronic Systems	√	√	√	√
EE560 Metros in Hong Kong and China	√	√	√	√
EE570 Design and Analysis of Smart Grids	√	√	√	√

8. Entrance Requirements

A Bachelor's degree with Honours in engineering, science or technology; or qualifications that satisfy the academic requirements for Corporate Membership of the Hong Kong Institution of Engineers (HKIE), or the equivalent.

Consideration will also be given to candidates without Honours degrees who have other relevant qualifications and/or appropriate working experience.

9. Programme Contents

Award Title	Core Subjects
MSc in Electrical Engineering	EE501 EE502 EE505 EE509 EE510 EE512 EE514 EE520 EE521 EE522 EE524 EE526 EE528 EE530 EE533 EE535 EE536 EE537 EE5381 EE539 EE545 EE546 EE547 EE548 EE549 EE550 EE552 EE553 EE560 EE570
MSc in Electrical Engineering (Electrical Power Systems)	EE501 EE502 EE505 EE509 EE524 EE526 EE545 EE570
MSc in Electrical Engineering (Electric Vehicles and Power Electronics) [4]	EE501 EE510 EE512 EE520 EE521 EE528 EE530 EE539 EE545 EE546 EE547 EE548
MSc in Electrical Engineering (Railway Systems)	EE509 EE510 EE533 EE535 EE536 EE537 EE5381 EE550 EE552 EE553 EE560

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[4] Retitled from the specialism of *'Power Electronics and Drives'* offered to students admitted in 2021-22 and before, this specialism is applicable for 2022-23 intake and beyond.

Master of Science in Electronic and Information Engineering

The programme also provides two specialisms of study option:

- MSc in Electronic and Information Engineering (Internet of Things)
- MSc in Electronic and Information Engineering (Multimedia Signal Processing and Communications)

1. Programme Aims

(a) To provide graduates of electronic and information engineering, electrical engineering, telecommunications engineering, computer science and other related disciplines an opportunity for further study at postgraduate level.

(b) To enable students to meet new challenges and tap new opportunities in relevant fields by studying a broad choice of core subjects in multimedia technologies, telecommunications and electronic engineering.

(c) To enable students to acquire the latest technical know-how by registering for specialized subjects in a chosen area that focuses on the cutting edge issues facing the engineering profession today.

2. Relationship of Programme Aims to University Mission

The University has the following mission:

(a) To pursue impactful research that benefits the world.

(b) To nurture critical thinkers, effective communicators, innovative problem solvers and socially responsible global citizens.

(c) To foster a University community in which all members can excel in their aspirations with a strong sense of belonging and pride.

The following table illustrates the relationship between programme aims and University mission:

Programme Aims	University Mission		
	(a)	(b)	(c)
(a)	x	x	x
(b)	x	x	x
(c)	x	x	x

3. Institutional Learning Outcomes

The institutional learning outcomes for taught postgraduate programmes are:

(a) **Professional competence of specialists/leaders of a discipline/profession:** Graduates of PolyU taught postgraduate programmes will possess in-depth knowledge and skills in their area of study and be able to apply their knowledge and contribute to professional leadership.

(b) **Strategic thinking:** Graduates of PolyU taught postgraduate programmes will be able to think holistically and analytically in dealing with complex problems and situations pertinent to their professional practice. They will be versatile problem solvers with good mastery of critical and creative thinking skills, who can generate practical and innovative solutions.

(c) Lifelong learning capability: Graduates of PolyU taught postgraduate programmes will have an enhanced capability for continual professional development through inquiry and reflection on professional practice.

4. Intended Learning Outcomes of the Programme

The programme has the following intended learning outcomes:

(a) **Professional competence of specialists/leaders of a discipline/profession:** Graduates will possess state-of-the-art knowledge and skills in the areas within electronic and information engineering and be able to apply their knowledge. They will have the readiness for assuming a leadership role in their field of practice.

(b) **Design capability:** Graduates will develop an ability to design an electronic system, component, or process to meet desired needs within realistic constraints such as technical, environmental, social, ethical, health and safety, manufacturability, and sustainability.

(c) **Critical and creative thinking:** Graduates will be able to think holistically and/or strategically in dealing with complex problems and situations pertinent to their professional practice. They will be versatile problem solvers with good mastery of critical and creative thinking skills, who can generate practical and innovative solutions to novel problems.

(d) **Lifelong learning capability:** Graduates will develop recognition of the need for, and an ability to engage in life-long learning.

5. Relationship of Intended Learning Outcomes to Programme Aims

The following table illustrates the relationship between intended learning outcomes and programme aims:

Intended Learning Outcomes	Programme Aims		
	(a)	(b)	(c)
(a)	x	x	x
(b)	x	x	x
(c)	x	x	x
(d)	x	x	x

6. Relationship of Intended Learning Outcomes of the Programme to Institutional Learning Outcomes

Intended Learning Outcomes	Institutional Learning Outcomes		
	(a)	(b)	(c)
(a)	x		
(b)	x		
(c)		x	
(d)			x

7. Curriculum Map

The curriculum map shown below indicates how each intended learning outcomes of the programme is addressed by the constituent subjects.

Core Subjects	**Intended Learning Outcomes**			
	(a) Professional competence	**(b) Design capability**	**(c) Critical & creative thinking**	**(d) Lifelong learning capability**
EIE509 Satellite Communications - Technology and Applications	√		√	√
EIE511 VLSI System Design	√	√	√	√
EIE515 Advanced Optical Communication Systems	√	√	√	√
EIE522 Pattern Recognition: Theory & Applications	√	√	√	√
EIE529 Digital Image Processing	√	√	√	√
EIE546 Video Technology	√	√	√	√
EIE553 Security in Data Communication	√		√	√
EIE557 Computational Intelligence and its Applications	√	√	√	√
EIE558 Speech Processing and Recognition	√	√	√	√
EIE560 Microelectronics Processing and Technologies	√	√	√	√
EIE563 Digital Audio Processing	√	√	√	√
EIE566 Wireless Communications	√	√	√	√
EIE567 Wireless Power Transfer Technologies	√	√	√	√
EIE568 IoT – Tools and Applications	√		√	√
EIE569 Sensor Networks	√	√	√	√
EIE570 Deep Learning with Photonics	√	√	√	√
EIE571 Photonic System Analysis	√	√	√	√
EIE572 Information Photonics	√		√	√
EIE573 Mobile Edge Computing	√	√	√	√
EIE575 Vehicular Communications and	√	√	√	√

Core Subjects	**Intended Learning Outcomes**			
	(a) Professional competence	**(b) Design capability**	**(c) Critical & creative thinking**	**(d) Lifelong learning capability**
Inter-Networking Technologies				
EIE577 Optoelectronic Devices	√	√	√	√
EIE579 Advanced Telecommunication Systems	√	√	√	√
EIE580 Radio Frequency and Microwave Integrated Circuits for Communication System Applications	√	√	√	√
EIE587 Channel Coding	√	√	√	√
EIE589 Wireless Data Network	√	√	√	√
COMP5434 Big Data Computing	√	√	√	√

8. Entrance Requirements

An Honours degree in engineering, science, or technology, or Chartered Engineer (CEng) status, or an equivalent qualification.

Consideration will also be given to candidates without Honours degrees who have other relevant qualifications and/or appropriate working experience.

9. Programme Contents

Award Title	Core Subjects
MSc in Electronic and Information Engineering	EIE509 EIE511 EIE515 EIE522 EIE529 EIE546 EIE553 EIE557 EIE558 EIE560 EIE563 EIE566 EIE567 EIE568 EIE569 EIE570 EIE571 EIE572 EIE573 EIE575 EIE577 EIE579 EIE580 EIE587 EIE589
MSc in Electronic and Information Engineering (Internet of Things)	EIE515 EIE546 EIE553 EIE557 EIE560 EIE566 EIE567 EIE568 EIE569 EIE570 EIE573 EIE575 EIE579 EIE589 COMP5434
MSc in Electronic and Information Engineering (Multimedia Signal Processing and Communications)	EIE522 EIE529 EIE546 EIE553 EIE557 EIE558 EIE563 EIE566 EIE567 EIE570 EIE573 EIE575 EIE589

Master of Science in Mechanical Engineering

The programme also provides three specialisms of study option:

- MSc in Mechanical Engineering (Aerospace Engineering)[5]
- MSc in Mechanical Engineering (Air/Noise Pollution Management)
- MSc in Mechanical Engineering (Product Development and Analysis)

1. Programme Aims

(a) To provide advanced education and training for students who intend to upgrade their knowledge and to seek a higher level career in the area of Mechanical Engineering;

(b) To enable students to develop their competence to increase their competitiveness in the job market and become the backbone in industry;

(c) To enable students to have good understanding and mastering of the most up-to-date advanced technologies in the area of Mechanical Engineering; and

(d) To enable students to apply their learned knowledge and skills to solve problems encountered in practice.

2. Relationship of Programme Aims to University Mission

The University has the following mission:

(a) To pursue impactful research that benefits the world.

(b) To nurture critical thinkers, effective communicators, innovative problem solvers and socially responsible global citizens.

(d) To foster a University community in which all members can excel in their aspirations with a strong sense of belonging and pride.

The following table illustrates the relationship between programme aims and University mission:

Programme Aims	University Mission		
	(a)	(b)	(c)
(a)		√	√
(b)		√	√
(c)	√	√	√
(d)	√	√	√

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[5] Retitled from the specialism of *'Aeronautical Engineering'* offered to students admitted in 2021-22 and before, this specialism is applicable for 2022-23 intake and beyond.

3. Institutional Learning Outcomes

The institutional learning outcomes for taught postgraduate programmes are:

(d) **Professional competence of specialists/leaders of a discipline/profession:** Graduates of PolyU taught postgraduate programmes will possess in-depth knowledge and skills in their area of study and be able to apply their knowledge and contribute to professional leadership.

(e) **Strategic thinking:** Graduates of PolyU taught postgraduate programmes will be able to think holistically and analytically in dealing with complex problems and situations pertinent to their professional practice. They will be versatile problem solvers with good mastery of critical and creative thinking skills, who can generate practical and innovative solutions.

(f) **Lifelong learning capability**: Graduates of PolyU taught postgraduate programmes will have an enhanced capability for continual professional development through inquiry and reflection on professional practice.

4. Intended Learning Outcomes of the Programme

The programme has the following intended learning outcomes:

(d) **Professional competence of specialists/leaders of a discipline/profession and Design capability**: Graduates will possess state-of-the-art knowledge and skills in the area of Mechanical Engineering and be able to apply their knowledge and contribute to professional competence, including ability to design and develop a product, system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability. They will have the readiness for assuming a leadership role in their field of practice.

(e) **Critical and creative thinking**: Graduates will be able to think holistically, critically, strategically and creatively in dealing with complex problems and situations pertinent to their professional practice. They will be versatile problem solvers with good mastery of critical and creative thinking skills, who can generate practical and innovative solutions to novel problems.

(f) **Lifelong learning capability**: Graduates will have recognition of the need for, and an ability to engage in life-long learning.

5. Relationship of Intended Learning Outcomes to Programme Aims

The following table illustrates the relationship between intended learning outcomes and programme aims:

Intended Learning Outcomes	Programme Aims			
	(a)	(b)	(c)	(d)
(a)	√	√	√	√
(b)	√	√	√	√
(c)		√		√

6. Relationship of Intended Learning Outcomes of the Programme to Institutional Learning Outcomes

Intended Learning Outcomes	Institutional Learning Outcomes		
	(a)	(b)	(c)
(a)	√		
(b)		√	
(c)			√

7. Curriculum Map

The curriculum map shown below indicates how each intended learning outcomes of the programme is addressed by the constituent subjects.

Compulsory/Core Subjects	Intended Learning Outcomes		
	(a) Professional competence	(b) Critical & creative thinking	(c) Lifelong learning capability
ME534 Engineering Acoustics	√	√	√
ME536 Vibration and Structure-borne Noise	√	√	√
ME540 Fuels and Engines	√	√	√
ME548 Computer Aided Product Analysis	√	√	√
ME552 Integrated Engineering Design	√	√	√
ME556 Advanced Combustion Systems	√	√	√
ME557 CFD & Thermo-fluid System Design	√	√	√
ME558 Advanced Materials and Structural Design	√	√	√
ME559 Advanced Environmental and Transportation Noise Control	√	√	√
ME564 Principles and Design of Air Pollution Control Devices	√	√	√
ME565 Prevention and Control of Vehicular Emission	√	√	√
ME566 Industrial and Environmental Measurement Technology	√	√	√
ME567 Advanced Control Technology	√	√	√
ME569 Thermal System Design and Management	√	√	√
ME570 Advanced Product Mechatronics	√	√	√
ME571 Corrosion Control	√	√	√

Compulsory/Core Subjects	Intended Learning Outcomes		
	(a) Professional competence	(b) Critical & creative thinking	(c) Lifelong learning capability
ME572 Design for Sustainable Development	√	√	√
ME573 Project on Product Design and Management	√	√	√
ME574 Product Noise Control	√	√	√
ME576 Turbulent Flows and Aerodynamics	√	√	√
ME577 Advanced Aircraft Structures	√	√	√
ME578 Aircraft Design	√	√	√
ME579 Aircraft Noise and Aeroacoustics	√	√	√

8. Entrance Requirements

A Bachelor's degree with Honours in a relevant branch of engineering, or a related applied science discipline; or qualifications that satisfy the academic requirements for Corporate Membership of the mechanical discipline of the Hong Kong Institution of Engineers (HKIE), or the equivalent.

Consideration will also be given to candidates without Honours degrees who have other relevant qualifications and/or appropriate working experience.

9. Programme Contents

Award Title	Compulsory/Core Subjects
MSc in Mechanical Engineering	*Core subjects:* ME534 ME536 ME540 ME548 ME552 ME556 ME557 ME558 ME559 ME564 ME565 ME566 ME567 ME569 ME570 ME571 ME572 ME573 ME574 ME576 ME577 ME578 ME579
MSc in Mechanical Engineering (Aerospace Engineering) [6]	*Compulsory subjects:* ME576 ME577 ME578 *Core subjects:* ME540 ME548 ME556 ME558 ME567 ME579
MSc in Mechanical Engineering (Air/Noise Pollution Management)	*Core subjects:* ME534 ME536 ME540 ME556 ME559 ME564 ME565 ME574
MSc in Mechanical Engineering (Product Development and Analysis)	*Core subjects:* ME548 ME552 ME557 ME558 ME564 ME570 ME571 ME572 ME573 ME574

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[6] Retitled from the specialism of *'Aeronautical Engineering'* offered to students admitted in 2021-22 and before, this specialism is applicable for 2022-23 intake and beyond.

Core Subjects Requirements of Individual Awards

Award (specialism)	Dissertation option	Non-dissertation option
▪ MSc in Aviation Engineering ▪ MSc in Electrical Engineering ▪ MSc in Electronic & Information Engineering ▪ MSc in Mechanical Engineering	Complete SEVEN taught subjects and a 9-credit dissertation. For an award in a designated area, a minimum of FOUR taught subjects shall be core subjects specified for the relevant area and the dissertation topic shall be pertinent to the area.	Complete TEN taught subjects. For an award in a designated area, a minimum of SIX subjects shall be core subjects specified for the relevant area.
MSc in Aviation Engineering (Aeronautical Engineering)	Complete SEVEN taught subjects and a 9-credit dissertation. A minimum of FOUR taught subjects shall come from the core subject list specified for the specialism of Aeronautical Engineering and the dissertation topic shall be pertinent to the specialism.	Complete TEN taught subjects. A minimum of SIX subjects shall come from the core subject list specified for the specialism of Aeronautical Engineering.
MSc in Aviation Engineering (Aviation Operations and Management)	Complete SEVEN taught subjects and a 9-credit dissertation. A minimum of FOUR taught subjects shall come from the core subject list specified for the specialism of Aviation Operations and Management and the dissertation topic shall be pertinent to the specialism.	Complete TEN taught subjects. A minimum of SIX subjects shall come from the core subject list specified for the specialism of Aviation Operations and Management.
MSc in Electrical Engineering (Electric Vehicles and Power Electronics) [7]	Complete SEVEN taught subjects and a 9-credit dissertation. A minimum of FOUR taught subjects shall come from the core subject list specified for the specialism of Electric Vehicles and Power Electronics and the dissertation topic shall be pertinent to the specialism.	Complete TEN taught subjects. A minimum of EIGHT subjects shall come from the core subject list, and of which at least SIX shall be core subjects specified for the specialism of Electric Vehicles and Power Electronics.
MSc in Electrical Engineering (Electrical Power Systems)	Complete SEVEN taught subjects and a 9-credit dissertation. A minimum of FOUR taught subjects shall come from the core subject list specified for the specialism of Electrical Power Systems and the dissertation topic shall be pertinent to the specialism.	Complete TEN taught subjects. A minimum of EIGHT subjects shall come from the core subject list, and of which at least SIX shall be core subjects specified for the specialism of Electrical Power Systems.

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[7] Retitled from the specialism of *'Power Electronics and Drives'* offered to students admitted in 2021-22 and before, this specialism is applicable for 2022-23 intake and beyond.

Award (specialism)	Dissertation option	Non-dissertation option
MSc in Electrical Engineering (Railway Systems)	Complete SEVEN taught subjects and a 9-credit dissertation. A minimum of FOUR taught subjects shall come from the core subject list specified for the specialism of Railway Systems and the dissertation topic shall be pertinent to the specialism.	Complete TEN taught subjects. A minimum of EIGHT subjects shall come from the core subject list, and of which at least SIX shall be core subjects specified for the specialism of Railway Systems.
MSc in Electronic & Information Engineering (Internet of Things)	Complete SEVEN taught subjects and a 9-credit dissertation. A minimum of FIVE taught subjects shall come from the core subject list specified for the specialism of Internet of Things and the dissertation topic shall be pertinent to the specialism.	Complete TEN taught subjects. A minimum of SEVEN subjects shall come from the core subject list specified for the specialism of Internet of Things.
MSc in Electronic & Information Engineering (Multimedia Signal Processing and Communications)	Complete SEVEN taught subjects and a 9-credit dissertation. A minimum of FIVE taught subjects shall come from the core subject list specified for the specialism of Multimedia Signal Processing and Communications and the dissertation topic shall be pertinent to the specialism.	Complete TEN taught subjects. A minimum of SEVEN subjects shall come from the core subject list specified for the specialism of Multimedia Signal Processing and Communications.
MSc in Mechanical Engineering (Aerospace Engineering) [8]	Complete SEVEN taught subjects, including THREE compulsory and at least ONE core subject specified for the specialism of Aerospace Engineering, and a 9-credit dissertation and the dissertation topic shall be pertinent to the specialism.	Complete TEN taught subjects, including THREE compulsory and at least THREE core subjects specified for the specialism of Aerospace Engineering.
MSc in Mechanical Engineering (Air/Noise Pollution Management)	Complete SEVEN taught subjects and a 9-credit dissertation. A minimum of FOUR taught subjects shall come from the core subject list specified for the specialism of Air/Noise Pollution Management and the dissertation topic shall be pertinent to the specialism.	Complete TEN taught subjects. A minimum of SIX subjects shall come from the core subject list specified for the specialism of Air/Noise Pollution Management.
MSc in Mechanical Engineering (Product Development and Analysis)	Complete SEVEN taught subjects and a 9-credit dissertation. A minimum of FOUR taught subjects shall come from the core subject list specified for the specialism of Product Development and Analysis and the dissertation topic shall be pertinent to the specialism.	Complete TEN taught subjects. A minimum of SIX subjects shall come from the core subject list specified for the specialism of Product Development and Analysis.

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[8] Retitled from the specialism of *'Aeronautical Engineering'* offered to students admitted in 2021-22 and before, this specialism is applicable for 2022-23 intake and beyond.

PgD Exit Awards	
▪ PgD in Aviation Engineering ▪ PgD in Electrical Engineering ▪ PgD in Electronic & Information Engineering ▪ PgD in Mechanical Engineering	Complete SIX taught subjects. For an award in a designated area, a minimum of FOUR taught subjects shall be core subjects specified for the relevant area.
PgD in Aviation Engineering (Aeronautical Engineering)	Complete SIX taught subjects. A minimum of FOUR subjects shall come from the core subject list specified for the specialism of Aeronautical Engineering.
PgD in Aviation Engineering (Aviation Operations and Management)	Complete SIX taught subjects. A minimum of FOUR subjects shall come from the core subject list specified for the specialism of Aviation Operations and Management.
PgD in Electrical Engineering (Electric Vehicles and Power Electronics) [9]	Complete SIX taught subjects. A minimum of FOUR subjects shall come from the core subject list specified for the specialism of Electric Vehicles and Power Electronics.
PgD in Electrical Engineering (Electrical Power Systems)	Complete SIX taught subjects. A minimum of FOUR subjects shall come from the core subject list specified for the specialism of Electrical Power Systems.
PgD in Electrical Engineering (Railway Systems)	Complete SIX taught subjects. A minimum of FOUR subjects shall come from the core subject list specified for the specialism of Railway Systems.
PgD in Electronic & Information Engineering (Internet of Things)	Complete SIX taught subjects. A minimum of FIVE subjects shall come from the core subject list specified for the specialism of Internet of Things.
PgD in Electronic & Information Engineering (Multimedia Signal Processing and Communications)	Complete SIX taught subjects. A minimum of FIVE subjects shall come from the core subject list specified for the specialism of Multimedia Signal Processing and Communications.
PgD in Mechanical Engineering (Aerospace Engineering) [10]	Complete SIX taught subjects, including THREE compulsory and at least ONE core subject specified for the specialism of Aerospace Engineering.
PgD in Mechanical Engineering (Air/Noise Pollution Management)	Complete SIX taught subjects. A minimum of FOUR subjects shall come from the core subject list specified for the specialism of Air/Noise Pollution Management.
PgD in Mechanical Engineering (Product Development and Analysis)	Complete SIX taught subjects. A minimum of FOUR subjects shall come from the core subject list specified for the specialism of Product Development and Analysis.

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[9] Retitled from the specialism of *'Power Electronics and Drives'* offered to students admitted in 2021-22 and before, this specialism is applicable for 2022-23 intake and beyond.

[10] Retitled from the specialism of *'Aeronautical Engineering'* offered to students admitted in 2021-22 and before, this specialism is applicable for 2022-23 intake and beyond.

SUBJECT DESCRIPTION FORMS

Subjects offered by the

Department of Aeronautical and Aviation Engineering

Subjects Code	**Subject Title**
AAE5001	Guidance, Navigation and Advanced Avionics System
AAE5002	Human Factors, Accident Prevention and Aircraft Maintenance
AAE5101	Next Generation Air Traffic Control and Air Traffic Flow Management
AAE5102	Operations Research, Resource Planning and Engineering Management in Aviation
AAE5103	Artificial Intelligence in Aviation Industry
AAE5104	Aviation Technical Services and Aircraft Leasing Management
AAE5105	Fleet Management and Aviation Sustainability
AAE5106	Flight Standards and Airworthiness
AAE5201	Aerodynamics and Computational Fluid Dynamics
AAE5202	Advanced Aircraft Structures and Materials
AAE5203	Aircraft Design and Certification
AAE5204	Autonomous Flight - Mechanics and Control
AAE5205	Aircraft Engine Systems and Combustion

Subject Description Form

Subject Code	AAE5001
Subject Title	Guidance, Navigation and Advanced Avionics System
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To provide students with knowledge of guidance theory, navigation systems and advanced avionics systems including communications, electronics and electrical aspects of avionics.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. develop an understanding of basic concepts in guidance, navigation and advanced avionics systems; b. apply the guidance theory to design advanced guidance system; c. understand the working principle of the state-of-the-art navigation systems used in aviation and aeronautical systems; and d. apply their knowledge, skills and hands-on experience to design, develop, manufacture, and analyse new products with advanced avionics systems for desired needs.
Subject Synopsis/ Indicative Syllabus	**Guidance**: Guidance mission and performance; Guidance laws (LOS and PN guidance laws); Advanced guidance system design; Optimal guidance. **Navigation**: Inertial navigation (coordinate systems and transformation, attitude estimation and Euler angles, strapdown navigation system); Satellite navigation (GNSS and its augmentation systems (SBAS, ABAS, GBAS)); Terrestrial navigation (NDB, VOR, DVOR, DME, ILS & GP, radar altimeters & AID); Concept and implementation of PBN (LNAV & VNAV, LPV, RNP). **Advanced avionics system**: Airborne communications systems (VHF & HF transceivers, VDL modes; NAVCOM; EPIRB); Fly-by-wire flight control (FBW flight control features, safety and integrity, redundancy and failure survival, digital implementation and problems, flight control software functions); Aircraft integrated systems (Integrated system of substantially all aircraft attitude and flight path command and control parameters and mode annunciation for the flight director and automatic pilot systems, real time software and advanced distributed architectures).

Teaching/Learning Methodology	The teaching and learning methods include lectures and tutorials. Lectures are aimed at providing students with an integrated knowledge required for understanding fundamental concepts in guidance, navigation and advanced avionics systems. Theories and examples will be presented to cover the syllabus. Tutorials are aimed at enhancing the analytical skills of the students. Examples will be provided to teach students the skills of designing advanced guidance laws and avionics systems. Students will be able to solve real-life problems using the knowledge they acquired in the class.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lecture	√	√	√	√
Tutorial	√	√	√	√

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	30%	√	√	√	√
2. Test	20%	√	√	√	√
3. Final examination	50%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.5 × Continuous Assessment + 0.5 × Final Examination

The continuous assessment consists of homework and test, which 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.

The final examination is used to assess the knowledge acquired by the students for understanding and analysing 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	35 Hrs.
	▪ Tutorial	4 Hrs.
	Other student study effort:	
	▪ Self-learning	45 Hrs.
	▪ Homework	21 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	1. Kabamba P.T. and Girard A.R., Fundamentals of Aerospace Navigation and Guidance, Cambridge Aerospace Series, 2014. 2. Nebylov A.V. and Watson J., Aerospace Navigation Systems. John Wiley & Sons, 2016. 3. Collinson R.P.G., Introduction to Avionics Systems, Springer, latest edition. 4. Tooley M, and Wyatt, Aircraft Electrical and Electronic Systems: Principles, Maintenance and Operation, Elsevier Ltd, latest edition.	

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Subject Description Form

Subject Code	AAE5002
Subject Title	Human Factors, Accident Prevention and Aircraft Maintenance
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject will provide students with 1. the essential concepts, ideas of human factors and accident prevention approaches in pilot training, ATC and aircraft maintenance industries; and 2. the neuroscience and research methodology in assessing human performance and errors.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. relate human cognitive and physical capabilities and limitations to the design of human-machine systems in aviation; b. apply sound methods to identify and analyse sources of human errors for aviation accident prevention; c. design solutions to reduce human errors with consideration for human, hardware, organization, and environmental factors; and d. design human factor experiments and conduct overall human-system design evaluation via neuroscience and research methodology.
Subject Synopsis/ Indicative Syllabus	**Human factors basics:** Human error and threat management**;** Situational awareness, fatigue and stress; Non-technical skills; Crew resource management. **Research methods:** Statistical analysis; Failure modes and effect analysis; Root cause analysis; Error-case removal programme; Cause-and-effect diagram; Fault tree analysis; Subjective Scales; NASA task load index; Subjective workload assessment technique; Cooper-harper rating scale; Situational awareness global assessment technique. **Accident analysis and prevention:** Accident prevention management; Safety assessment, hazard identification and resolution; Integration of system safety and human performance in ATC, pilot and crew; Dirty dozen; **Human factors in aircraft maintenance and inspection:** Maintenance resource management; Line operations safety assessment; Maintenance error and decision aid.

Teaching/Learning Methodology

Teaching is conducted through class lectures and case study. The basic knowledge, research methodology and theoretical models will be introduced. The understanding of how to address and identify the human factors problem and formulate the resolution will be emphasized. Research methodology, case study and analytics skills are taught in class as well as the related real-life scenarios to enhance the teaching and learning abilities.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lecture	√	√	√	√
Case Study		√	√	√

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. Assignment	30%	√	√		
2. Case study	30%			√	√
3. Final examination	40%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.6 × Continuous Assessment + 0.4 × Final Examination

The continuous assessment (60%) is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus via assignment and case study. The final examination (40%) will also be considered to assess the students learning outcome.

Student Study Effort Expected

Class contact:	
▪ Lecture/Case Study	39 Hrs.
Other student study effort:	
▪ Self-learning/preparation	36 Hrs.
▪ Literature study/case study/reading	36 Hrs.
Total student study effort	111 Hrs.

Reading List and References	1. Campbell, R. D., & Bagshaw, M. (2008). Human performance and limitations in aviation. John Wiley & Sons. 2. De Florio, F. (2016). Airworthiness: An introduction to aircraft certification and operations. Butterworth-Heinemann. 3. Dhillon, B. S. (2009). Human reliability, error, and human factors in engineering maintenance. 4. Dekker, S. (2004). Ten questions about human error: A new view of human factors and system safety. CRC Press. 5. Kinnison, H. A. (2013). Aviation maintenance management. McGraw-Hill Education. 6. Rodrigues, C. C., & Cusick, S. K. (2012). Commercial aviation safety. McGraw-Hill Education. 7. Stolzer, A. J., Halford, M. C. D., & Goglia, M. J. J. (2015). Safety management systems in aviation. Ashgate Publishing, Ltd. 8. Tsang, P. S., & Vidulich, M. A. (Eds.). (2002). Principles and practice of aviation psychology. CRC Press. 9. Wiegmann, D. A., & Shappell, S. A. (2017). A human error approach to aviation accident analysis: The human factors analysis and classification system. Routledge. 10. Wise, J. A., Hopkin, V. D., & Garland, D. J. (Eds.). (2016). Handbook of aviation human factors. CRC Press.

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Subject Description Form

Subject Code	AAE5101
Subject Title	Next Generation Air Traffic Control and Air Traffic Flow Management
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject will provide students with 1. broad understanding of airport, air traffic control and air traffic flow management; 2. the latest development of the Next Generation Air Transportation System (NextGen) and Asia-pacific airport collaborative decision-making (A-CDM); and 3. the essential knowledge in managing air and surface traffic.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. apply techniques to optimise the airport and air traffic capacity; b. understand and establish a review on the effectiveness of an air traffic management system; c. streamline airport, ground and air traffic operations to gain overall turn-a-round efficiency; and d. identify the airline-airport conflict resolution approach and risk management.
Subject Synopsis/ Indicative Syllabus	**Air traffic control and managemen**t: Air traffic management, congestion control and capacity management, aviation system; Air traffic control and air traffic control aids; Seamless air traffic management and air navigation service; Extreme weather operations; airport emergencies. **Runway scheduling and capacity analysis:** Runway capacity analysis; Airport airside and landside structure and layout; First-come first-served heuristics; Runway design and configuration. **Advancement in airspace technology and performance indicators:** Measurement of system performance; Key issue in airport collaborative decision making in Asia pacific; Critical elements of the Next Generation Air Transportation System (NextGen); Performance and concerns of the NextGen; Airspace Technology Demonstration (ATD): ATD-2/ATD-3.

Teaching/Learning Methodology

Teaching is conducted through lectures and case study. Both the basic knowledge and theoretical models are going to be introduced. The understanding of how to address problems by using scientific tools is emphasised. Normally, examples of problem-solving techniques are taught in class and related scenarios are provided to students to enhance their application abilities.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lecture	√	√	√	√
Case Study	√	√	√	

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. Assignment	30%	√	√		√
2. Case study	40%	√	√	√	√
3. Individual essay	30%		√	√	
Total	100%				

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

Overall Assessment:

1.0 × Continuous Assessment

The continuous assessment (100%) is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus via reading assignment and case study. Individual essay is used to assess the students' capacities of self-study and problem-solving and understanding on a specific topic to fulfil the requirements of working in the aviation industry.

Student Study Effort Expected

Class contact:	
▪ Lecture/Case Study	39 Hrs.
Other student study effort:	
▪ Literature review/case study/reading	36 Hrs.
▪ Self-learning/preparation	36 Hrs.
Total student study effort	111 Hrs.

Reading List and References	1. Ashford, N. J., Stanton, H. M., Moore, C. A., Pierre Coutu, A. A. E., & Beasley, J. R. (2013). Airport operations. McGraw-Hill Education. 2. Cusick, S. K., Cortes, A. I., & Rodrigues, C. C. (2017). Commercial aviation safety. McGraw-Hill Education. 3. De Neufville, R., Odoni, A. R., Belobaba, P. P., & Reynolds, T. G. (2013). Airport systems: Planning, design, and management. McGraw-Hill Education. 4. Horonjeff, R., McKelvey, F. X., Sproule, W. J., & Young, S. B. (2010). Planning and design of airports. McGraw-Hill Education. 5. Wells, A. T. (2007). Air transportation: A management perspective: Ashgate Publishing, Ltd. 6. Young, S. B., & Wells, A. T. (2011). Airport planning and management. McGraw-Hill Education.

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Subject Description Form

Subject Code	AAE5102
Subject Title	Operations Research, Resource Planning and Engineering Management in Aviation
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject will provide students with 1. the main concepts, ideas and techniques of advanced operations research (OR), optimisation methods, resource planning and engineering management in the aviation industry; 2. the essential principles, research methodology, data interpretation and data analysis with case examples in airline and airport operations; 3. outlook of OR development and its importance in aviation operations.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. design and develop mathematical modelling and optimisation algorithms and adopt OR tools in solving engineering problems in airline and airport operations; b. illustrate, interpret and analyse the numerical results; c. evaluate the resource planning and financial requirement in airlines and airport operations critically; and d. determine the optimal solution and alternatives for aviation engineering problems.
Subject Synopsis/ Indicative Syllabus	**Operations research,** Convex optimisation and optimisation methods in aviation engineering problems; Fundamental theorem of linear programming; Relations to convexity; Simplex method; Duality. **Resource planning and engineering management**: Transportation and network flow problems; Minimum cost flow; Maximal flow; Branch-and-bound algorithms; Heuristics; Critical path method and resource planning in aviation project management. **Aviation Engineering applications:** Airline scheduling planning and optimisation; Gate assignment planning and optimisation; Runway scheduling planning and optimisation; Air logistics transportation problem and optimisation; Flight route optimization.

Teaching/Learning Methodology

Teaching is conducted through lectures and assignment. The basic knowledge, research methodology and theoretical models will be introduced. The understanding of how to address and formulate problems by using mathematical programming, OR and optimisation algorithms techniques with modern programming language is emphasised. Research methodology, data analytics skills, algorithm design skills and programme methods are taught in class as well as the related real-life scenarios.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lecture	√	√	√	√

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. Assignment	20%	√	√	√	√
2. Mid-term examination	30%	√	√	√	√
3. Final examination	50%	√	√	√	√
Total	100%				

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

Overall Assessment:

$$0.5 \times \text{Continuous Assessment} + 0.5 \times \text{Final Examination}$$

The continuous assessment (50%) is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus via assignment and mid-term examination. The final examination (50%) will also be considered to assess the students' learning outcome.

Student Study Effort Expected

Class contact:	
▪ Lecture	39 Hrs.
Other student study effort:	
▪ Self-learning/preparation	36 Hrs.
▪ Assignment	36 Hrs.
Total student study effort	111 Hrs.

Reading List and References	1. Ashford, N. J., Stanton, H. M., Moore, C. A., Pierre Coutu, A. A. E., & Beasley, J. R. (2013). Airport operations. McGraw-Hill Education. 2. Birge, J. R., & Louveaux, F. (2011). Introduction to stochastic programming. Springer Science & Business Media. 3. Bondy, J. A., & Murty, U. S. R. (1976). Graph theory with applications (Vol. 290). London: Macmillan. 4. Boyd, S., Boyd, S. P., & Vandenberghe, L. (2004). Convex optimization. Cambridge university press. 5. Hillier, F. S. (2012). Introduction to operations research. Tata McGraw-Hill Education. 6. Leon, S. J., Bica, I., & Hohn, T. (1998). Linear algebra with applications (Vol. 6). Upper Saddle River, NJ: Prentice Hall. 7. Michael, L. P. (2018). Scheduling: theory, algorithms, and systems. Springer. 8. Nocedal, J., & Wright, S. (2006). Numerical optimization. Springer Science & Business Media. 9. O'neil, P. V. (2017). Advanced engineering mathematics. Cengage learning.

July 2022

Subject Description Form

Subject Code	AAE5103
Subject Title	Artificial Intelligence in Aviation Industry
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject will provide students with 1. the main concepts, ideas and techniques of advanced artificial intelligence (AI) in the aviation industry; 2. the essential principles, research methodology, data interpretation and data analysis with case examples in airline and airport operations; and 3. outlook of artificial intelligence development and its important in future air traffic and unmanned aircraft system traffic management.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. design and develop AI algorithms or adopt AI tools in solving engineering problems in airline and airport operations; b. illustrate and analysis the knowledge and data pattern generated by the AI-engine; c. master and understand the complex causal relationship and inferences of AI; and d. apply AI techniques for solving aviation engineering problems.
Subject Synopsis/ Indicative Syllabus	**Fundamental of machine learning, data mining, data analytics and artificial intelligence**: Basic soft computing methods, data mining and artificial intelligence algorithms in airline and airport applications; AI and machine learning algorithm design; Data analytics, managerial implications and actionable insights with aviation case studies analysis. **Supervised learning:** Least squares and nearest neighbours; statistical decision theory; Linear methods for regression; Linear discriminant analysis; Classifications; Logistic regression; Separating hyperplanes; Support-vector machine. **Unsupervised learning:** Clustering; Association dimensionality reduction; K-means clustering; KNN; Neural network; Principle component analysis. **Model inference and averaging:** Bootstrap and maximum likelihood methods; Bayesian method; Relationship between the bootstrap and Bayesian inference. **Advancement in artificial intelligence:** Semi-supervised learning algorithmic architecture; Generative adversarial network; Self-trained

Naïve Bayes classifier; Reinforcement learning; Q-learning; Model-based value estimation; Deep learning.

Data-driven optimisation and time-series modelling: Air traffic demand forecasting; Flight delay prediction; Operations management and dynamic pricing.

Teaching/Learning Methodology

Teaching is conducted through lectures and case study. The basic knowledge, research methodology and theoretical models will be introduced. The understanding of how to address and formulate problems by using mathematical programming, artificial intelligence algorithms, and soft computing techniques with modern programming language is emphasised. Research methodology, data analytics skills, algorithm design skills and programme methods are taught in class as well as the related real-life scenarios using data to enhance their research abilities.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lecture	√	√	√	√
Case Study	√	√	√	√

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. Assignment	30%	√	√		
2. Case study	40%		√	√	√
3. Project report	20%		√	√	√
4. Project presentation	10%		√	√	√
Total	100%				

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

Overall Assessment:

1.0 × Continuous Assessment

The continuous assessment (100%) is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus via reading assignment and case study. Project report is are used to assess the students' capacities of self-study and problem-solving and effective communication skills in English so as to fulfil the requirements of working in the aviation industry.

Student Study Effort Expected	Class contact:	
	▪ Lecture/Case Study	39 Hrs.
	Other student study effort:	
	▪ Literature review/case study/reading	36 Hrs.
	▪ Self-study/preparation	36 Hrs.
	Total student study effort	111 Hrs.
Reading List and References	1. Barber, D. (2012). Bayesian reasoning and machine learning. Cambridge University Press. 2. Boyd, S., Boyd, S. P., & Vandenberghe, L. (2004). Convex optimization. Cambridge university press. 3. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2009). Introduction to algorithms. MIT press. 4. De Neufville, R., & Odoni, A. (2003). Airport systems. planning, design and management. New York: McGraw-Hill. 5. EASA (2020). EASA Artificial Intelligence Roadmap 1.0 published: A human-centric approach to AI in aviation. EASA. 6. Eurocontrol. (2020). FLY AI report – demystifying and accelerating AI in aviation/ATM. Eurocontrol. 7. Guido, S., & Müller, A. (2016). Introduction to machine learning with python (Vol. 282). O'Reilly Media. 8. Marsland, S. (2015). Machine learning: an algorithmic perspective. CRC press. 9. Richert, W. (2013). Building machine learning systems with Python. Packt Publishing Ltd.	

July 2022

Subject Description Form

<table>
<tr><td>Subject Code</td><td>AAE5104</td></tr>
<tr><td>Subject Title</td><td>Aviation Technical Services and Aircraft Leasing Management</td></tr>
<tr><td>Credit Value</td><td>3</td></tr>
<tr><td>Level</td><td>5</td></tr>
<tr><td>Pre-requisite/
Co-requisite/
Exclusion</td><td>Nil</td></tr>
<tr><td>Objectives</td><td>This subject will provide students with
1. the operations and management of aircraft leasing industry; and
2. the advanced knowledge of aviation finance, taxation and insurance.</td></tr>
<tr><td>Intended Learning Outcomes</td><td>Upon completion of the subject, students will be able to:
a. design technical services planning in MRO, inventory pooling and logistics arrangement;
b. understand the roles and functions of various airlines business in aircraft leasing and aviation financing management;
c. evaluate the cost-and-benefit in aircraft trading modes and aircraft leasing approaches; and
d. perform risk assessment and management related to aircraft leasing.</td></tr>
<tr><td>Subject Synopsis/ Indicative Syllabus</td><td>Aviation technical services: Technical services in maintenance, repair and overhaul; Inventory pooling, repair management and ad-hoc support aircraft remarketing; Aircraft technical services; Aircraft delivery, acceptance and transition management.
aircraft leasing management: Aircraft specification review and evaluation; Auditing of aircraft and their records; Aircraft lease management; Operating lease structuring; Sales and leasebacks; Transaction risk assessment; Aircraft acquisition.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>Teaching is conducted through class lectures and tutorials, which are aimed at providing students with the understanding of how to address aviation technical services and aircraft leasing problem and resolve the problem by risk assessment and operational management methods.
<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="4">Outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td></tr>
<tr><td>Lecture</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Tutorials</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
</table>
</td></tr>
</table>

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. Assignment	40%	√	√	√	√
2. Final examination	60%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.4 × Continuous Assessment + 0.6 × Final Examination

The continuous assessment (40%) is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus via assignment. The final examination (60%) will also be considered to assess the students learning outcome.

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	13 Hrs.
Other student study effort:	
▪ Self-study	66 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Anyafo, A. (2018). Buy or Lease Decision in Fixed Assets Acquisition in the Nigerian Civil Aviation Industry. Journal of Administration, 1(1).
2. Coulter, J. M., Redpath, I. J., & Vogel, T. J. (2018). Leasing Agreements in the Airline Industry: A Case Study Examining the Impact of Asu 2016-02. Journal of Business and Educational Leadership, 7(1), 114-123.
3. Donald H. Bunker. International Aircraft Financing (Volume 1 – General Principles and Volume 2 – Specific Documents).
4. Gillen, D., & Morrison, W. G. (2015). Aviation security: costing, pricing, finance and performance. Journal of Air Transport Management, 48, 1-12.
5. Keaveny, C., & Murray, S. (2013). Aviation finance and leasing. Offshore Investment, 239, 12-14.
6. Mann, E. D. (2009). Aviation finance: An overview. Journal of Structured Finance, 15(1), 109.

	7. Murphy, R., & Desai, N. (Eds.). (2011). Aircraft financing. Euromoney Books. 8. Morrell, P. S. (2013). Airline finance. Ashgate Publishing, Ltd. 9. Vasigh, B., Fleming, K., & Humphreys, B. (2014). Foundations of airline finance: Methodology and practice. Routledge. 10. Vitaly S. Guzhva, Sunder Raghavan, Damon J. D'Agostino (2018). Aircraft Leasing and Financing: Tools for Success in International Aircraft Acquisition and Management. Elsevier Science. 11. Wensveen, J. (2018). Air transportation: A management perspective. Routledge.

July 2022

Subject Description Form

Subject Code	AAE5105
Subject Title	Fleet Management and Aviation Sustainability
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject will provide students with 1. advanced airline fleet management, crew pairing and fatigue management; and 2. the advanced engines types, aviation fuel, emission mitigation strategy, sustainable aviation system in airline aspect.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. design and develop mathematical modelling in resolving airline fleet, crew pairing and aircraft routing problem; b. design and develop proper airline resource planning in profitable manner; c. evaluate the impact of aviation emission and its mitigation strategy; and d. determine airline solution contributing to the societal, economic and global environment factors.
Subject Synopsis/ Indicative Syllabus	**Operations management, fleet and crew management and flight route management**: Airline fleet management, crew management, aircraft routing and sustainability; Aircraft model configuration and serviceability; Air route planning and schedule recovery; Aircraft life cycle and associated legislation; Risk management in airline operation; Human resource management: crew pairing and rostering management. **Sustainable aviation:** Carbon budgets for aviation; Environmental technology and the future of flight; Aviation and the EU emissions trading system; Airport noise control and modelling; Environmental impact of aviation emission; Sustainable aviation system. **Airline strategic planning:** Coalition, competition, integration and substitution; Pricing strategies; Business models of full-service carriers and low-cost carriers; Competition of airline and high-speed rail; Changes of airline business in post-pandemic situation.

Teaching/Learning Methodology

Teaching is conducted through lectures and assignments. The basic knowledge, research methodology and theoretical models will be introduced.

The understanding of how to address and formulate problems by using mathematical programming, OR and optimisation algorithms techniques with modern programming language is emphasised. Research methodology, data analytics skills, algorithm design skills and programme methods are taught in class as well as the related real-life scenarios using data to enhance their research abilities.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lecture	√	√	√	√

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. Assignment	20%	√	√		
2. Mid-term examination	30%		√	√	√
3. Final examination	50%		√	√	√
Total	100%				

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

Overall Assessment:

0.5 × Continuous Assessment + 0.5 × Final Examination

The continuous assessment (50%) is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus via assignment and mid-term examination. The final examination (50%) will also be considered to assess the students learning outcome.

Student Study Effort Expected

Class contact:	
▪ Lecture	39 Hrs.
Other student study effort:	
▪ Self-study / preparation	66 Hrs.
Total student study effort	105 Hrs.

Reading List and References	1. Abdelghany, A., & Abdelghany, K. (2016). Modeling applications in the airline industry. Routledge. 2. Bazargan, M. (2016). Airline operations and scheduling. Routledge. 3. Bridger, R. (2013). Plane truth: Aviation’s real impact on people and the environment. 4. Budd, L., Griggs, S., & Howarth, D. (2013). Sustainable aviation futures. Emerald Group Publishing. 5. Clark, P. (2017). Buying the big jets: fleet planning for airlines. Taylor & Francis. 6. Walker, T., & Bergantino, A. S. (2020). Sustainable Aviation. Palgrave Macmillan. 7. Wu, C.-L. (2016). Airline operations and delay management: insights from airline economics, networks and strategic schedule planning: Routledge.

July 2022

Subject Description Form

Subject Code	AAE5106
Subject Title	Flight Standards and Airworthiness
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject will provide students with 1. the advanced knowledge in the aircraft airworthiness, flight standards, airworthiness and certification; 2. profile and qualification tests for onboard aircraft system and equipment; and 3. legal requirement of airworthiness and the importance of aircraft performance in safe operational aspects.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. conduct documentation and review of legation requirement for flight standards and airworthiness certifications; b. understand and review the aviation safety, quality, maintenance approval and procedures and procedures of certification continuality; and c. implement and conform the relevant regulations in practices.
Subject Synopsis/ Indicative Syllabus	**Airworthiness –** Airworthiness requirement, regulations and standards; Airworthiness directive (AD); Aircraft registration; Type certification; Production of products, parts and appliances; Certificates of airworthiness and permits to fly; Air operation regulation; Renewal of certificate of airworthiness (C of A) issue; Air operator’s certification; Certification arrangements with other authorities, human factors and safety management. **Flight standards –** Requirement and criteria for the approval of type rating training; Pilot licences and associated ratings; Low visibility operations; Air operator’s certificates requirements; Avoidance of fatigue in aircrews. **Licensing and certification –** Aeromedical matters; Air operator’s certificate; Pilot licensing; Aircraft maintenance licensing; Conversion of license among contracting states. **Quality control and assurance –** Joint maintenance management (JMM); Technical arrangement (TA); Maintenance management exposition (MME); airworthiness control procedures; Maintenance support arrangement and contracted-out maintenance.

Accident prevention and analysis – Safety management system (SMS); Accident analysis; Human factors.

Air operator's certificate (AOC) – CAD 360, AOC requirements document; Operation of aircraft, arrangement for maintenance support.

Flight operations – The air operators certificate, organisation and facilities, operations manual, training and testing; Emergency and survival training, cabin safety, safety management.

International and Hong Kong civil aviation – ICAO history, annexes, safety oversight concept, safety oversight system; HK legislation system, basic law of HKSAR, civil aviation ordinance, air navigation (Hong Kong) order; Safe operating environment.

Teaching/Learning Methodology

Teaching is conducted through class lectures and case studies of airworthiness and aircraft performance to the students. The industrial experts will provide several cases and their experiences throughout the teaching and learning in this course.

Teaching/Learning Methodology	Outcomes		
	a	b	c
1. Lecture	✓	✓	✓
2. Case study	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Assignment / Case study	30%	✓	✓	✓
2. Group project	20%	✓	✓	✓
3. Final examination	50%	✓	✓	✓
Total	100 %			

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

Overall assessment:

0.50 × End of Subject Examination + 0.50 × Continuous Assessment

The continuous assessment (50%) is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus via several assignments, case study and group project. The final examination assessment (50%) will also be considered to assess the students learning outcome.

Student Study Effort Expected	Class contact:	
	▪ Lecture	30 Hrs.
	▪ Case study	9 Hrs.
	Other student study effort:	
	▪ Self-study / preparation	36 Hrs.
	▪ Assignments / group project	36 Hrs.
	Total student study effort	111 Hrs.
Reading List and References	1. Hong Kong Aviation Requirements. 2. Airport Planning & Management. Edited by Alexander T. Wells, latest Edition, McGraw Hill. 3. Aircraft Safety: Accident Investigations, Analyses & Applications. Edited by Shari Stamford Krause, latest Edition, McGraw Hill.	

November 2022

Subject Description Form

Subject Code	AAE5201
Subject Title	Aerodynamics and Computational Fluid Dynamics
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To provide students with knowledge of aerodynamics and computational fluid dynamics (CFD). 2. To develop students' capability in theoretical and numerical analysis of canonical aerodynamic problems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. acquire fundamental knowledge of aerodynamics and CFD primarily in terms of inviscid flow; b. perform theoretical and numerical analysis of canonical aerodynamic problems; and c. gain basic understanding of state-of-the-art CFD techniques.
Subject Synopsis/ Indicative Syllabus	**Inviscid, incompressible flow**: Laplace equation and elementary solutions; Thin airfoil theory **Inviscid, compressible flow**: Shock and expansion waves; Quasi-one-dimensional flow; Linearized flow; Transonic flow; Hypersonic flow **Basics of numerics**: Finite differences; Difference equations; Stability analysis **Numerical techniques for incompressible flow**: Pressure correction technique **Time-marching techniques for compressible flow**: Lax–Wendroff technique; MacCormack's technique; Stability criterion **Modern CFD techniques**: Upwind schemes; Limiters; Total variation diminishing; Implicit methods

Teaching/Learning Methodology

The teaching and learning methods include lectures and tutorials, which are aimed at providing students with integrated knowledge required for aerodynamics and CFD. Technical/scientific examples and problems will be presented and discussed.

Teaching/Learning Methodology	Outcomes		
	a	b	c
Lecture	√	√	√
Tutorial	√	√	√

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
1. Homework	30%	√	√	√
2. Test	20%	√	√	
3. Final examination	50%	√	√	
Total	100%			

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

Overall Assessment:

0.5 × Continuous Assessment + 0.5 × Final Examination

The continuous assessment consists of homework and test, which 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.

The final examination is used to assess the knowledge acquired by the students for understanding and analysing 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.
▪ Tutorial	6 Hrs.
Other student study effort:	
▪ Self-learning	30 Hrs.
▪ Homework	40 Hrs.
Total student study effort	109 Hrs.

Reading List and References	1. Anderson J. D., Fundamentals of Aerodynamics. McGraw-Hill, 6th edition. 2. Anderson J. D., Computational Fluid Dynamics: The Basics with Applications. McGraw-Hill, 1st edition. 3. Bertin J. J. and Cummings R. M., Aerodynamics for Engineers. Pearson, 6th edition.

July 2022

Subject Description Form

Subject Code	AAE5202
Subject Title	Advanced Aircraft Structures and Materials
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Exclusion: ME577 Advanced Aircraft Structures
Objectives	1. To provide students an overview of the structures in modern aircraft. 2. To provide students with tools that are needed to formulate and solve problems concerning compression/tension, bending, torsion and buckling in aircraft structures. 3. To provide students with an overview of the advanced materials that are used for aircraft vehicles. 4. To provide students with an overview of the non-destructive testing techniques that are used to ensure the safe operation of aircraft vehicles.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. perform stress analysis for typical aircraft structural components using both analytical methods and computational tools; b. obtain in-depth understanding of the mechanical behavior of the materials that are used for aircraft vehicles; c. choose the non-destructive testing methods that best suit certain aerospace structural components; and d. recognize the frontier of research in aircraft structures and materials.
Subject Synopsis/ Indicative Syllabus	**Structures**: Structural components of aircraft; Airframe load; Bending, shear and torsion of thin-wall beams; Stress analysis of aircraft structural components. **Materials**: Typical aircraft materials and characteristics; Characteristics of composite materials; Lamina and laminate theories; Functional composites. **Non-destructive testing (NDT):** Standard NDT techniques; Ultrasonic testing; Piezoelectric transducers; Guided wave testing; Phased array scanning; Structural health monitoring. **Finite element analysis:** 1D elements; 2D elements; 3D elements; High-order elements; Static analysis; Dynamic analysis.

Teaching/Learning Methodology

Lectures is used to deliver the fundamental knowledge and research elements in relation to aircraft structures and materials.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lecture	√	√	√	√

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. Project report	20%	√	√		
2. Assignment	40%		√	√	√
3. Final examination	40%	√	√	√	√
Total	100%				

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

Overall Assessment:

$$0.6 \times \text{Continuous Assessment} + 0.4 \times \text{Final Examination}$$

The project report is aimed at enhancing the students' comprehension and understanding of aircraft structures and the state-of-the-art technologies in relevant area. The assignment is used to assess the students' understanding of the stress analysis methods and their capabilities of mathematical problem formulation and programme application for typical aircraft structures. The final examination will be conducted to evaluate the students' performance in all the topics of the syllabus with a limited examination time.

Student Study Effort Expected	Class contact:	
	▪ Lecture	39 Hrs.
	Other student study effort:	
	▪ Self-learning	45 Hrs.
	▪ Project report preparation	22 Hrs.
	Total student study effort	106 Hrs.

Reading List and References	1. Sun C. T., Mechanics of Aircraft Structures, John Wiley & Sons, latest edition. 2. Megson, T. H. G., Aircraft Structures for Engineering Students, Elsevier, latest edition. 3. Gibson, R. F., Principles of Composite Material Mechanics, McGraw-Hill, International Editions, latest edition.

July 2022

Subject Description Form

Subject Code	AAE5203
Subject Title	Aircraft Design and Certification
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Exclusion: ME578 Aircraft Design
Objectives	1. To provide students with the key knowledge relevant to the process and principle of aircraft design, and the capacity to formulate the design requirements for an aircraft using modern engineering tools. 2. To provide students with the multi-disciplinary design optimization (MDO) knowledge to conduct aircraft system optimization from aerodynamics, propulsion, structure, stability, and performance perspectives. 3. To provide students with the knowledge about aircraft certification process and requirement.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. understand fundamental concepts and constraints during an aircraft design process; b. evaluate common aircraft configurations; c. design and layout aircraft major components; d. design and sizing aircraft that meets aerodynamic requirements; e. optimize the aircraft design process by multi-disciplinary design optimization principles; and f. understand airworthiness and aircraft certification process during an aircraft design.
Subject Synopsis/ Indicative Syllabus	**Introduction to Aircraft Design*:*** Design process and basic aircraft requirements; Evolution of aircraft design and its performance: a brief history; Overview of aircraft design iteration cycle **Modern Aircraft Configuration:** Advantages and drawbacks of conventional and modern configurations; Considerations for special aircraft; Primary considerations for the fuselage, wing, and tail design **Aerodynamic Consideration of Aircraft Design:** Fundamentals of aerodynamic; Friction and pressure drag; Airfoil; Finite wings; Drag and lift; Dependence of lift and drag on the angle of attack; End effects of wingtips; Induced drag **Sizing and Costing:** Internal layout; Structures and weight; Geometry constraints; Sizing equation; Weight fraction method; Weight and balance; Cost analysis; Elements of life-cycle cost; Cost-estimating methods; Operations and maintenance costs; Cost measures of merit

Main Components Selection and Design: Selection and design of main components such as fuselage, wing, tail and landing gear; Calculation and design of control surfaces such as aileron, elevator and rudder

Multi-disciplinary Design Optimization (MDO): uses optimization methods to solve design problems incorporating a number of disciplines

Aircraft certification and Airworthiness: Airworthiness requirements; Load factor determination; Aircraft safety; Airframe loads; Designing against fatigue; Prediction of aircraft fatigue life

Teaching/Learning Methodology

Lectures are used to deliver the fundamental knowledge in relation to aircraft design. Tutorials and case study are used to illustrate the application of fundamental knowledge to practical situations.

Teaching/Learning Methodology	Outcomes					
	a	b	c	d	e	f
Lecture	√		√	√		√
Tutorial/Case Study	√	√	√	√	√	√

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	f
1. Assignment/Test	20%	√	√		√	√	√
2. Design Project	30%	√	√	√	√	√	√
3. Examination	50%	√	√	√	√	√	√
Total	100%						

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

Overall Assessment:

0.5 × Continuous Assessment + 0.5 × Final Examination

Examination is adopted to assess students on the overall understanding and the ability of applying the concepts. It is supplemented by continuous assessment including assignment, closed-book test and design project. The continuous assessment is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus. Design project is used to assess the students' capacities of self-learning and problem-solving and effective communication skill in English to fulfil the requirements of being aircraft design engineers.

Student Study Effort Expected	Class contact:	
	▪ Lecture	33 Hrs.
	▪ Tutorial/case study	6 Hrs.
	Other student study effort:	
	▪ Course work and design project	42 Hrs.
	▪ Self-study	25 Hrs.
	Total student study effort	106 Hrs.
Reading List and References	1. Raymer D., Aircraft Design: A Conceptual Approach. American Institute of Aeronautics and Astronautics, Inc., 2018. 2. Torenbeek E., Advanced Aircraft Design: Conceptual Design, Technology and Optimization of Subsonic Civil Airplanes, John Wiley & Sons, 2013. 3. Raymer D., Enhancing Aircraft Conceptual Design Using Multidisciplinary Optimization, Swedish Royal Institute of Technology (KTH), 2002.	

July 2022

Subject Description Form

Subject Code	AAE5204
Subject Title	Autonomous Flight - Mechanics and Control
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To provide students with the key knowledge relevant to the flight mechanics, dynamics, and control. 2. To provide students with the capacity to formulate the flight control system by using modern engineering tools and algorithms. 3. To provide students with the knowledge about intelligent planning and control methods to achieve autonomous flight for manned or unmanned aircraft.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. understand fundamental concepts aircraft coordinate systems and forces; b. able to analysis the longitudinal and lateral direction flight mechanics; c. evaluate aircraft flight stability, controllability and handling quality; d. understand classic and modern flight control system; e. understand search-based and sample-based planning methods and trajectory generation methods; and f. extend their knowledge to analyse and develop new modules or algorithms for desired autonomous flight by flight simulation.
Subject Synopsis/ Indicative Syllabus	**Aircraft Six Degrees of Freedom (6-DOF) Equations of Motion:** Aircraft coordinate systems; Kinematic model; Dynamic model; Propulsion system model; Model linearization method **Longitudinal and Lateral Flight Dynamics and Control**: Longitudinal motion and mode approximations; Lateral motion and mode approximations; Handling quality **Classic and Modern Flight Control System**: Classic flight control system; Modern flight control system; State space modelling; Stability, controllability and observability; State feedback design and optimal control **Planning for Autonomous Flight**: Global path planning methods including search-based methods and sample-based methods; Local smooth trajectory generation methods

Autopilot System Integration and Flight Simulation: Open-source flight controller; Flight simulation platform; Programming and hardware interface; Implementation of control and planning algorithms; Introduction to autonomous aerial robotic system

Teaching/Learning Methodology

The teaching and learning methods include lectures, assignment, test, mini project and examination. The tutorials and case study are aimed at providing students with integrated knowledge required for unmanned aircraft systems. Technical/practical examples and problems will be raised and discussed in class/hands on sessions.

Teaching/Learning Methodology	Outcomes					
	a	b	c	d	e	f
Lecture	√	√	√	√	√	√
Tutorial/Case Study	√		√		√	

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	f
1. Assignment/Test	20%	√	√	√	√	√	
2. Mini Project	30%	√	√		√	√	√
3. Examination	50%	√	√	√	√	√	√
Total	100%						

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

Overall Assessment:

$$0.5 \times \text{Continuous Assessment} + 0.5 \times \text{Final Examination}$$

Examination is adopted to assess students on the overall understanding and the ability of applying the concepts. It is supplemented by continuous assessment including assignment, closed-book test and mini-project. The continuous assessment is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus. Mini-project is used to assess the students' capacities of self-learning and problem-solving and effective communication skill in English so as to fulfil the requirements of being aircraft design engineers.

<table>
<tr><td rowspan="7">Student Study Effort Expected</td><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture</td><td>30 Hrs.</td></tr>
<tr><td>▪ Tutorial/case study</td><td>9 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Course work and mini project</td><td>42 Hrs.</td></tr>
<tr><td>▪ Self-study</td><td>25 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>106 Hrs.</td></tr>
<tr><td>Reading List and References</td><td colspan="2">1. Pamadi B.N. Performance, stability, dynamics, and control of airplanes. AIAA, 2015.
2. Stevens B.L., Lewis F.L., Johnson E.N., Aircraft Control and Simulation: Dynamics, Controls Design, and Autonomous Systems, Wiley, 2015.
3. Nonami K., Kendoul F., Suzuki S., Wang W., Nakazawa D., Autonomous flying robots: unmanned aerial vehicles and micro aerial vehicles, Springer, 2010.</td></tr>
</table>

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Subject Description Form

Subject Code	AAE5205
Subject Title	Aircraft Engine Systems and Combustion
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To provide students with fundamental knowledge of advanced aircraft engine systems and combustion sciences and their applications in modern gas-turbine engines.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. obtain state-of-the-art knowledge in the areas of aircraft propulsion systems and combustion sciences; b. apply their knowledge, skills and hand-on experience to the design and analysis of aircraft propulsion and combustion systems; c. extend their knowledge of aeronautical engineering to different situations of engineering context and professional practice in propulsions and combustion systems; and d. recognize the need for and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	**Introduction to propulsion**: Fluid momentum; Reaction force; Rockets; Propellers; Turbojets; Turboprop; Turbofans. **Review of thermodynamics**: Mass, momentum and energy conservation laws; Thermal properties; First Law of Thermodynamics; *p*-*v*-*T* relation; Ideal gas model; Kelvin-Planck and Clausius statements; Reversible and irreversible processes; Carnot cycle; Clausius inequality; Entropy; Isentropic processes; Isentropic efficiencies; Brayton cycle. **Steady-state, one-dimensional (1-D), compressible flow**: Quasi-1-D flow of perfect gas; Isentropic and non-isentropic flow; Stagnation concept; Nozzle equations. **Propulsion basics**: Thrust equations; Thermal and propulsion efficiencies; Fuel consumption rate and specific thrust; Engine performance; Aircraft range. **Cycle analysis and engine performances**: Turbojet, turbofan, turboprop and turbo-shaft engines. **Subsystems** – Inlets; Turbomachinery: basics of compressors and turbines; Combustors; Nozzles. **Modern aircraft engines:** High-by-pass engines. **Introduction to Combustion**: Combustion modes and flame types; Stoichiometric and equivalence fuel-air ratio; Complete, lean & rich combustion; Chemical kinetics on flame propagation; Combustor types; Combustor design and flame-holders.

Teaching/Learning Methodology

The teaching and learning methods include lectures, homework assignment, test, and examination. Technical/practical examples and problems will be raised and discussed in class. Project is designed to evaluate the aircraft engine systems.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lecture	√	√	√	√

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. Project	15%	√	√	√	√
2. Test and homework assignment	35%	√	√	√	√
3. Final examination	50%	√	√	√	
Total	100%				

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

Overall Assessment:

0.5 × Continuous Assessment + 0.5 × Final Examination

The continuous assessment consists of project, homework assignments and tests. 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.

The examination is used to assess the knowledge acquired by the students for understanding and analysing 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	39 Hrs.
Other student study effort:	
▪ Self Study	67 Hrs.
Total student study effort	106 Hrs.

Reading List and References	1. Thermodynamics: An Engineering Approach, 8th Edition, 2014, by Yunus A. Cengel and Michael A. Boles. McGraw-Hill Education 2. Mechanics and Thermodynamics of Propulsion, 2nd Ed., 1992. Philip Hill & Carl Peterson. Pearson/Addison-Wesley Publishing Co. 3. Aircraft Engines and Gas Turbines, 2nd Edition, 1992. Jack Kerrebrock. MIT Press. 4. Elements of Propulsion: Gas Turbine and Rockets, 2nd Edition, 2006. Jack Mattingl., AIAA. 5. Elements of Gas Turbine Propulsion, (1st Edition) 1996. Jack Mattingly. McGraw-Hill. 6. Jet Engines: Fundamentals of Theory, Design and Operation, 2005. Klaus Huenecke. Zenith Press. 7. Aircraft Gas Turbine Engine Technology, 3rd ed., 1997. Irwin E. Treager. McGraw-Hill. 8. Combustion, 5th ed., 2014, Glassman, I. , Yetter, R. A., Glumac, N. G., Academic Press.

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SUBJECT DESCRIPTION FORMS

Subjects offered by the

Department of Computing

Subjects Code	**Subject Title**
COMP5434	Big Date Computing

Subject Description Form

Subject Code	COMP5434
Subject Title	Big Data Computing
Credit Value	3
Level	5
Pre-requisites	Knowledge in database systems, machine learning and data analytics is preferred.
Objectives	The objectives of this subject are to: 1. introduce students the concept and challenge of big data; 2. teach students in applying skills and tools to manage and analyze the big data.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. understand the concept and challenge of big data and why traditional technology is inadequate to analyze the big data; b. understand how to collect, manage, store, and query various form of big data; c. familiar with the classical data analysis and machine learning algorithms; d. familiar with large-scale analytics tools to solve some open big data problems; and e. analyze the impact of big data for real-world business decisions and strategy.
Subject Synopsis/ Indicative Syllabus	1. Introduction to Big Data: Different V's, their challenges and application domains. 2. Cloud Computing Basics: Software as a service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), Desktop as a Service (DaaS), Public, Private and Enterprise Cloud. 3. Big Data Computing: Concepts, Platform, Service, and Tools 4. Large-Scale Programming Abstraction: MapReduce and its open source implementation of Hadoop 5. Large-Scale Data Processing Framework: Apache Spark and its Built-in Modules 6. Large-Scale Database Management: NoSQL and other tools, e.g. MongoDB, Google BigTable, etc. 7. Machine Learning Systems for Big Data: Methods and Tools 8. Big Data Visualization: Data types and dimensions; Visual encoding and perception 9. Big Data Case Studies

Teaching/Learning Methodology

A mix of lectures, discussions and case studies.

Class activities include lectures, tutorials, laboratory works and seminars.

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 or lab works	55	✓	✓	✓	✓	✓
2. Project		✓	✓	✓	✓	✓
3. Quiz		✓	✓	✓	✓	
4. Examination	45	✓	✓	✓		✓
Total	100					

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

Continuous assessments consist of a project, assignments, lab exercises, and quizzes, which are designed to facilitate students to achieve intended learning outcomes. Lab exercise is designed to encourage students to acquire good understanding of the relevant knowledge, practice in order to enrich their hands-on experience with various software tools. The project is designed to enhance students' ability to acquire the understanding and using different knowledge, principles, techniques, tools to solve a real problem through team. Quizzes are to ensure the students understand the concepts.

Examination will evaluate student's understanding and usage of big data technologies.

Student Study Effort Expected

Class contact:	
Class activities (lecture, tutorial, lab, etc.)	39 Hrs.
Other student study effort:	
Assignments, Quizzes, Projects, Examination	65 Hrs.
Total student study effort	**104 Hrs.**

Reading List and References

1. Jared Dean, Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners. Wiley, 2014.
2. Steele, Julie, and Noah Iliinsky, Beautiful visualization: looking at data through the eyes of experts, O'Reilly Media, Inc., 2010.
3. Dean, Jeffrey and Ghemawat, Sanjay, "MapReduce: simplified data processing on large clusters", Communications of the ACM, January 2008.
4. Stonebraker, M., Abadi, D., DeWitt, David J., Madden, S., Paulson, E., Pavlo, A. and Rasin, A., "MapReduce and Parallel DBMS's: Friends or Foes?", Communications of the ACM, January 2010.

5. Dean, Jeffrey and Ghemawat, Sanjay, “MapReduce: A Flexible Data Processing Tool”, Communications of the ACM, January 2010.
6. Lin, Jimmy and Dyer, Chris, Data-Intensive Text Processing with MapReduce, Morgan and Claypool, 2010.
7. K. Shvachko, H. Kuang, S. Radia and R. Chansler, “The Hadoop Distributed File System”, IEEE Symposium on Mass Storage Systems and Technologies, 2010.
8. White, Tom, Hadoop: The definitive guide, O'Reilly Media, Inc., 2012.
9. Cattell, Rick, “Scalable SQL and NoSQL Data Stores”, ACM SIGMOD Record, Volume 39, Issue 4, December 2010.
10. Chodorow, Kristina. MongoDB: the definitive guide: powerful and scalable data storage, O'Reilly Media, Inc., 2013.
11. Silberschatz, Abraham, Henry F. Korth, and Shashank Sudarshan, Database System Concepts, 7th Edition, 2019.
12. Page, Lawrence and Brin, Sergey and Motwani, Rajeev and Winograd, Terry, “The PageRank Citation Ranking: Bringing Order to the Web”, Technical Report, Stanford InfoLab, 1999.
13. Wu, X.D., Kumar, V., Quinlan, J. Ross, Ghosh, J., Yang, Q. et al., “Top 10 Algorithms in Data Mining, Knowledge and Information Systems”, Journal of Knowledge and Information Systems, Volume 14, Issue 1, page 1-37, 2007.
14. Leskovec, Rajaraman, Ullman, Mining of Massive Datasets, 2nd Edition, Cambridge University Press, 2014.
15. Tan, Pang-Ning, Michael Steinbach, and Vipin Kumar, Introduction to data mining, Pearson Education India, 2016.
16. Hastie, Trevor, Robert Tibshirani, and Jerome Friedman, The Elements of Statistical Learning: Data mining, Inference, and Prediction, Springer Science & Business Media, 2009.
17. Bishop, Christopher M., Pattern Recognition and Machine Learning, Springer, 2006.
18. Goodfellow, Ian, et al., Deep Learning: Adaptive Computation and Machine Learning series, MIT press, 2016.
19. McKinney, W., Python for data analysis: Data wrangling with Pandas, NumPy, and IPython, O'Reilly Media, Inc., 2012.
20. Hothorn, Torsten and Everitt, Brian S., A Handbook of Statistical Analyses Using R, CRC Press, 2014.
21. Géron, A., Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems, O'Reilly Media, 2019.
22. Nickoloff, J., Docker in action, Manning Publications Co., 2016.

SUBJECT DESCRIPTION FORMS

Subjects offered by the

Department of Electrical Engineering

Subjects Code	**Subject Title**
EE501	Alternative Energy Technologies
EE502	Modern Protection Methods
EE505	Power System Control and Operation
EE509	High Voltage Engineering
EE510	Electrical Traction Engineering
EE512	Electric Vehicles
EE514	Real Time Computing
EE520	Intelligent Motion Systems
EE521	Industrial Power Electronics
EE522	Optical Fibre Systems
EE524	Open Electricity Market Operation
EE526	Power System Analysis and Dynamics
EE528	System Modelling and Optimal Control
EE530	Electrical Energy Saving Systems
EE533	Railway Power Supply Systems
EE535	Maintenance and Reliability Engineering
EE536	Signalling and Train Control Systems
EE537	Railway Vehicles
EE5381	System Assurance and Safety in Railways
EE539	Aerospace Power Electronics and Actuation Systems
EE545	Modern Generation and Grid Integration Technologies
EE546	Electric Energy Storage and New Energy Sources for Electric Vehicles
EE547	Electric Vehicle Charging Systems
EE548	Advanced Electric Vehicle Technology
EE549	Modern Sensor Technology
EE550	Enterprise Risk and Asset Management
EE552	High Speed Rail
EE553	Railway Electronic Systems
EE560	Metros in Hong Kong and China
EE570	Design and Analysis of Smart Grids

Subject Description Form

Subject Code	EE501
Subject Title	Alternative Energy Technologies
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To enable students to establish a broad concept on alternative energy techniques in engineering. 2. To provide an in-depth knowledge on selected topics of alternative energy systems in engineering. 3. To enable students to understand typical alternative energy technologies, its associated issues of application and related technical considerations. 4. To enable students to understand the potential of alternative energy and characteristics & performance of various types of alternative energy systems. 5. To enable students to understand various techniques and systems for control and monitoring of alternative energy technologies, as well as the related communication protocol and interfacing requirements.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Describe the operation principle & control strategy of various alternative energy systems and topologies of these systems. b. Identify benefits & impacts of the applications of these alternative energy systems; such as their effects on environment and utility energy efficiencies. c. Describe the operation principle, characteristics and performance of various alternative energy devices/systems. d. Identify different alternative energy technologies for industrial & commercial plants and multi-storey buildings, including giving examples. e. Able to carry out literature search and report the findings in a presentation, when given a technical topic.
Subject Synopsis/ Indicative Syllabus	1. ***Energy resources and types*****:** Renewable and non-renewable energy resources. World potential and trends. Environmental effects. Alternative energy types and present developments. Role and importance of alternative energy. 2. ***Wind and solar energy*****:** Wind characteristics. Extraction characteristics. Windmill aerodynamics. Design and materials of windmills. Wind turbines. Types of wind turbines and connection. Siting and designs. Wind farms. Case study. On-shore and off-shore wind farms. Solar characteristics. Solar cells and solar thermal power. Photovoltaic conversion systems. Case study. Design and monitoring techniques. New developments. 3. ***Wave and tidal energy*****:** Wave and tide characteristics for energy extraction. Tidal schemes. Tidal sites. Single and multiple basin schemes. Case study. Wave energy schemes. Case study. Ocean energy conversion. 4. ***Geothermal energy and fuel cells*****:** Geothermal energy sources and methods. Characteristics. Hot dry rock technology. Case study. Fuel cells types and principles. Biomass energy types and case study. Future potentials. 5. ***Co-generation and combine-cycle plants*****:** New technologies for co-generation and CCGT. Efficiency and environmental benefits. Case study examples. Future development potentials. 6. ***Better utilization of energy resources*****:** Pollution reduction techniques and emission trading mechanisms and practices around the world. Clean coal technologies. Nuclear power. Environmental impacts of better utilization of energy.

Teaching/Learning Methodology

Lectures and tutorials are effective teaching methods:

1. To provide an overview or outline of the subject contents.
2. To introduce new concepts and knowledge to the students.
3. To explain difficult ideas and concepts of the subject.
4. To allow students to feedback on aspects related to their learning.

Mini-project works/Assignments are essential ingredients of this subject:

1. To supplement the lecturing materials.
2. To add real experience for the students.
3. To provide deeper understanding of the subject.
4. To enable students to organise principles and challenge ideas.

Seminars from industrial experts may also be arranged, this will give student up-to-date status of the development in alternative energy area, as well as market trends.

Teaching/Learning Methodology	Outcomes				
	a	b	c	d	e
Lectures	√	√	√		
Tutorials	√	√	√		
Mini-project/Assignments/Presentations				√	√

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
1. Class tests	18%	√	√	√		
2. Mini-project/Assignments/ Presentations	18%				√	√
3. Examination	64%	√	√	√	√	
Total	100%					

The understanding on theoretical principle and practical considerations, analytical skills and problem solving technique will be evaluated. Examination, class tests, assignments, presentations and mini-project report 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.
▪ Seminar/Case studies	6 Hrs.
Other student study effort:	
▪ Mini-project/Assignments	22 Hrs.
▪ Self-study	44 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Reference books:

1. *Wind power in power systems. Wiley, Thomas Ackerman*
2. Andy McCrea, Renewable Energy, Crowood Press 2013
3. L.L. Freris, Wind Energy Conversion Systems, Prentice Hall.
4. Vaughn Nelson Kenneth Starcher, Introduction to Renewable Energy, CRC Press, 2016
5. W. Avery and C. Wu, Renewable Energy from the Ocean, A Guide to OTEC, Oxford University Press, 1994
6. CDM Consultancy Stage 1 Report, Study on the Potential Applications of Renewable Energy in Hong Kong, 2003 (from website of EMSD-EEO of HKSAR Government).
7. R. Messenger, Photovoltaic Systems Engineering, CRC Press, 2004
8. G.N. Tiwari, Solar Energy: Fundamental, Design, Modelling and Applications, CRC Press 2002
9. Biofuels for Transport: An International Perspective, International Energy Agency, 2004
10. William E Glassley, Geothermal Energy: Renewable Energy and the Environment, CRC Press, 2010
11. M. Stiebler, Wind Energy Systems for Electric Power Generation, Springer 2008
12. J. Cruz, Ocean Wave Energy: Current Status and Future Perspectives, Springer-Verlag 2008

Subject Description Form

Subject Code	EE502
Subject Title	Modern Protection Methods
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Student should have some prior knowledge in Power Transmission and Distribution
Objectives	1. To introduce the concept of modern power system protection to students. 2. To integrate theory and practical knowledge of power system protection. 3. To understand the design philosophy and working principle of power system protection. 4. To master the analytical techniques. 5. To apply protective relaying in power systems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Master the concept and philosophy on power system protection. b. Apply and adapt applications of mathematics, engineering skills in the analysis, comparison, interpretation of various protection schemes in power systems. c. Integrate and justify techniques to be used in the planning and operation of power system protection. d. Solve technical problems for power system protection. e. Present technical results in the form of a technical report.
Subject Synopsis/ Indicative Syllabus	1. ***Overview of protection system and its development*****:** General considerations. Components of protection. Structure of protective relays. Unit protection and non-unit protection. Trend of protection development. 2. ***Fault and transient in power systems*****:** Fault transient behaviour in power systems. Computer simulations of the transient behaviour in power systems. 3. ***Current and voltage transducers*****:** Sources of errors. Requirements of transducers for measurement and protection. Their features and characteristics under steady state and transient conditions. 4. ***Protection systems for distribution networks*****:** Protection criteria for distribution systems. Features of directional and non-directional protection schemes for distribution systems. 5. ***Protection systems for transmission networks*****:** Distance protection system and characteristics. Differential line protection. Phase comparison line protection. Use of line carrier and communication for protection systems. 6. ***Busbar, transformer and generator protection systems*****:** High impedance and low impedance differential protection schemes. Protection schemes for busbar, transformer, and generator. 7. ***Digital protection relaying technique*****:** Features of digital protection relay. Digital relay architecture. Digital relaying algorithms. Adaptive and intelligent relays. Recent development.

Teaching/Learning Methodology

Lectures and tutorials are the primary means of conveying the basic concepts and theories. Knowledge on system analysis, design and practical applications are given through case studies, in which students are expected to integrate and justify modern techniques to be used in the planning and operation of power system protection with critical and analytical thinking. Mini-projects and experiments are designed to supplement the lecturing materials so that students are encouraged to take extra readings and to look for relevant information.

Teaching/Learning Methodology	Outcomes				
	a	b	c	d	e
Lectures	√	√		√	
Tutorials	√	√		√	
Mini-projects and 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
1. Examination	60%	√	√	√	√	
2. Class Tests	18%	√	√	√	√	
3. Mini-project and report	12%		√	√		√
4. Laboratory and report	10%		√	√		√
Total	100%					

The examination and tests assess the technical competence of students in power system protection analysis methods and methods of protection design, planning, and operation. Mini-projects, experiments and written reports assess those on analytical skills, problem-solving techniques and practical considerations of protection design, as well as technical reporting.

Student Study Effort Expected

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

Reading List and References

Reference books:

1. L. Hewitson, M. Brown and R. Balakrishnan, Practical Power System Protection, Newnes, 2005
2. Network Protection and Automation Guide, Alstom Grid, 2011
3. S.H. Horowitz and A.G. Phadke, Power System Relaying, Wiley, 2014
4. J.L. Blackburn and J. Domin, Protective Relaying: Principles and Applications, CRC Press, 2014
5. A.T. Johns and S.K. Salman, Digital Protection for Power Systems, IEE Power Series, 1995
6. Advancements in Microprocessor Based Protection and Communication – IEEE Tutorial Course, Publication No. 97TP120-0, 1997
7. Power System Protection, Vol. 1, 2, & 3, The Electricity Training Association, 1995

Subject Description Form

Subject Code	EE505
Subject Title	Power System Control and Operation
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To introduce the concept of modern power system control & operation to students; 2. To integrate theory and practical knowledge of power system control & operation; 3. To understand the working principle of power system control and operation; 4. To apply the theory in power system control & operation; and 5. To understand the industrial practice and tools used in power system control and operations
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Ability to analyse power system security control & operation; b. Ability to analyse interconnected power system interchange and economic operation. c. Ability to analyse power system computer control and applications; d. Understand the functionalities and able to use to appropriate level of competence of selected specialty software for power system control and operation purpose; e. To be aware of new technologies development trends and environmental impacts of modern power system control and operation techniques; and f. Ability to write technical reports and present the findings through individual effort as well as team work
Subject Synopsis/ Indicative Syllabus	1. ***Power system operational security and dispatch*****:** Power system security concepts. Contingency analysis. Static and dynamic security. States of operation. Prevention of blackouts. Power system state estimation concepts. Application of state estimation. 2. ***Unit commitment and economic dispatch*****:** Priority lists. Methodologies for large system economic dispatch and unit commitment. Programming methods. 3. ***Frequency and voltage control*****:** Frequency and voltage control concepts. Control loops and analysis. Automatic generation control (AGC) concepts, methodology and implementation. 4. ***Interconnected systems operation*****:** System interconnection merits and problems. Economic interchange and control. Multi-area operation. 5. ***Energy management and real-time control*****:** Energy management systems. Software systems. Computer hardware resources and configurations. Data management. Communication and distributed computing. Load forecasting. Contingency and security assessment. System restoration and emergency control concepts. **Case Study:** 1. Local system control centre arrangement. 2. Case study of past system blackout in overseas countries. 3. AGC and voltage control case studies. 4. Power system developments in HK and China as well as overseas countries. 5. Applications of computer technology in power system control and monitoring

Teaching/Learning Methodology

Lectures and tutorials are the primary means of conveying the basic concepts and theories. Experiences on real world cases and associated analysis are given through case studies, in which the students are expected to power system control and operation problems with real-life constraints and to attain pragmatic solutions with critical and analytical thinking. Guest lecture / industrial seminars will be given to provide hands-on experience and knowledge on this subject from industry practice. Mini-project is designed to supplement the lecturing materials so that the students are encouraged to take extra readings and practice specialty software tools for power system operation and control.

Teaching/Learning Methodology	Outcomes					
	a	b	c	d	e	f
Lectures	√	√	√	√		
Tutorials	√	√	√	√		
Report	√	√	√	√	√	√

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. Exam	60%	√	√	√		√	
2. Class test	18%	√	√	√		√	
3. Mini-project & report	12%	√	√	√	√	√	√
4. Essay Assignment	10%	√				√	√
Total	100%						

The assessment methods include an examination, a class test, and written assignment in the form of mini-project report. The examination and class test assess the technical competence of students in power system analysis methods and methods of power system operation and control. The written reports assess the students' ability to apply the theories learned in class to practical project, and to communicate in written form.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	39 Hrs.
Other student study effort:	
▪ Mini-project preparation/report/Essay	22 Hrs.
▪ Self-study	54 Hrs.
Total student study effort	115 Hrs.

Reading List and References

Reference books:

1. W.D. Stevenson, Elements of Power System Analysis, McGraw Hill
2. Wood & Wollenberg, Power Generation, Operation and Control, J. Wiley.
3. Weedy and Cory, Electric Power Systems, 4th Edition, Wiley
4. Grainger & Stevenson, Power System Analysis, McGraw Hill
5. H. Saadat, Power System Analysis, McGraw Hill
6. Antonio Gomez-Exposito, Antonio J. Conejo, and Claudio Canizares, Electric Energy Systems: Analysis and Operation, CRC Press, 2009

Subject Description Form

Subject Code	EE509
Subject Title	High Voltage Engineering
Credit Value	3
Level	5
Pre-requisite / Co-requisite / Exclusion	Nil
Collaboration Institute	HK Electric Institute
Objectives	To provide students with knowledge to understand the techniques of design and analysis pertaining to high voltage engineering, including causes and manner of insulation failure and problems encountered in practice.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Describe the insulation breakdown mechanisms so as to identify the failure phenomena of different insulation systems. b. Understand the principles and practices of high voltage equipment so as to get on to the pragmatic design and applications of high voltage equipment in industry.
Subject Synopsis / Indicative Syllabus	1. ***Introduction to Electrical Insulation*****:** Electric fields; Dielectric breakdown; Electrical insulating materials; Industrial applications of electrical insulating materials. 2. ***Breakdown of Gaseous Insulation*****:** Ionization processes; Townsend breakdown mechanism; Experimental determination of Townsend's ionization coefficients; Breakdown in electronegative gases; Streamer breakdown mechanism; Paschen's law; Corona discharges; Breakdown in non-uniform fields; Post-breakdown phenomena and applications; Vacuum insulation and breakdown. 3. ***Breakdown of Liquid Insulation*****:** Breakdown in pure liquids and commercial liquids; Purification and breakdown test; Power law for commercial liquids. 4. ***Breakdown of Solid Insulation*****:** Breakdown due to treeing, surface flashover, and surface tracking; Breakdown in composite insulation. 5. ***Partial Discharges & In-house Demonstration*****:** Classification of partial discharges by origin; Principle of partial discharge measurements; Demonstration of state-of-the-art measuring equipment. 6. ***High Voltage Equipment for Power System Networks*****:** Hierarchy of power system networks; Introduction to high voltage equipment and their general specifications. 7. ***Transmission Gas Insulated Switchgears*****:** Design and busbar topologies; Layout and internal construction; Environmental, health, and safety precautions in handling SF_6 gas; Type and routine tests; Inspection before installation; Commissioning test and precautions; Typical incidents around the world. 8. ***High Voltage Cables*****:** Basic high voltage cable technology; Dielectric properties; Types and constructions; Type, routine, and diagnostic tests; Health index; Water tree formation; Accessory design, operations, and maintenance considerations; Reliability reviews and failure analysis; Faulty joint dissections and lessons learnt. 9. ***Site Visit to HK Electric*****:** Introduction to transmission and distribution facilities; Demonstration of transmission gas insulated switchgears and relevant high voltage test equipment used in the power industry.

Teaching / Learning Methodology

Lectures are the primary means of conveying the fundamental knowledge to understand the techniques of analysis and design pertaining to high voltage engineering. In-house Demonstration and Site Visit to HK Electric are the complementary means of providing real-life experience on the pragmatic design and applications of high voltage engineering in industry. Students are expected to solve design problems with real-life constraints and to attain pragmatic solutions with critical and analytical thinking.

Teaching/Learning Methodology	Outcomes	
	a	b
Lectures	✓	✓
In-house Demonstration	✓	
Site Visit to HK Electric		✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended learning outcomes to be assessed	
		a	b
1. Examination	60%	✓	✓
2. Continuous Assessment	40%	✓	✓
Assignments (Insulation breakdown)		✓	
Assignments (High voltage equipment)			✓
Log (In-house demonstration)		✓	
Log (Site visit)			✓
Total	100%		

The assessment methods include: Examination (60%) and Continuous Assessment (40%), both in alignment with intended learning outcomes a and b. Examination (60%) is in form of a three-hou r, closed-book, end-of-subject written examination. Continuous Assessment (40%) consists of assignments (32%) and logs (8%) which, in turn, are after-class exercises for lectures on Insulation Breakdown (16%) and High Voltage Equipment (16%) and records of practical learning for In-house Demonstration (4%) and Site Visit to HK Electric (4%), respectively.

Student Study Effort Expected

Class contact:	
▪ Lecture/In-house Demonstration/Site Visit to HK Electric	39 Hrs.
Other student study effort:	
▪ Assignments	16 Hrs.
▪ Self-study	50 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Textbooks:

NIL (Refer to Lecture Notes).

Reference books:

1. M. S. Naidu and V. Kamaraju, High-Voltage Engineering, 5th Edition, Tata McGraw-Hill, 2013.
2. F. A. M. Rizk and G. N. Trinh, High Voltage Engineering, 1st Edition, Routledge, 2017.
2. V. Y. Ushakov, Insulation of High-Voltage Equipment, Springer Verlag, 2004.
3. E. Kuffel, W. S. Zaengl and J. Kuffel, High Voltage Engineering: Fundamentals, 2nd Edition, TBS, 2000.
4. C. L. Wadhwa, High Voltage Engineering, 3rd Edition, New Age Science, 2010.
5. A. Ravindra and M. Wolfgang, High Voltage and Electrical Insulation Engineering, Wiley: IEEE Press, 2011.
6. F. H. Kreuger, Partial Discharge Detection in High-Voltage Equipment, Butterworth-Heinemann, 1990.
7. IET Digital Library, Lightning Protection, Edited by C. Vernon, Institution of Engineering and Technology, 2010.

Subject Description Form

Subject Code	EE510
Subject Title	Electrical Traction Engineering
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To provide students with a comprehensive understanding of traction systems from an engineering viewpoint, with emphasis on the applications to railways. 2. To provide students with an appreciation of the current state-of-the-art design and applications of electric drives. 3. To enable students to understand the implications of design of traction systems for railway applications. 4. To introduce the quality indicators of railway operations and their relationships with the performance of traction drives and traction power supply systems. 5. To identify the necessary future technologies to improve the service quality in railway from the perspectives of traction drives and traction power supply systems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Analyse the operation principles of the sub-systems in an electrified railway system with the state-of-the-art approaches and critically review their advantages and limitations with reference to operating railway lines. b. Identify the railway service quality parameters and evaluate the impact of the performance of the sub-systems to the overall system reliability, availability, safety and maintainability. c. Recognise the importance to engage in self-learning on latest technologies on railway systems at this advanced level of study.
Subject Synopsis/ Indicative Syllabus	1. ***General aspects of traction system***: Technical and design aspects of railway electrification. Train dynamics and speed-time characteristics. AC and DC railways, power supply systems and interference. Supply system requirements: performance under normal and emergency feeding conditions. Requirement of traction substations. Overhead and track level current collection systems. 2. ***Computer-aided design and operation of traction systems*****:** Elements of design and analysis of traction systems: cost/benefit analysis; computer simulation of AC/DC power converter drives and traction equipment; power-factor, maximum-demand and energy-efficient operation; computer simulation of train performance for optimum headway, schedule speed and energy consumption; use of expert systems for system control and train scheduling. Computer modeling of non-linear source and traction load. Power quality issues of single phase AC traction: imbalance, harmonics and voltage dip; impact to traction system and public. Corrective measures and filter design. 3. ***Traction drives*****:** Introduction of traction drives. Overview of the traction transmission systems. Tractive effort and power calculation. Overview of traction motors. Traction transformers. Single-phase drives; three-phase drives; chopper drives; inverter drives. Induction motor control for traction drives: VVVF control, PWM control and CVVF control. Principles of powering and regenerative braking; blended regenerative and rheostatic brake control. DC traction drives. 4. ***Maglev and linear drives*****:** Principle and limitations of electromagnetic techniques of suspension and levitation. Levitation using permanent magnets, superconducting magnets and eddy currents induced by mains frequency excitation. Suspension using controlled DC electromagnets. Operation of linear motors. Application of linear drives in high speed transit systems.

Case Study:
1. Traction drive systems
2. Feeding systems in AC traction
3. Signalling system installation
4. Load-flow analysis in traction power system

Teaching/Learning Methodology

Video clips together with computer animations are used to supplement conventional lectures. Case studies will be used extensively to highlight the practicality of the subject materials being covered. Practitioners are also invited to have experience sharing sessions with the class. A group project is to be carried out to demonstrate and integrate the knowledge learned.

Teaching/Learning Methodology	Outcomes		
	a	b	c
Lectures	√	√	
Tutorials		√	√
Project Work	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Mini-project (group project)	20%			√
2. Tests	20%	√	√	
3. Examination	60%	√	√	
Total	100%			

This is an advanced and yet introductory subject for students, particularly practicing engineers in the railway industry. The subject encompasses all the important elements in a typical railway and a number of case studies are used to supplement the analytical discussions. The outcomes are assessed through a mini-project (which aims to integrate the various aspects learnt), tests and written examinations.

Student Study Effort Expected

Class contact	
▪ Lecture/Tutorial	36 Hrs.
▪ Invited lecture	3 Hrs.
Other student study effort:	
▪ Assignment, mini-projects and self-studies	66 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Textbooks:
1. M.H. Rashid, Power Electronics: Circuits, Devices and Applications, 3rd Edition, Prentice Hall 2004
2. Managing railway operations & maintenance: best practices from KCRC / edited by Robin Hirsch; technical co-editors, Felix Schmid, Michael Hamlyn. A & N Harris; Birmingham: University of Birmingham Press, 2007

Reference books/journals:
1. J. Pachl, Railway Operation and Control. VTD Rail Publishing, Mountlake Terrace (USA) 2004.
2. Bonnett, Clifford F. Practical railway engineering, London: Imperial College Press, 2005.
3. Petros A. Ioannou, Intelligent Freight Transportation (Automation and Control Engineering), CRC Press, Taylor and Francis Group, 2008
4. Selected papers from IEE/IET Proceedings – Electric Power Applications

Subject Description Form

Subject Code	EE512
Subject Title	Electric Vehicles
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Exclusion: EE543
Objectives	1. To acquire a broad knowledge on modern electric vehicles (EVs). 2. To understand the development of EVs from technological, environmental, and societal perspectives.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the importance of EVs for environment, energy sustainability and climate change. b. Understand various underpinning technologies for modern EVs, including electric motor drives, energy storage, batteries, charging methods, infrastructure and auxiliary systems. c. Explain the emerging technologies such as hybrid electric vehicles (HEVs), fuel cell electric vehicles (FEV) and energy storage methods.
Subject Synopsis/ Indicative Syllabus	1. ***Introduction to electric vehicles (EVs)*****:** Historical perspective. EV advantages and impacts. EV market and promotion: infrastructure needs, legislation and regulation, standardization. 2. ***Electric vehicle (EV) design options*****:** EV configurations: fixed vs. variable gearing, single- vs. multiple-motor drive, in-wheel drives. EV parameters, driving cycles and performance specifications. Choice of system voltage levels: electrical safety and protection. 3. ***Vehicle dynamics and motor drives*****:** Road load: Vehicle kinetics; Effect of velocity, Acceleration and grade. EV drivetrain and components. EV motor drive systems: DC drives, Induction motor drives, Permanent-magnet synchronous motor drives, Switched reluctance motor drives. Control strategies. 4. ***Batteries*****:** Battery parameters. Types and characteristics of EV batteries. Battery testing and maintenance; Charging schemes. Battery Management System. Open-circuit voltage and ampere-hour estimation. Battery load levelling Energy Storage. 5. ***Auxiliaries*****:** On-board and off-board battery chargers. Energy management units. Battery state-of-charge indicators. Temperature control units. Power steering. 6. ***Emerging EV technologies*****:** Hybrid electric vehicles (HEVs): types, operating modes, torque coordination and control, generator/motor requirements. Fuel cell electric vehicles (FEVs): fuel cell characteristics, hydrogen storage systems, reformers. Alternative sources of power: super- and ultra-capacitors, flywheels.

Teaching/Learning Methodology

Delivery of the subject is mainly through formal lectures, complemented by tutorials and worked examples. Self-learning on the part of students is strongly encouraged and extensive use of web resources will be made. A term paper and a related presentation enable students to develop skills in literature survey and writing. Oral presentation sessions develop students’ skills in spoken communication and peer evaluation.

Teaching/Learning Methodology	Outcomes		
	a	b	c
Lectures	√	√	√
Tutorials	√	√	√
Assignment and oral presentation	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Examination	60%	√	√	√
2. Test	25%	√	√	√
3. Assignment (Term Paper/Homework)	10%	√	√	√
4. Oral presentation	5%	√	√	√
Total	100%			

It is an advanced elective on electric vehicles. The outcomes on electric vehicle technology and its impacts are assessed by the usual means of test and examination, and partly by the term paper. The outcomes on technical communication and presentation skills are evaluated by the term paper and a related oral presentation.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	30 Hrs.
▪ Presentation/Tests	9 Hrs.
Other student study effort:	
▪ Self-study and revision	48 Hrs.
▪ Report – Case Study	18 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Reference books:

1. K. T. Chau, Electric Vehicle Machines and Drives: Design, Analysis and Application, Wiley, 2015.
2. K.T.Chau, Energy Systems for Electric and Hybrid Vehicle, IET, Aug 2016
3. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, New York: RC Press, 2003.

Subject Description Form

Subject Code	EE514
Subject Title	Real Time Computing
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To understand the properties of real time programming languages, operating systems and associated hardware. 2. To apply real time system technologies and concepts in engineering applications. 3. To demonstrate and realize advantages in real time system underlying in today advanced technological evolvements.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Appreciate the important issues in real time computing systems, and their relations in engineering applications. b. Identify and understand the complications in a real time computing system. The mechanism of overcoming these obstacles is explored. c. Communicate effectively with concerned topics during discussions and presentations. d. Equip individual the ability to analyse related issues and identify the proper solution in a real-time computing design.
Subject Synopsis/ Indicative Syllabus	1. ***Real time computing systems concepts*****:** Characteristics of Real Time Computing. Properties and Speed Requirements of Real Time Systems. Synchronous Real Time Systems: Polled, Main Polled Loop with Interrupts, Cyclic Schedulers. Multi-Processors Real Time Systems: Multi-Processor Structures, Process Dispatch Latency, Inter CPU Communication, Hierarchical Approach to Real Time Systems. Process Scheduling Architecture of Cloud Computing. Example: A Real Time Control System in Coal-Fired Power Plant. 2. ***Real time systems design issues*****:** Time Handling: Representation of Time, Time constraints, Time Service and Synchronization, Real Time System Life Cycle: Requirement Specification. Real Time System Modelling Example: Cluster computing, Internet of things in power energy platform. 3. ***Real time system applications*****:** System supervision in Power System Process Operation. Implementation of IoT technology to resolve the real-time system operation issues. **Mini-Project:** Implementation of a real-time computing system based on the Real-time OS

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 a mini-project, in which the students are expected to understand design problems with real-life constraints and to attain pragmatic solutions.

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	15%	√	√		
3. Assignment/Presentation	10%	√	√	√	
4. Mini project	15%	√	√		√
Total	100%				

The outcomes on concepts, design and applications of real-time systems are assessed by the usual means of examination and test whilst those on analytical skills, problem-solving techniques and practical considerations, as well as technical reporting and teamwork, are evaluated by a mini-project.

Student Study Effort Expected

Class contact:	
▪ Lecture/Seminar	33 Hrs.
▪ Mini-project presentation demonstration	6 Hrs.
Other student study effort:	
▪ Mini-project	30 Hrs.
▪ Self-study	41 Hrs.
Total student study effort	110 Hrs.

Reading List and References

Reference books/materials:

1 Hermann Kopetz, Real-Time Systems: Design Principles for Distributed Embedded Applications, 2nd Ed., Springer, 2013
2. C.M.Krishna, K.G.Shin, Real-Time systems, McGraw-Hill, 2015
3. J.E. Cooling, Software Design for Real-time Systems, Chapman & Hall, 1991
4. J.A. Stankovic and K. Ramamritham, Advances in Real-Time Systems, IEEE Computer & Society Press, 1993
5. Selected papers from Proceedings of Real-time Systems Symnposium (IEEE)
6. Chris Moyer, Building Applications in the Cloud, Pearson Education, 2011

Subject Description Form

Subject Code	EE520
Subject Title	Intelligent Motion Systems
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To describe an in depth knowledge on the design and operation of intelligent motion systems. 2. To relate and compare numerous application examples, which ranges from CD players and hard disc drives to robots and component insertion machines. 3. To enable the students to have the ability to design motion control systems for industry and domestic purposes.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Contrast and compare different motion control system configurations, and select the most appropriate one for the task. To comprehend and understand numerous motion control examples for domestic and industrial applications. b. Understand the in-depth knowledge of motion drive and sensing techniques, and the ability to use them in real engineering applications. c. Have a broad understanding of motion control platform hardware and a visionary perspective on the future developments of computing/control hardware.
Subject Synopsis/ Indicative Syllabus	1. ***Structures of intelligent motion systems*****:** Specifications and requirements of intelligent motion systems. Operating modes: point to point motion, trajectory path tracking, velocity path tracking, force and tension control, compliance control, vibration damping. Switching between operation modes. 2. ***Motion actuators and driving techniques*****:** Using Voice Coil Motors and DC brush motors in motion control. AC brushless motors, linear direct drive AC brushless motors and their driving techniques. Stepping motors and their limitations in motion tracking systems. Microstepping and electronic damping of stepping motors. 3. ***Motion sensing and estimation techniques*****:** Optical encoders: working principle, decoding method, and resolution enhancement through interpolation. Syncro-resolvers: working principle and interface electronics. Velocity estimation and position estimation methods for large speed range actuators. 4. ***Motion control platform*****:** Computer hardware requirements. Tightly coupled systems versus distributed systems. Application of DSPs in motion control. Communication methods in motion systems. Real time operating system for motion control. 5. ***Intelligent algorithms for motion control and trajectory generation*****:** PID controllers and their variations. Servo tuning methods. Motion control systems based on state space configuration. States observation and Kalman filters. Using Notch filters in non-rigid systems. Profile generation and motion planning algorithms. 6. ***Issues in multi-axis intelligent motion systems*****:** co-ordinate mapping and dynamics transformation. Multi-axis motion planning and profile generation. Motion synchronisation between axis. Decoupling inter-axis motion interference. Applying MIMO structure in tightly coupled system.

7. ***Case studies in intelligent motion systems*:**

   Three examples will be selected from the following list:
   - a. Optical based position tracking in CD-ROMs and Laser discs.
   - b. Magnetic head positioning in hard disk drives.
   - c. Motion control system design in multi-axis robot manipulators.
   - d. Gantry robot motion systems for SMT component insertion machines.
   - e. Motion systems in high precision CNC tooling machines.

Case study:

Report on a high performance motion control application example

Teaching/Learning Methodology

Delivery of the subject is mainly through formal lectures, complemented by tutorials and worked examples. Self-learning on the part of students is strongly encouraged and extensive use of web resources will be made. A term paper and a related presentation enable students to develop skills in literature survey and writing. Oral presentation sessions develop students' skills in spoken communication and peer evaluation.

Teaching/Learning Methodology	Outcomes		
	a	b	c
Lectures	√	√	√
Tutorials	√	√	√
Assignment and oral presentation	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Examination	60%	√	√	√
2. Test	30%	√	√	√
3. Report	5%	√	√	√
4. Oral presentation	5%	√	√	√
Total	100%			

One end-of-semester written examination; one mid-semester-test; one end-of-semester test; a report on an assigned topic; and a power point presentation for the particular topic.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	30 Hrs.
▪ Presentation/Test	9 Hrs.
Other student study effort:	
▪ Case study	18 Hrs.
▪ Self-study	48 Hrs.
Total student study effort	105 Hrs.

Reading List and References

References books:

1. Precision Motion Control: Design and Implementation (Advances in Industrial Control) Dec 10, 2010 by Kok Kiong Tan and Tong Heng Lee, Springer
2. Motion Control Systems, Feb 21, 2011 by Asif Sabanovic and Kouhei Ohnishi, Wiley
3. S. Meshkat, Advanced Motion Control, PCIM reference series in Power Conversion and Intelligent Motion, 1988
4. M.M. Gupta, Intelligent Control Systems: Concepts and Applications, IEEE Press, 1996
5. K. Rajashekara, Sensorless Control of AC Motors, IEEE Press, 1996

Subject Description Form

Subject Code	EE521
Subject Title	Industrial Power Electronics
Credit Value	3
Level	5
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 their applications in renewable energy systems. 3. To give industrial concern in power electronics design including passive components and standards 4. To introduce to students to the various topologies of the power electronics circuits. 5. To enable students to understand the power quality issues and the active and reactive power flow.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Acquire a good understanding of power supply concept and design and be able to analyse the industrial needs for static power conversion. b. Understand the international standards on power electronics design. c. Have a global view on recent development on power electronics and be aware of applications of power electronics in various industries d. Understand the various topologies and working principles of basic power converters e. 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, AC-DC power conversion and recent advance in renewable energy systems such as wind and solar power 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. ***Power quality improvement:*** Fourier analysis of voltage current waveforms, total harmonic distortion, rectifier, passive/active filters, power quality issues, reactive power compensation. 6. ***Magnetics and capacitors:*** High frequency inductors and transformers, winding techniques, core loss analysis, optimization of magnetics and power capacitors. **Laboratory Experiments :** Select 2 experiments from topics in computer simulation, DC-AC and DC-DC power converters.

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	e
Lectures	√	√	√	√	
Tutorials	√	√	√	√	
Experiments/Laboratory	√				√
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
1. Examination	60%	√	√	√	√	
2. Test and/or Assignment	20%	√	√	√	√	
3. Laboratory performance & report	10%	√			√	√
4. Mini-project & report	10%	√	√	√	√	√
Total	100%					

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

Student Study Effort Expected

Class contact:	
▪ Lecture/tutorial	33 Hrs.
▪ Laboratory	6 Hrs.
Other student study effort:	
▪ Lab report/Mini-project	15 Hrs.
▪ Self-study	51 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Reference books:

1. A. M. Trzynadlowski, Introduction to Modern Power Electronics, Third Edition, Wiley, 2015.
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: Converters, Applications, and Design, John Wiley & Sons, 2012.
4. G. M. Masters, Renewable and efficient electric power systems, John Wiley & Sons, 2004
5. K.W.E. Cheng, Classical Switched Mode and Resonant Power Converters, The Hong Kong Polytechnic University, 2002

Subject Description Form

Subject Code	EE522
Subject Title	Optical Fibre Systems
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To re-introduce to students the fundamentals of light emission, modulation, detection, amplification, and light propagation in optical fibres. 2. To enable students to understand the operating principle and performance specifications of various fibre-optic components, as well as their applications in modern fibre-optic systems. 3. To equip students with the ability to analyse and design simple fibre-optic communication and sensing systems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Appreciate recent developments in fibre optic communication systems, importance of fibre optic technology to the development of communications, engineering applications of fibre-optic technologies, and advantages of fibre optic sensors to the electrical engineering industry. b. Understand the principles of different types of optical fibres, fibre components, sensors, and communication systems. c. Know the same function may be achieved by using different technologies and understand the advantages and limitations of each technology. d. Select the most appropriate passive and active fibre-optic components to design fibre-optic sensor systems and fibre optic communication links. e. Have hands-on experience in the use of fusion splicer to make low-loss fibre joints, optical spectrum analyzer to perform spectral measurements, and fibre grating sensors for temperature and strain measurements.
Subject Synopsis/ Indicative Syllabus	1. **Overview:** Introduction to lightwave communication and sensor systems. Historical perspective. Basic concept and components. Channel capacity. 2. **Optical fibres:** Theory of optical wave-guiding. Numerical aperture. Fibre modes. Fibre fabrication. Attenuation and dispersion. Special optical fibres. 3. **Passive fibre components**: Light coupling. Splices and connectors. Couplers and splitters. Optical filters. Wavelength multiplexers/de-multiplexers. Fibre Bragg gratings. Optical isolators and circulators. 4. **Optical sources:** Light emission and absorption. Light emitting diodes. Optical feedback. Threshold condition. Laser modes. Semiconductor lasers. Tunable lasers. Modulation of light. Optical transmitters. 5. **Optical amplifiers:** Rare-earth doped fibres. Optical fibre amplifiers. Semiconductor amplifiers. 6. **Optical detectors:** PIN and avalanche photodiode. Noise and response time. Responsivity. Optical receivers. 7. **Optical fibre communication:** System architectures. Operating wavelength and system limitations. Power and rise-time budgets. Noise effects and other source of power penalty.

8. **Optical fibre sensor systems:** Intrinsic and extrinsic sensors. Intensity modulation sensors. Phase modulation sensors. Polarisation modulation sensors. Wavelength and frequency modulation sensors. Fibre grating sensors. Multiplexed and distributed sensing systems.

Laboratory Experiments/Demonstrations:
Observation of fibre modal patterns; Measurement of source spectrums and power-current relations of LED, multi and single mode diode lasers; Fibre splicing and insertion loss measurement; Fibre Bragg grating sensors.

Teaching/Learning Methodology

Lectures, quizzes, tests, laboratory experiments, mini-projects, and examination.

Teaching/Learning Methodology	Outcomes				
	a	b	c	d	e
Lectures	√	√	√	√	
Tutorials		√	√	√	
Demonstration/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
1.Tests/Quizzes	18%	√	√	√	√	
2. Assignments	8%	√	√	√	√	
3. Lab and report	8%				√	√
4. Mini-project and report	6%	√	√	√		
5. Examination	60%		√	√	√	
Total	100%					

This subject introduces the theory and applications of optical fibre communication and sensor technology. The outcomes are assessed by quizzes, tests, mini-projects, laboratory experiments and examination.

Student Study Effort Expected

Class contact:	
▪ Lectures/Tutorials/Laboratory demo	39 Hrs.
Other student study effort:	
▪ Mini-project and report	20 Hrs.
▪ Self-study and assignments	46 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Reference books:

1. G. Keiser, Optical Fiber Communications, 3rd Edition, McGraw-Hill, 1999
2. J.M. Senior, Optical Fiber Communications-Principles and Practice, 3rd Edition, Prentice Hall, 2008
3. J.C. Palais, Fiber Optic Communications, 5th Edition, Prentice Hall, 2005
4. G.P. Agrawal, Fiber-optic Communication Systems, 3rd Edition, Wiley, 2002
5. J. P. Dakin and B. Culshaw, Optical Fibre Sensors, Artech House, Vols.1&2, 1989, and Vols.3&4, 1997.

Subject Description Form

Subject Code	EE524
Subject Title	Open Electricity Market Operation
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To enable students to understand the key and practical issues of restructuring electricity supply industry and to establish a broad knowledge of open electricity market operation. 2. To enable students to understand the key issues in open electricity market operation including deregulated power system operation, transmission pricing, procurement of ancillary services, congestion management, available transmission capacity so that students are provided with knowledge and techniques they need to meet the electric industry's challenges in the 21st century.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Acquire a good understanding of the rationale and key issues for restructuring electricity supply industry, practical operation and design considerations for real world electricity markets, and financial tools to hedge risks used in electricity supply industries. b. Analyse the available transmission capacity and formulate equitable transmission pricing in electricity markets. c. Assess ancillary services requirements and values based on security, economic and performance considerations. d. Present technical results in the form of technical report and verbal presentation
Subject Synopsis/ Indicative Syllabus	1. ***Restructuring of the Electricity supply industry* (*ESI*):** ESI structures; Privatisation and competition; Market structures and architectures; Regulation of Electricity Markets; Role of existing players. 2. ***Electricity market*:** Timeline coordination, design considerations and practical operation of a real-world electricity market system. Use of different financial contracts/tools including derivatives and electricity futures for risk management in electricity markets. Game theory approach for market competition analysis. Transmission congestion management in electricity market. Security considerations. 3. ***Transmission and ancillary services*:** Transmission ownership and restructuring. Measuring available transmission capacity in energy markets. Purchasing transmission capacity. Network and point to point transmission services. Fixed and firm transmission rights. Ancillary services and technical specifications, and performance based cost model. 4. ***Transmission pricing*:** The costs of transmission services. Locational prices. Embedded cost allocation methods. Stranded assets. Short-run marginal cost. Long-run marginal cost. Integrated approach of transmission pricing.

Teaching/Learning Methodology

The concept of electricity market modelling and economic analysis framework will be presented through lectures and tutorials with reference to real-life market environment. Students will be required to form groups to work through cases covering the market structure and operational aspects so as to develop ability to critically evaluate principles and operation of electricity markets. Tutorials will be structured on different sessions for better understanding on the theoretical concepts which require sufficient contributions from students. Students will also learn through active participation in the presentation of finding of their case studies.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lectures	√	√	√	
Case Studies & Presentation	√	√	√	√

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	62%	√	√	√	
2. In-class tests	19%	√	√	√	
3. Cases study & presentation	19%	√	√	√	√
Total	100%				

The outcomes on the concepts of modelling, analysis and applications are assessed by the usual means of examination and tests whilst those on problem-solving techniques and presentation of findings, as well as technical reporting and teamwork, are evaluated by the case study exercise.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	33 Hrs.
▪ Presentation	6 Hrs.
Other student study effort:	
▪ Case study and report	15 Hrs.
▪ Self-study	51 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Reference books:

1. D. Gan, D. Feng and J. Xie, Electricity Markets and Power System Economics, CRC Press, 2013
2. D. Kirschen, G. Strbac, Fundamentals of Power System Economics, 2nd Edition, John Wiley & Sons, 2018
3. K. Bhattacharya, M.H.J. Bollen, and J.E. Daalder, Operation of Restructured Power Systems, Kluwer Academic Publishers, 2001

Subject Description Form

Subject Code	EE526
Subject Title	Power System Analysis and Dynamics
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To introduce the students to the advanced concepts and analytical skills for the stability analysis in modern power systems. 2. To understand the impact due to different system instabilities. 3. To analyse and provide solutions to the power system stability problems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Acquire in-depth understanding of different types of power system stability problems. b. Model the dynamic behaviours of system components under disturbances. c. Apply and adapt applications of mathematics and engineering skills in the analysis of stability problems. d. Discuss the causes and effects of instabilities and recommend possible solutions. e. Acquire skills in presentation and interpretation of experimental results and communicate in written form
Subject Synopsis/ Indicative Syllabus	1. ***Power system stability*: ** Basic concepts and classification. Past incidents of system instability and consequences. Power system stability issues and solutions. 2. ***Reactive power compensation*: ** System Q-V Characteristics. Reactive support theory. Load Characteristics. Synchronous condensers, Static Var Compensators (SVS), Thyristor Switched Capacitor (TSC), Thyristor controlled Reactor (TCR). 3. ***Voltage stability*: ** Fundamental concepts. Singularities and multiple load flow techniques, eigenvalue methods. Load modelling, tap-changer effects, voltage controllability and voltage compensation. Proximity of collapse, Measures against collapse. Practical experience. 4. ***Dynamic stability & power system stabilisers*: ** Eigenvalue and modal analysis. Generator and load modelling. Power system stabiliser. Small-signal stability of multi-machine systems. Selection of input signal and installation location, parameter design and commissioning of PSS. 5. ***Application of HVDC, FACTS and ESS in improving stability*: ** HVDC link operation and its control for stability improvement. Flexible AC transmission devices, power angle control. Energy storage system, e.g. BESS, SOFC, FESS, and its application in stability control. **Mini-projects:** 1. Power system stability analysis using industrial power systems design and analysis software 2. Power system stabiliser design for damping of low frequency power oscillation

<table>
<tr><td>Teaching/Learning Methodology</td><td>
Lectures and tutorials are the primary means of conveying the basic concepts and theories. Experiences on system analysis, design and practical applications are given through experiments, in which the students are expected to solve the power system stability and control design problems with practical constraints and to attain pragmatic solutions with critical and analytical thinking. Students will be required to form groups to work through a mini-project for a selected topic. Mini-Projects are used to enhance students learning experiences and practical applications.
<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="5">Outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td></tr>
<tr><td>Lectures</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>Tutorials</td><td></td><td></td><td>√</td><td></td><td></td></tr>
<tr><td>Mini-project</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
</table>
</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="5">Intended subject learning outcomes to be assessed</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td></tr>
<tr><td>1. Examination</td><td>60%</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>2. Class Test</td><td>18%</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>3. Mini-project/report</td><td>12%</td><td></td><td></td><td></td><td>√</td><td>√</td></tr>
<tr><td>4. Essay assignment</td><td>10%</td><td>√</td><td></td><td></td><td>√</td><td>√</td></tr>
<tr><td>Total</td><td>100%</td><td colspan="5"></td></tr>
</table>
The outcomes on concepts, design and applications are assessed by the usual means of examination and test Experiments and written reports assess those on analytical skills, problem-solving techniques and practical considerations of power system stability and control design as well as technical reporting.
</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture/Tutorial</td><td>39 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Mini-project and report</td><td>15 Hrs.</td></tr>
<tr><td>▪ Essay assignment/Self-study</td><td>51 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>105 Hrs.</td></tr>
</table>
</td></tr>
<tr><td>Reading List and References</td><td>
Reference Books:
1. P. Kundur, Power System Stability and Control, McGraw Hill, 1994
2. P.M. Anderson and A.A. Fouad, Power System Control and Stability, Wiley-IEEE Press, 2nd Edition, 2002
3. G. Rogers, Power System Oscillations, Springer, 1999
4. Voltage Stability of Power Systems: Concepts, Analytical Tools and Industry Experience, IEEE Publication 90th 0358-2-PWR, 1990
5. Y.H. Song, and A.T. Johns, Flexible AC Transmission Systems, IEE, 1999
6. T.V. Cutsem, and C. Vournas, Voltage Stability of Electric Power Systems, Springer, 2nd Edition, 2007
</td></tr>
</table>

Subject Description Form

Subject Code	EE528
Subject Title	System Modelling and Optimal Control
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To provide students with a sound knowledge of system identification and modelling techniques in areas of prediction and control. 2. To introduce modern control design techniques.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Model systems using State Variable and Transfer Functions. b. Design optimal controllers for system models. c. Apply computer packages for control system modelling and design.
Subject Synopsis/ Indicative Syllabus	1. ***System models***: functions, transformations and mapping, Laplace transformation and z-transformation, state variables and state space models of dynamic systems, relations between state space models and transfer function models, solutions of unforced linear state equations, matrix exponential, eigenvalues and eigenvectors, Jordan form, solutions of linear state equations, transition matrix. 2. ***Modelling of physical systems***: power, energy, sources, passive elements (C-, I-, R-, transformer, and Gyrator), through and across variables, linear graph, modelling examples for typical mechanical systems such as vehicle suspension, electrical motor, etc. 3. ***Stability, controllability, and observability***: stability, Lyapunov stability, Lyapunov function, controllability and observability, definition and criteria, stabilizability and detectability, feedback control. 4. ***Optimal control***: Calculus of variations, formulation of optimal control problems, Pontryagin maximum principle, Riccati equation, application to linear regulator.
Teaching/Learning Methodology	Basic concepts and theories are taught in lectures and tutorials. Computer experiments will be assigned as part of the interactive assignments, where the students are expected to solve theoretical and practical control problems with critical and analytical thinking.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lectures	√	√	√	
Tutorials	√	√	√	
Assignments			√	√

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. Assignments	40%	√	√	√	√
Total	100%				

The outcomes on concepts, analytical skills, problem-solving techniques, design and applications, and practical considerations of designing control systems are assessed by the usual means of examination and assignments, including computer-package-based assignments.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	39 Hrs.
Other student study effort:	
▪ Reading and studying	43 Hrs.
▪ Completing assignments	23 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. L. Ljung, System Identification: Theory for the User (2nd Edition), Prentice Hall.
2. C.C. Hang, T.H. Lee and W.K. Ho, Adaptive Control, Instrument Society of America.
3. N. Nise, Control Systems Engineering, Wiley.
4. 4. P. J. Antsaklis and A. N. Michel, Linear Systems, McGraw Hill.

Subject Description Form

Subject Code	EE530
Subject Title	Electrical Energy Saving Systems
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To enable students to establish a broad concept 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. Describe the operation principle & control strategy of various energy storage systems and topologies of these systems and identify their benefits & impacts. b. Describe 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. 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. Describe 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*:** Utility Load Factor, peak lopping and valley filling, energy storage systems, battery energy storage, super-capacitor, 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, distributed power generation, passive solar devices on buildings 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, energy storage and regeneration for 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 and/or Assignment	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, assignment 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	20 Hrs.
▪ Self-study	46 Hrs.
Total student study effort	105 Hrs.

Reading List and Reference

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, 2013
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, 2017 edition
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/
10. S. Kouro, Grid-connected photovoltaic systems – an overview of recent research and emerging PV converter technology, IEE Industrial Electronics Magazine, 2015.

Energy Saving Control and Monitoring Systems

11. EMSD of HKSAR Govt, Code of Practice for Energy Efficiency of Building Services Installation, 2012
12. EMSD of HKSAR Govt, Code of Practice for Building Energy Audit, 2012
13. Anna Magrini, Building Refurbishment for Energy Performance: A Global Approach (Green Energy and Technology) Springer, 2014th Edition.
14. Bela Liptak, Instrument Engineers' Handbook, 4th Edition, Volume Two: Process Control and Optimization, CRC 2005.

Lighting, Ballast, and Variable Speed Drives

15. T. Q. Khanh, LED lighting: Technology and Perception, Wiley-VCH, 2015
16. J.R. Benya, D.J. Leban, Lighting Retrofit and Relighting: A Guide to Energy Efficient Lighting, John Wiley & Son, 2011
17. M.H. Rashid, Power Electronics Handbook: Devices, Circuits and Applications, Academic Press, 2010
18. Guidelines on Energy Efficiency of Lift and Escalator Installations, 2007 Edition, Electrical and Mechanical Services Department (EMSD), the Government of the HKSAR, Hong Kong
19. 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	EE533
Subject Title	Railway Power Supply Systems
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Collaboration Institute	MTR Academy
Objectives	1. To enable students to develop a comprehensive understanding of the modern railway power supply systems in metro and mainline systems. 2. To provide an appreciation of the specifications and design of the supply system configuration. 3. To enable students to understand the implications of supply system design on safety and service quality, as well as the practices and difficulties in implementation. 4. To provide students with the basic terminology and the practical processes of testing and commissioning. 5. To enable students to comprehend the connection of the railway supply system to the utility distribution network.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Identify the key components in a railway supply system and their functions and appreciate the relationship of the supply system to other systems in railway. b. Differentiate the requirements on power supply systems in different railway systems, metros, mainlines and light rails. c. Apply the knowledge on power supply system to comprehend the design and installation of power supply system. d. Discuss procedures of testing and commissioning of railway power system and analyse possible faults. e. Recognise the importance to engage in self-learning on latest technologies on railway systems at this advanced level of study.
Subject Synopsis/ Indicative Syllabus	1. General aspect of railway power supply system: Metro system, Light rail system, electric multiple units and locomotives, functions of traction supply system, interface requirement among power and traction supply system, contact line system, permanent way, signalling, SCADA and train. 2. Railway power supply system – requirement and specification: Types of railway power supply systems, basic structure and design of standard AC distribution and DC traction substation and control system. 3. DC and AC overhead line system and equipment: Terminology, overhead contact line types and basic characteristic; Basic design – mechanical, electrical and civil; Design for installation, testing and commissioning; failure analysis. 4. Traction earthing and DC stray current control system: Terminology, operation requirement and specification; DC current return, earthing and bonding; Design for installation, testing and commissioning; Failure analysis.

5. AC traction supply system and power quality issues: Configuration and operation of 25kV system; Power quality; Voltage dip, harmonics, imbalance, and remedial measures.
6. Traction drives, tractive effort and power calculations, overview of traction motors, VVVF control, PWM control, and regenerative braking.
7. EMC: Principles of EMC, railway-related interference problems and their solutions, booster transformer.
8. Site visit to MTR power supply systems.

Teaching/Learning Methodology

The main lecturers are from MTRC, and their experiences/knowledge are shared with students via lectures and tutorials for conveying the concept and theories. The site visit to MTR system has reinforced the pragmatic design and application in a realistic system. Problem solving skill and team work are trained via minor project and laboratory.

Teaching/Learning Methodology	Outcomes				
	a	b	c	d	e
Lectures	√	√	√	√	√
Tutorials		√	√	√	√

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
1. Examination	60%	√	√	√	√	
2. Test	20%	√	√	√	√	
3. Presentation/ Essay Submission	20%	√	√	√	√	√
Total	100%					

The proposed assessment methods will be effective and adequate in gauging the extent of learning outcomes acquired by the students of this subject.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	33 Hrs.
▪ Site visit	6 Hrs.
Other student study effort:	
▪ Presentation and Report preparation	24 Hrs.
▪ Self-study	42 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Reference books:

1. Selected papers on IEE Proceedings on Electric Power Applications
2. Selected papers on IEE Proceedings on Power Systems

Subject Description Form

Subject Code	EE535
Subject Title	Maintenance and Reliability Engineering
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To provide students with a comprehensive understanding on various maintenance management processes. 2. To enable students to understand the impact of maintenance management on railway objectives in safety, reliability and cost effectiveness. 3. To enable students to acquire knowledge and techniques in reliability engineering. 4. To equip students to make decisions on sound maintenance and reliability improvement. 5. To enable students to apply the techniques in reliability engineering to railway operation.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Identify the possible faults in railway systems and their impacts to the overall system reliability. b. Develop fault trees for a sub-system in railways and apply various reliability models on fault analysis. c. Discuss system data collection for reliability assessment. d. Evaluate maintenance schedules and assess the corresponding risk with appropriate techniques and tools. e. Review the advantages and limitations on condition-based monitoring maintenance, alternative sourcing of inventory and maintenance outsourcing management for railway assets. f. Organise and present an assigned research topic.
Subject Synopsis/ Indicative Syllabus	**Reliability Engineering** 1. Reliability fundamentals: Reliability Mathematics. Failure distributions. Causes of failures and their treatment. Reliability apportionment and prediction. Reliability data books. Data Recording and Corrective Action System (DRACAS). 2. Reliability analysis and modelling methods: Fault tree analysis, Failure Mode Effects and Criticality Analysis (FMECA), Reliability block diagram, Reliability Growth Models – IBM and Duane Reliability Growth modelling, Reliability testing. Monte Carlo Reliability Simulation. Weibull Analysis. **Maintenance Management** 1. Asset management framework based on ISO55000/55001. Alignment with corporate asset management direction. Asset management organization. Asset management and business sustainability. 2. Maintenance techniques and tools: Maintenance as an essential element for asset management. Reliability Centred Maintenance as a means for maintenance decision. Topics on conditioned based maintenance. 3. Management for business performance: Computerized Maintenance Management System – from planning to implementation. Alternative spare sourcing. Maintenance outsourcing management for railway assets. Site visits to MTR depots and industrial/research seminars.

Teaching/Learning Methodology

Video clips together with computer animations are used to supplement conventional lectures. Case studies will be used extensively to highlight the practicality of the subject materials being covered. Practitioners are also invited to have experience sharing sessions with the class. A group project is to be carried out to demonstrate and integrate the knowledge learned.

Teaching/Learning Methodology	Outcomes					
	a	b	c	d	e	f
Lectures	√	√		√		
Tutorials		√	√		√	
Project works	√	√	√	√	√	√

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. Group Mini Project	20%		√		√	√	√
2. Tests	20%	√		√			
3. Examination	60%	√		√	√	√	
Total	100 %						

This is a specialist subject with bias on maintenance and reliability of railway assets, in particular on rolling stocks. A large number of case studies are discussed in the lectures and the outcomes are to test the understanding of the student on the underlying fundamentals through quizzes, mini-projects and written examinations.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	36 Hrs.
▪ Industrial/Research seminars	3 Hrs.
Other student study effort:	
▪ Assignment and Self-studies	66 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Textbooks:

1. V. A. Profillidis, Railway management and engineering, 3rd Edition, Burlington, Ashgate Pub. Co., 2006.
2. P. D. T. O'Connor, Practical Reliability Engineering, Wiley, 2006

Reference Books:

1. ISO 55000 – Asset Management
2. ISO 55001 - Asset management — Management systems — Requirements
3. ISO 55002 - Asset management — Management systems — Guidelines for the application of ISO 55001

Subject Description Form

Subject Code	EE536
Subject Title	Signalling and Train Control Systems
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Collaboration Institute	MTR Academy
Objectives	1. To provide students with a comprehensive understanding on the basic principles and terminology of railway signalling. 2. To enable students to acquire knowledge on train control systems and their implications to safe and efficient railway operation. 3. To enable students to understand the design processes of signalling layout the control of signals. 4. To provide students with the basic concepts on the principles, means, instrumentation and commissioning of train detection and interlocking systems. 5. To appreciate the structure and components of an automatic train control system.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Identify the functions, operation principles and key components of a signalling system. b. Given track layout and signalling requirements, formulate a simple signalling layout. c. Describe the train detection methodologies and implementation considerations, and compare their advantages and limitations. d. Compare between relay interlocking and processor-based interlocking, their safety principles and commissioning plans. e. Explain the requirements and structure of an automatic train control system.
Subject Synopsis/ Indicative Syllabus	1. ***Basic signalling principles*:** Safe operation of trains, prevention of trains collision and locking of points and routes; type of signalling, signal spacing and signalling layout; headways line capacity, headways for different types of signalling systems, factors affecting headways; control table, conditions for setting of routes, clearing of signals and locking of routes and points; aspect sequence, meaning of signal aspect and the circumstances under which signals display. 2. ***Train detection*:** Track circuit, axle counter and advanced detection system; track circuit bonding; track circuit connections and maintenance of traction return at points and crossings. 3. ***Signalling interlocking*:** Interlocking implementation based on relays, safety principles; processor based interlocking, interlocking implementation based on processors/computers, safety principles. 4. ***Principles of testing*:** Competence, functional tests, scenario tests, independent test, test strategy, test plan, commissioning plan, records. 5. ***Automatic train control system*:** Automatic train protection, automatic train operation and automatic train supervision. **Case Study:** Site visits to MTR train control centres Industrial/Research seminars

Teaching/Learning Methodology

Basic principles of signalling functions and operations are usually simple but they are always complicated by the implementation and practices in systems with unique requirements. Lectures are necessary to cover the fundamentals, supplemented by the examples and exercises from real-life applications. Site visits to the MTR Control Centres are also arranged so that the students are able to co-relate what they have learned to actual operations.

Teaching/Learning Methodology	Outcomes				
	a	b	c	d	e
Lectures	√	√	√	√	
Site visits		√		√	√
Industrial seminars					√

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
1. Examination	60%	√	√	√	√	√
2. Test	25%	√	√			
3. Assignments	15%	√	√			
Total	100%					

The examination is to evaluate the students' understanding of the underlying principles in general. Signalling involves signal layout and route setting, which requires substantial practical skills through exercises. Test and assignment provides the means to assess such practical design skills.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	33 Hrs.
▪ Industrial/Research seminars	6 Hrs.
Other student study effort:	
▪ Assignments	10 Hrs.
▪ Self-study	53 Hrs.
▪ Site visit	3 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Textbooks:

1. Edited by B. Ning, Advanced Train Control Systems, WIT, 2010

Reference books:

1. Proceedings of International Conferences on Computers in Railways, WIT Press
2. Selected papers on IRSE Proceedings
3. IRSE Green Book No. 27, Signalling the Layout
4. IRSE Green Book No. 29, Solid State Interlocking

Subject Description Form

Subject Code	EE537
Subject Title	Railway Vehicles
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Collaboration Institute	MTR Academy
Objectives	1. To provide students with a comprehensive understanding on design and applications of railway vehicles. 2. To ensure the students aware of the current state-of-the-art on design, operation and maintenance of railway vehicles in Hong Kong and overseas. 3. To enable students to understand the procurement process of railway vehicles and the necessary management. 4. To acquire knowledge on the components in railway vehicles and their modelling for analysis. 5. To appreciate the testing standards for vehicles; and the inspection and quality control measures.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Identify various types and configurations of railway vehicles. b. Discuss the design principles and system performance of railway vehicles and be aware of the latest development in the technology. c. Elaborate on the project management process for railway vehicle procurement and devise feasibility study and maintenance planning. d. Apply appropriate modelling for vehicles, body design and train dynamics in vehicle performance analysis. e. Given the acceptance standards, formulate tests and inspection for quality control purposes. f. Appreciate the role of engineers on matters other than technical issues. g. Recognise the importance to engage in self-learning on latest technologies on railway vehicle design at this advanced level of study.
Subject Synopsis/ Indicative Syllabus	1. ***Project management for procurement of railway vehicle*****:** Planning and preliminary design, System selection, definition of vehicle, specification, design management, testing and commissioning, maintenance planning. 2. ***Railway vehicle design and development*****:** Types and configurations of railway vehicles, design principles, system performance, Interface and environmental considerations, modern development. 3. ***System description and mechanism design*****:** Carbody, bogie, coupler, door, brake, pneumatics, air-conditioning, traction and control, pantograph, and train management system. 4. ***Vehicle modelling and gauging*****:** Rail vehicle components, suspension system, modelling of vehicles and analysis, kinetic envelope, load gauge. 5. ***Vehicle structures and dynamics*****:** Body shell design, load cases, structural testing and analysis, fundamentals of train dynamics, wheel rail interface, track geometry effect, derailment prediction. 6. ***Vehicle acceptance and testing*****:** Acceptance standards, type test, inspection and quality control, static testing, dynamic runs, trial operation and reliability monitoring. **Case Study:** Site Visits to MTRCL Depots Industrial/Research Seminars

<table>
<tr>
<td>Teaching/Learning Methodology</td>
<td>
<p>The main lecturers are from MTRC, and their experiences/knowledge are shared with students via lectures and tutorials for conveying the concept and theories. The site visit to MTR system has reinforced the pragmatic design and application in a realistic system. Problem solving skill and team work are trained via minor project.</p>
<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="7">Outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td></tr>
<tr><td>Lectures</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Tutorials</td><td></td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
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<tr>
<td>Assessment Methods in Alignment with Intended Learning Outcomes</td>
<td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="7">Intended subject learning outcomes to be assessed</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td></tr>
<tr><td>1. Examination</td><td>60%</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>2. Test</td><td>25%</td><td>√</td><td></td><td>√</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>3. Presentation with Essay Submission</td><td>15%</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Total</td><td>100%</td><td colspan="7"></td></tr>
</table>
<p>The outcomes on concepts, design and applications are assessed by the usual means of examination and test.
The problem solving skill is evaluated via presentation (with essay submission).</p>
</td>
</tr>
<tr>
<td>Student Study Effort Expected</td>
<td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture/Tutorial</td><td>33 Hrs.</td></tr>
<tr><td>▪ Presentation seminar</td><td>3 Hrs.</td></tr>
<tr><td>▪ Site visit</td><td>3 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Presentation preparation/report</td><td>24 Hrs.</td></tr>
<tr><td>▪ Self-study</td><td>42 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>105 Hrs.</td></tr>
</table>
</td>
</tr>
<tr>
<td>Reading List and References</td>
<td>
<p>Textbooks:
1. A.H. Wickens, Fundamentals of Rail Vehicle Dynamics: Guidance and Stability, Swets & Zeitlinger Publishers, 2003</p>
<p>Reference books:
1. Selected papers from the Proceedings of IMechE Part F – Journal of Rail and Rapid Transit</p>
</td>
</tr>
</table>

July 2022

Subject Description Form

Subject Code	EE5381
Subject Title	System Assurance and Safety in Railways
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Exclusion: EE538
Collaboration Institute	MTR Academy
Objectives	1. To allow students to appreciate the importance of safety in railway operation and the required organisation for hazard management. 2. To provide students with a comprehensive understanding on the relationship between railway safety and service performance objectives and application of methodologies of system assurance and safety risk. 3. To enable students to acquire knowledge on the key management processes and analysis techniques adopted in various project phases. 4. To enable students to apply international standards on railway system assurance and safety risk. 5. To enable students to acquire hand-on experience from railway operators on system assurance and safety risk practices.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Identify safety performance indicators and the safety risk principles to produce such indicators. b. Given a railway sub-system, devise the simple safety risk ranking and matrices; and carry out hazard operability study. c. Conduct various system assurance analyses with different techniques to ensure fulfillment of international standards for different purposes. d. Organise safety committees, formulate system assurance programme planning and develop safety cases. e. Analyse the collected safety statistics and plan the hazard registration system. f. Appreciate the safety management skills required in engineering systems g. Recognise the importance to engage in self-learning on latest technologies on railway systems at this advanced level of study.
Subject Synopsis/ Indicative Syllabus	1. ***Safety Risk Assessment*****:** Railway safety performance, lifecycle safety management process, ALARP (As Low AS Reasonably Practicable) principle, societal perception of risk, risk ranking and matrices, closed-loop risk management process, tolerability of risk and formulation of risk criteria, value of preventing a fatality, equivalent fatality, risk mitigation principle 2. ***System Assurance Analysis Techniques & Standards*****:** Hazard & operability study, use of guidewords in identification of hazards, fault tree analysis, event tree analysis, cause-consequence analysis, preliminary hazard analysis, operation & support hazard analysis, cost-benefit analysis, qualitative and quantitative risk analyses, system safety modelling, classification of safety critical items, human error & system safety, safety integrity level & software, MIL STD 882D, IEC 61508, EN50126, BS 5760

3. ***Organisation & Programme Management*:** Safety committees, system assurance programme planning, structure of system safety report/safety Case, in-service safety risk monitoring programme, collection and use of safety statistics, hazard registration system, hazard management organisation.

Case Study:

MTRCL System assurance practices
Industrial/Research seminars

Teaching/Learning Methodology

Lectures and tutorials are effective teaching methods:

1. To provide an overview or outline of the subject contents.
2. To introduce new concepts and knowledge to the students.
3. To explain difficult ideas and concepts of the subject.
4. To allow students to feedback on aspects related to their learning.

Mini-project works/Assignments are essential ingredients of this subject:

1. To supplement the lecturing materials.
2. To add real experience for the students.
3. To provide deeper understanding of the subject.
4. To enable students to organise principles and challenge ideas.

Case studies:

1. To give real examples for some of the concept presented in the lectures.
2. To explain some practical considerations when applying technologies in real projects
3. To motivate and stimulate students interest

Teaching/Learning Methodology	Outcomes						
	a	b	c	d	e	f	g
Lectures	√	√	√	√	√		
Tutorials			√	√	√		
Mini-project works/Assignments					√	√	√
Case studies						√	√

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	g
1. Examination	60%	√	√	√	√	√		
2. Class Test	20%	√	√	√	√	√		
3. Assignments/Mini-project works	20%			√		√	√	√
Total	100%							

The understanding on theoretical principle and practical considerations, analytical skills and problem-solving technique will be evaluated. Examination, class tests, assignments, presentations and mini-project report 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	39 Hrs.
	Other student study effort:	
	▪ Assignment/Mini Project	21 Hrs.
	▪ Self-study	45 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	**Textbooks:** 1. D.J. Smith, Reliability, Maintainability and Risk, 5th Edition, Butterworth-Heinemann, 1997 2. J.D. Andrews and T.R. Moss, Reliability and Risk Assessment, Longman, 1993 3. F. Redmill, M. Chudleigh and J. Catmur, System Safety: HAZOP and Software HAZOP, Wiley, 1999 **Reference books/journals:** 1. EN50126:1999 "Railway Applications – The specification and Demonstration of Reliability, Availability, Maintainability and Safety" 2. MIL -STD-882D "Standard Practice for System Safety", Department of Defence, USA	

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Subject Description Form

Subject Code	EE539
Subject Title	Aerospace Power Electronics and Actuation Systems
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To provide engineers with in depth knowledge of the use of power electronics and actuation systems in the aerospace industry. 2. To provide latest development and applications in power conversion, electric actuator, fly-by-wire, fly-by-light and space power engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Have the ability to acquire a good understanding of aircraft actuation systems. Be able to present the understanding of the basic requirements of aircraft actuation systems. b. Understand and analyse power system needed for the aerospace applications. Be able to present the understanding of power systems for aircrafts. c. Understand the power electronics needs to military devices and space applications. Be able to present the understanding of the basic requirements of power electronics to aerospace environment.
Subject Synopsis/ Indicative Syllabus	1. ***More electric aircraft*****:** Basic concept of more electric aircraft, review of electric systems of aircraft, wiring and cabling, cabin lighting and utilities, electric aircraft 2. ***Aircraft power electronics*****:** Soft power system, rectifier units, distribution systems, and power supplies. 3. ***Actuation systems*****:** Review of hydraulic and electro-hydraulic control systems, hydraulic servo valve, fuel pump, landing gear, secondary flight control system, flux-reverser. 4. ***Aerospace standards*****:** Military standards, British standards on aerospace, and NASA standards. 5. ***Aerospace and aeronautic control:*** Reliability, fly-by-wire, fly-by-light, unmanned air vehicles, propulsion, aeronautic computing system and gyroscope. 6. ***Military power electronics and actuation*****:** Packaging for Military-standard, missile control and guidance system, E-bomb. 7. ***Space power engineering*****:** Ion-thrusters, rocket power electronics and system, power conversion and energy storage in space, space transportation, and photovoltaic system. **Laboratory Class:** Each student is required to conduct a laboratory test or attend a demonstration to understand the aerospace devices and components. **Assignment and mini-project:** Each student is required to work on a mini-project which covers the above selected areas. Written report and presentation are needed.

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 a practical case study, in which the students are expected to understand design problems with real-life constraints and to attain pragmatic solutions.

Teaching/Learning Methodology	Outcomes		
	a	b	c
Lectures	√	√	√
Tutorials	√	√	√
Assignment/Presentation	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Examination	60%	√	√	√
2. Tests	20%	√	√	√
3. Report/Presentation/ Assignment	20%	√	√	√
Total	100%			

One end-of-semester written examination; test(s); a laboratory report; a power point presentation and report for the particular topic.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	30 Hrs
▪ Laboratory	6 Hrs
▪ Test/Presentation	3 Hrs
Other student study effort:	
▪ Case Study	18 Hrs
▪ Self-study	48 Hrs
Total student study effort	105 Hrs

Reading List and References

Reference books:

1. Selected articles from Military and Aerospace Electronics, PennWell Publishing Company
2. Selected articles from Defense & Aerospace Electronics, Pasha Publications, Inc.
3. A.M. Cruise, J.A. Bowles, T.J. Patrick, C.V. Goodall, Principles of Space Instrument Design, Cambridge University Press, 2006
4. Noah D. Manring, Fluid Power Pumps and Motors: Analysis, Design and Control McGraw-Hill Education, 2013
5. M. Jelali, A. Kroll, Hydraulic Servo-systems: Modelling, Identification and Control, Springer, 2013
6. R.P.G. Collinson, Introduction to Avionics Systems, Kluwer Academic, 2011.
7. I. Moir, A. Seabridge, Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Wiley, 2012.
8. P.Thalin, Fundamentals of Electric Aircraft, SAE International, 2018.

Subject Description Form

Subject Code	EE545
Subject Title	Modern Generation and Grid Integration Technologies
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students are expected to have substantial knowledge about electrical power systems. Exclusion: EE501
Collaboration Institute	HK Electric Institute
Objectives	1. To enable students to establish a broad concept on modern power generation technologies, including local relevant renewable energy and gas turbines. 2. To enable students to understand typical renewable energy technologies and related energy storage systems, its associated characteristics, performance, issues of application and related technical considerations. 3. To provide an in-depth knowledge on gas turbine power plants, combined cycle systems, cogeneration and trigeneration systems. 4. To enable students to understand how to integrate renewable energy into power grid, its related issues, concept of micro grid, smart grid, distributed generation and distribution automation.
Intended Learning Outcomes	Upon Completion of the subjects, student will be able to: a. Identify suitable renewable energy source and fuel-mix for electricity generation in Hong Kong under current situations b. Explain the principle of operation for the generation technologies, including their integration into the modern power grid or micro grids. c. Design the overall architecture for the power generation systems and the interfacing parts, and analysis their performance.
Subject Synopsis/ Indicative Syllabus	1. Energy resources and types (1.5 weeks): Renewable and non-renewable energy resources. World potential and trends. Environmental effects. Local relevant renewable energy types and present developments. Role and importance of renewable energy. 2. Wind and solar energy (2 weeks): Overview of wind energy, wind turbine technology, onshore and offshore wind farms, planning considerations for offshore wind farm, wind resource assessment, wind farm siting and optimization, case study. PV technology, PV panel comparison (performance, cost) and criteria for PV module selection, photovoltaic conversion systems, feasibility study and site selection, design and monitoring techniques, new development in PV technology, case study. 3. Energy storage technology (2 weeks): Types of utility scale energy storage systems and the associated power electronic systems and energy management: pumped water storage, hydroelectric dams, batteries, supercapacitors, superconducting magnetic energy and hydrogen storage. Concept of vehicles-to-grid. 4. Gas turbine and cogeneration technology (1 week): comparison of its emission with other fossil fuel plants. Types of gas turbines and its characteristics and operation features. Combined cycle, cogeneration and trigeneration. Major equipment of a Combined Cycle Generation Unit, Thermal cycle and performance indices of combined cycle generation unit.

5. Electrical System in a Power Generation Plant (1 week): Theory of Electricity Generation, Major Electrical Equipment and Machines of a Generation Unit, Power Distribution Systems in a Power Plant, Case study.
6. Grid integration (3 weeks): Integrating renewable energy sources into the power grid, the issues, the associated power electronic systems and its design, load levelling, energy demand response & management, related power dispatching issues. Complementary characteristics among RE sources and energy storages. Case studies: possible example is Longyangxia Dam Solar Park and Alto Rabagao Solar Dam. Applications of smart grids in this area. Concept of micro-grid and distributed generation & distributed automation.
7. Application examples, demonstration and trends (1.5 weeks): Demonstration projects or case study on micro-grid, smart meters, distributed automation, co-generation, trigeneration and vehicle-to-grid concept. Future trends.

Note: 1 week is reserved for test(s) and revision.

Site Visit in a weekend: Lamma Power Station and Lamma Winds
1. L9 Combined-Cycle Generation Unit
2. Gas Receiving Station
3. PV Solar Panel System
4. Wind Turbine

Teaching/Learning Methodology

Delivery of the subject is mainly through formal lectures, complemented by tutorials, work examples/case studies and a visit/ demonstration. Self-learning on the part of students is strongly encouraged and extensive use of web resources will be made. Assignments, in-class assignments, tests and final examination will be the assessment tools.

Teaching/Learning Methodology	Outcomes		
	a	b	c
Lectures	√	√	√
Work examples/ case studies	√	√	√
Visit/demonstration		√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Examination	60%	√	√	√
2. Tests	15%	√	√	√
3. Assignments	15%	√	√	√
4. In-class assignments	10%	√	√	
Total	100%			

This is an advanced and yet appreciation subject for students who are interested in power and energy systems. The outcomes are assessed by usual means of examination, tests and assignments.

Student Study Effort Expected	Class contact:	
	▪ Lecture/Tutorial	39 Hrs.
	Other student study effort:	
	▪ Assignment and Self-study	66 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	1. Ibrahim Dincer and Calin Zamfirescu, “Advanced power generation systems“, Elsevier Science, 2014 2. Nicu Bizon, “Advances in energy research : distributed generations systems integrating renewable energy resources”, Nova Science Publishers, 2011 3. IEA, “The power of transformation : wind, sun and the economics of flexible power systems”, PECD Publishing 2014 4. Mukund R Patel, “Wind and solar power systems : design, analysis, and operation”, CRC Press 2006 5. Rolf Kehihofer, “Combined-cycle gas & steam turbine power plants”, PennWell, 2009 6. Masoos Ebrahimi and Ali Keshavarz, “Combined cooling, heating and power : decision-making, design and optimization”, Elsevier, 2015 7. Ashok D Rao, “Combined cycle systems for near-zero emission power generation”, Oxford England : Woodhead Pub., 2012 8. Q Zhong and T Hornik, “Control of power inverters in renewable energy and smart grid integration”, John Wiley & Sons, 2013 9. Antonio Moreno-Munoz, “Large scale grid integration of renewable energy sources”, IET 2017 10. Ali Keyhani, “Design of smart power grid renewable energy systems”, Wiley, 2011 11. Fereidon P Sioshansi, “Smart grid integrating renewable, distributed & efficient energy”, Elsevier/Academic Press, 2011 12. K. Salman, “Introduction to the Smart Grid: concepts, technologies and evolution”, IET 2017	

Subject Description Form

Subject Code	EE546
Subject Title	Electric Energy Storage and New Energy Sources for Electric Vehicles
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To acquire a broad knowledge on classical and modern electric energy storage 2. To understand the development of energy storage from technological, environmental, and societal perspectives.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the importance of energy storage as it pertains to environmental concerns, energy sustainability and climate change. b. Understand various underpinning technologies for conventional and modern energy storage including both portable and stationary systems, such as batteries, supercapacitors, compressed air, flow batteries, new fuel, and fuel cells. c. Explain the role of energy storage in new energy in electric vehicles (EV) and discuss how energy storage devices can be optimally integrated for these applications.
Subject Synopsis/ Indicative Syllabus	1. ***Concept of energy storage***: History of energy storage, classification of the types of energy storage. 2. ***Electrochemical storage***: Lead-acid and Nickel batteries, Lithium/sodium-based battery, Flow and Redox batteries, Fuel cell, Sustainability considerations for future electrochemical systems. 3. ***Carbon-hydride:*** Carbon hydride energy storage system, non-carbon based fuel, cracking, fuel transportation, fuel storage. 4. ***Mechanical storage***: Compressed air energy storage, pumped hydro energy storage, flywheels. 5. ***Static Energy Storage***: Super-capacitor, Magnetic Energy storage. 6. ***Electrical energy storage parameters***: State of Charge, State of Health, cell impedance and electrochemical impedance spectroscopy, cell models 7. ***Energy management System***: Battery management, Energy management, cell equalization, conditional monitoring. 8. ***New Energy for vehicles***: Solar vehicles, Fuel cell vehicles, hydrogen engine, compressed gas vehicles, power conversion for new energy.
Teaching/Learning Methodology	Delivery of the subject is mainly through formal lectures, complemented by tutorials. worked examples and assignment. Self-learning on the part of students is strongly encouraged and extensive use of web resources will be made.

Teaching/Learning Methodology	Intended subject learning outcomes		
	a	b	c
1. Lectures	✓	✓	✓
2. Tutorials	✓	✓	✓
3. Assignment	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Assignment	20%	✓	✓	✓
2. Test	20%	✓	✓	✓
3. Examination	60%	✓	✓	✓
Total	100 %			

The assignment is designed to assess students’ understanding of the energy storage principles and whether they can present the study clearly.

The test is designed to assess students’ understanding of the topics that they have learnt relative to learning outcomes (a), (b) and (c). The test is usually conduced in the mid-semester to measure students' performance.

Examination: questions are designed to assess learning outcomes (a), (b) and (c). Students are required to answer questions that cover all of the learning outcomes.

Student Study Effort Expected

Class contact:	
▪ Lecture	30 Hrs.
▪ Tutorial and presentation	9 Hrs.
Other student study effort:	
▪ Mini project or Assignment	27 Hrs.
▪ Self-study	49 Hrs.
Total student study effort	115 Hrs.

Reading List and References

1. “Battery Systems Engineering”, A John Wiley & Sons, Ltd., Publication, 2013
2. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer New York, 2013
3. Gregory L. Plett, “Battery Management Systems”, Boston : Artech House 2015
4. Serguei N. Lvov, Introduction to Electrochemical Science and Engineering. Boca Raton: CRC Press, 2015.
5. G. Pistoia and B.Liaw, “Behaviour of Lithium-Ion Batteries in Electric Vehicles: Battery Health, Performance, Safety, and Cost”, Green Energy and Technology, 2018.
6. R.Xiong, “Battery Management Algorithm for Electric Vehicles”, 1st ed., Kindle Edition, 2020.

Subject Description Form

Subject Code	EE547
Subject Title	Electric Vehicle Charging Systems
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To acquire a broad knowledge of electric vehicle charging technology 2. To understand the development of electric vehicle charger from technological, environmental, and societal perspectives.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a Understand the importance of chargers as it pertains to environmental concerns, energy sustainability, climate change, and global policy. b. Understand various underpinning technologies for charger including conductive, wireless and battery swapping. c. Acquire the knowledge of charger practice, charger policy and infrastructure.
Subject Synopsis/ Indicative Syllabus	1. ***Introduction to electric vehicle charging technology:*** Charging system, Constant voltage, Constant current, Pulse charging. 2. ***Charger Circuit:*** Circuit topology, Charging control, AC and DC chargers, Semi-fast, fast and quick chargers. 3. ***Inductive charging:*** Concept of wireless power transfer, Dynamic wireless charger, Coil design, Coupling, Electromagnetic interference. 4. ***Charger standards:*** Wireless standards including Qi, PMA, A4WP, Magnet, conductive charger standard including CHAdeMO, SAE and IEC, Connection and plug. 5. ***Charger infrastructure:*** Charging station and network, pantograph, load management, Vehicle to Grid, EV Penetration, Synergistic control of EV and planning. 6. ***Other Charging technologies***: Battery swapping, Hydrogen and solid fuel.
Teaching/Learning Methodology	Delivery of the subject is mainly through formal lectures, complemented by tutorials. worked examples and assignment. Self-learning on the part of students is strongly encouraged and extensive use of web resources will be made.

Teaching/Learning Methodology	Intended subject learning outcomes		
	a	b	c
1. Lectures	✓	✓	✓
2. Tutorials	✓	✓	✓
3. Assignment	✓	✓	✓
4. Laboratory		✓	

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Assignment	10%	✓	✓	✓
2. Laboratory performance & reports	10%		✓	
2. Test	20%	✓	✓	✓
3. Examination	60%	✓	✓	✓
Total	100 %			

The assignment is designed to assess students’ understanding of the electric vehicle charging principles and whether they can present the study clearly.

Laboratory class is designed to teach students some practical understanding of a charger and its operation.

The test is designed to assess students’ understanding of the topics that they have learnt relative to learning outcomes (a), (b) and (c). The test is usually conduced in the mid-semester to measure students' performance.

Examination: questions are designed to assess learning outcomes (a), (b) and (c). Students are required to answer questions that cover all of the learning outcomes.

Student Study Effort Expected

Class contact:	
▪ Lecture	27 Hrs.
▪ Laboratory, Tutorial and Presentation	12 Hrs.
Other student study effort:	
▪ Mini project or Assignment	21 Hrs.
▪ Laboratory	6 Hrs.
▪ Self study	49 Hrs.
Total student study effort	115 Hrs.

Reading List and References

7. K.T.Chau, “Battery Systems Electric Vehicle Machines and Drives”, Wiley 2015.
8. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer New York, 2013
9. Rik De Doncker, Duco W.J. Pulle, André Veltman, “Advanced Electrical Drives - Analysis, Modeling, Control”, Springer Dordrecht Heidelberg London New York, 2011.
10. The Institution of Engineering and Technology, “Code of Practice for Electric Vehicle Charging Equipment Installation”, IET Standard, 3rd edition, 2018.
11. C.T.Rim, C.Mi, “Wireless Power Transfer for Electric Vehicles and Mobile Devices”, Wiley – IEEE, 1st Edition, Kindle Edition, 2017.
12. L.A.Kumar, S.A.Alexander, “Power Converters for Electric Vehicles”, 1st Edition, Kindle Edition, 2020.

Subject Description Form

Subject Code	EE548
Subject Title	Advanced Electric Vehicle Technology
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: EE512
Objectives	3. To acquire a high level of electric vehicles technology and future EV design 4. To understand the development of the impact of electric vehicles on society and security.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the advanced knowledge of the electric vehicle. b. Understand various advanced parts and components in electric vehicles. c. Understand the future energy sources and storage for electric vehicles. d. Impact of electric vehicles and emerging technologies.
Subject Synopsis/ Indicative Syllabus	1. ***Future EV design and demand:*** All electric parts and components design, configurable EVs, high speed vehicles, hyperloop vehicle, Magnetic levitation vehicle. 2. ***Advanced motor drive:*** In-wheel motor, anti-braking system (ABS), Continuously Variable Transmission (CVT), active suspension. 3. ***Advanced energy storage:*** Distributed energy storage, future battery, future fuel cell. 4. ***Power electronics for EV:*** High power density power electronics, High current power electronics. 5. ***EV and security:*** Advantage and disadvantage of EVs, Autocrypt V2G, EV accidents and safety, EV maintenance, Internet of Thing (IoT) for EVs, Intra vehicle security, Vehicle to Data Center security 6. ***Autonomous vehicles:*** Layers of autonomy, Unmanned ground vehicle (UGV), Advanced Driver Assistance Systems (ADAS), Smart sensors, radar, Lidar, Path control. 7. ***Future power sources for EV:*** Photovoltaic to EV, Catenary-free electric trains and Trolley bus, Non-Carbon fuel, New energy for EVs. 8. ***EV policy:*** Government Policy in EVs, Infrastructure of EVs, sustainability and the environment.
Teaching/Learning Methodology	Delivery of the subject is mainly through formal lectures, complemented by tutorials, worked examples and assignment. Self-learning on the part of students is strongly encouraged and extensive use of web resources will be made.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lectures	✓	✓	✓	✓
2. Tutorials	✓	✓	✓	✓
3. Assignment/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
1. Assignment/mini-project	15%	✓	✓	✓	✓
2. Test	25%	✓	✓	✓	✓
3. Examination	60%	✓	✓	✓	✓
Total	100 %				

The assignment is designed to assess students' understanding of the electric vehicle principles and its impact to society and whether they can present the study clearly. Oral presentation for their assignment is needed.

The test is designed to assess students' understanding of the topics that they have learnt relative to learning outcomes (a), (b), (c) and (d). The test is usually conduced in the mid-semester to measure students' performance.

Examination: questions are designed to assess learning (a), (b), (c) and (d). Students are required to answer questions that cover all of the learning outcomes.

Student Study Effort Expected

Class contact:	
▪ Lecture	30 Hrs.
▪ Tutorial and presentation	9 Hrs.
Other student study effort:	
▪ Mini project or Assignment	27 Hrs.
▪ Self-study	49 Hrs.
Total student study effort	115 Hrs.

Reading List and References

13. Mark Daly, "Electric Vehicles: A Guide for Just About Anyone", Eninserv Limited, 2017.
14. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer New York, 2013.
15. Tom Denton, "Electric and Hybrid Vehicles", Routledge, Taylor & Francis Group, 2016.
16. Wanrong Tang, Y. J. Zhang, "Optimal Charging Control of Electric Vehicles in Smart Grids", Springer, 2017.
17. Hanky Sjafri. "Introduction to Self-Driving Vehicle Technology", Chapman & Hall/CRC Artificial Intelligence and Robotics Series, 2019.
18. S. Liu, L. Li, J. Tang, S.Wu, J.Gaudiot, "Creating Autonomous Vehicle Systems", Synthesis Lectures on Computer Science, 2020.

Subject Description Form

Subject Code	EE549
Subject Title	Modern Sensor Technologies
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Undergraduate-level circuit and electromagnetic theory
Objectives	1. To acquire the fundamentals of sensor technologies. 2. To make the students to understand the structures and working principles of resistive, capacitive, piezoelectric, acoustic, electric and magnetic sensors. 3. To enable the students to understand and design thermal and mechanical sensors, optical sensors, optical fiber sensors and micro-electromechanical system (MEMS) sensor technologies. 4. To know the applications of sensors in Electrical Engineering
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Acquire the operation principles and recent developments of sensors and transducer technologies, including thermal and mechanical sensors, electric and magnetic sensors, optical sensors as well as MEMS sensors technologies. b. Understand the structures and working principles of thermal sensors, mechanical sensors, acoustic sensors, electric and magnetic sensors for practical applications. c. Select the most appropriate optoelectronic components and optical fiber devices to design optical sensors and optical fiber sensor systems. d. Comprehend the structures and multidisciplinary working principles of MEMS-technology and sensor networks. e. Have hands-on experience in the assembling and testing of electric/optical sensors or MEMS sensors.
Subject Synopsis/ Indicative Syllabus	1. ***Introduction to sensor fundamentals***. Definition of sensors; sensor and information; physical quantities; relation between quantities; sensor classification; uncertainty aspects. 2. ***Thermal, mechanical and acoustic sensors***. Resistivity and resistance; construction, general properties and applications of potentiometric sensors; strain gauges and their applications; thermoresistive sensors; capacitance and permittivity; flat-plate and multi-plate capacitive sensors; silicon capacitive sensors and applications. 3. ***Electric and magnetic sensors***. Magnetic induction, permeability and magnetostriction; magnetic field sensor; magnetic and induction based displacement and force sensors; piezoelectric materials and parameters; piezoelectric force, pressure and acceleration sensors and applications. 4. ***Optical sensors and optical fiber sensors.*** Electro-optical components; classification of optical sensors; optoresistive sensors; optical displacement sensors; optical acoustic sensors; optical fiber grating sensors; optical fiber distributed sensors and applications. 5. ***MEMS and smart sensors.*** Production of MEMS; MEMS-based pressure sensors, mass air flow sensors, inertial sensors and angular rate sensors; optical MEMS sensors, sensor network. 6. ***Applications: sensors in Electrical Engineering.*** Electrical and optical current sensors; power cable fault-detection methods; smart railway monitoring systems. **Laboratory Experiments:** Design, fabrication and testing of mechanical or optical fiber sensors; demonstration of the package and testing of MEMS sensors.

Teaching/Learning Methodology

Lectures, quizzes, tests, laboratory experiments, mini-projects, and examination.

Teaching/Learning Methodology	Outcomes				
	a	b	c	d	e
Lectures	√	√	√	√	
Tutorials	√	√	√	√	
Experiments/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
1.Tests/Quizzes	18%	√	√	√	√	
2. Assignments	6%	√	√	√	√	
3. Lab and mini-project	16%	√		√		√
4. Examination	60%	√	√	√	√	
Total	100%					

This subject introduces the structures, working principles and applications of electrical/optical sensor technologies. Tests/assignments/examination will be used to assess the outcomes about the structures and operation principles and applications of various electrical/magnetic/optical sensors. Experiments/mini-project will be used to assess the hands-on experience in electrical/optical sensors and MEMS devices.

Student Study Effort Expected

Class contact:	
▪ Lectures/Tutorials/Laboratory demo	39 Hrs.
Other student study effort:	
▪ Mini-project and report	20 Hrs.
▪ Self-study and assignments	46 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Sensors for Mechatronics, 2nd edition, Paul P. L Regtien, Edwin Dertien, Elsevier, 2018.
2. Sensors, actuators, and their interfaces: a multidisciplinary introduction, Nathan Ida, SciTech Publishing, 2014.
3. Handbook of Modern Sensors: Physics, Designs, and Applications, Jacob Fraden, Springer International Publishing AG, 2015.
4. Sensors handbook, 2nd edition, Sabrie Soloman, McGraw-Hill, 2010.

Subject Description Form

Subject Code	EE550
Subject Title	Enterprise Risk and Asset Management
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Collaboration Institute	MTR Academy
Objectives	1. To allow students to appreciate how enterprise risk management and asset management contribute to business sustainability of railway operation and the required organisation. 2. To provide students with basic understanding of Enterprise Risk Management in railway industry. 3. To provide students with comprehensive understanding on asset management for railways and the concept and principles of which are also applicable to other industry sectors. 4. To enable students to acquire knowledge on the key asset management processes and techniques adopted. 5. To enable students to apply international standard and practices on asset management.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the key elements of asset management and ERM framework, international standards and critical success factors for system implementation. b. Appreciate the asset management and enterprise risk management techniques. c. Recognise the importance to engage in self-learning on latest industry best practices on asset management at this advanced level of study.
Subject Synopsis/ Indicative Syllabus	1. ***Enterprise Risk Management*** • Enterprise Risk Management (ERM) framework • Risk management organisation for ERM • Risk aggregation and reporting, risk categorization and measurement, risk identification and assessment, risk control and responses, review and audit • Critical success factors for ERM • Application of ERM in typical railway system 2. ***Asset Management*** **Asset Management Framework** • Introduction to ISO55000:2014 • Alignment with corporate asset management direction • Asset management organizations • Asset management and business sustainability **Enabling Processes for Asset Management** • Establishment and measurement for levels of service • Demand forecasting and management • Risk management for asset management • Condition assessment and performance monitoring • Reliability Centred Maintenance • Asset criticality • Maintenance management planning • Asset investment and reinvestment decision making • Value engineering, life cycle costing & Internal Rate of Return • Audit and management review for asset management

Asset Management Information Systems and Data Management

- Asset management information system
- Data structure and numbering
- Data collection and management
- Data analytics and machine learning for asset management

Case Study:
Case studies of asset management and ERM techniques and practices
Industrial/Research seminars

Teaching/Learning Methodology

The concept of risk and asset management, reliability analysis and system assurance analysis will be presented through lectures and tutorials with reference to real-life applications on railway and related systems. Students will be required to form groups to work through cases covering practices on the real-life cases. Guest lectures are structured on appropriate sessions for relating the theoretical concepts real-life to practices. Students are required to share, present and defense their finding on their case studies.

Teaching/Learning Methodology	Outcomes		
	a	b	c
Lectures	√	√	√
Case Studies	√	√	√
Discussion Forum and Presentation	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Examination	60%	√	√	√
2. Class Test	20%	√	√	
3. Case study report	20%	√	√	√
Total	100%			

The outcomes on the concepts of analysis are assessed by the usual means of examination and test whilst those on practical application, problem-solving techniques and presentation of findings, as well as technical reporting and teamwork, are evaluated by the case study exercise.

Student Study Effort Expected

Class contact:	
▪ Lecture	33 Hrs.
▪ Guest Lecture	6 Hrs.
Other student study effort:	
▪ Case study preparation/report	18 Hrs.
▪ Self-study	48 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Reference books/journals:

1. ISO55000 : 2014 and ISO55001 :2014
2. ISO 31000: 2009 Risk management – Principles and guidelines
3. BS 31100: 2008 Risk management – Code of practice

Subject Description Form

Subject Code	EE552
Subject Title	High Speed Rail
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To provide students with a comprehensive understanding of the updated operation principles and applications of high speed rail systems from an engineering viewpoints. 2. To enable students to acquire knowledge of the state-of-the-art design of high speed trains, on-board train control systems and train detection systems to ensure safe and efficient operation of high speed rail. 3. To enable students to understand the latest design concepts of the high speed rail signaling systems (ETCS, European Train Control Systems and CTCS, China Train Control Systems) and moving block signaling concepts. 4. To enable students to acquire knowledge of the key infrastructures and engineering systems of high speed rail. 5. To enable students to appreciate the planning of a high speed rail project and the design principles of the high speed rail terminus and platforms with focus on the design considerations for passenger flow and movement.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Identify the design concepts, functions, and operation principles of a high speed rail. b. Understand the design and operation principles of high speed rolling stocks and traction control systems as well as the engineering practices in real-life applications. c. Analyze the operation principles of a high speed train control system and signaling system in terms of advantages and limitations and also formulate a simple signaling system configuration. d. Acquire a comprehensive knowledge of the key engineering systems and infrastructures of a high speed line to pave way for more advanced studies. e. Understand the key issues in the planning and design of a high-speed line, and its stations and platforms.
Subject Synopsis/ Indicative Syllabus	1. **Introduction:** What is a high speed rail, speed/time/travel distance characteristics, line capacity and headways, high speed lines development worldwide, basic design and operation concepts, station/tunnel/bridge design considerations, international high speed rail standards, 2. **High Speed Rolling Stocks:** Types of rolling stocks (concentrated power/distributed power/articulated/tilting trains), train body design, key engineering components design, braking characteristics, traction curves, train resistance and aerodynamics, Davis equation, train detection and navigation systems, future rolling stocks. 3. **Traction Control:** AC drives, torque-speed characteristics, traction equations, tractive effort curves, eco-driving, traction drive controls-resistance control, chopper control and PWM control, AC-DC (thyristor phase-control bridges, pulse width modulated, PWM converter), DC-AC (insulated gate bipolar transistor, IGBT inverter), traction supply system (25 kV AC), earthing and ground return current for AC traction power supply, auxiliary power supply

4. **Signaling Systems:** Fail safe principle, route setting, movement authority, Automatic train protection system (ATP), Automatic train operation (ATO), moving block signaling (with worked calculation example), Global system for mobile communication – Railways (GSM-R), European Train Control System (ETCS) – Eurobalise, radio block centre (RBC), lineside electronic unit (LEU), Euroloop, ETCS levels 1, 2 & 3 – system architecture, ETCS operation modes, European Rail Traffic Management System (ERTMS), Driver machine interface, DMI, China Train Control System (CTCS) levels 0, 1, 2 & 3 – system architecture, RBC, CBI, train control centre (TCC), track circuits, balise, LEU, DMI, CTCS operation modes, Grade of automation, GoA (IEC 62290), future signaling
5. **Terminal and Station Design:** planning of a high speed line project, high speed rail terminus and station design, platform design, passenger flows-vertical and horizontal movements, Level of service, LoS
6. **Infrastructures: C**atenary supply systems (OHL), overhead rigid conductor (ORCR), p way, track form, track geometry and gauge, rail cant, switch and crossing, rail fasteners, rail welding, wheel-rail wear, tunneling (drill and blast, cut and cover, immersed tube, TBM), structural gauge and kinematic envelope.

Teaching/Learning Methodology

Main lectures are delivered by subject lecturer, who share his practical experience and knowledge with students through lectures and tutorials. The design, operation principles and engineering concepts of high speed rail and key systems will be discussed. The site visit to MTR XRL line is also arranged to enable students to reinforce what they have learned with the real-life applications.

Teaching/Learning Methodology	Outcomes				
	a	b	c	d	e
Lectures	√	√	√	√	√
Tutorials	√	√	√	√	√
Site Visit	√	√	√	√	

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
1. Assignments/mini projects	40%	√	√	√	√	√
2. Examination	60%	√	√	√	√	√
Total	100 %					

The examination is to evaluate the students' understanding of the design and operation principles of the high speed rail and its engineering systems. Assignments/mini projects provide the means to assess the students' analytical skills and the knowledge learned.

Student Study Effort Expected	Class contact:	
	▪ Lectures/Tutorials	33 Hrs.
	▪ Invited lecture	3 Hrs.
	▪ Site visit	3 Hrs.
	Other student study effort:	
	▪ Assignments	10 Hrs.
	▪ Self-study	56 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	**Reference books/journals:** 1. High Speed Rail – Fast Track to Sustainable Mobility, International Union of Railways (UIC) 2. High Speed Railway System - Implementation Handbook, UIC (www.uic.org/highspeed) 3. Railway in Hong Kong – Stepping into a new Era at the Asia Pacific Rail Conference in HK, March 2015 by Dr KM Leung 4. Application of Automatic Platform Gate to reduce safety risks at the International Railway Safety Conference in Johannesburg, October 2015 by Dr KM Leung 5. Managing Human Factors in Hong Kong through a Risk-based Approach at the International Railway Safety Conference in Vancouver, October 2013 by Dr KM Leung 6. High-Speed EMUs: Characteristics of Technological Development and Trends, Elsevier Journal, Engineering 6, 2020, by Hongwei Zhao, Jian Ying Liang, Chang Qing Liu 7. Optimization of High-Speed Railway Line Planning Considering Extra-Long Distance Transportation, Journal of Advanced Transportation Volume 2020, by Ying Wang, Qi-Yuan Peng ,1 Ling Liu, and Jia-Kang Wang 8. High Speed Rail Development Worldwide, EESI, June 2018.	

Subject Description Form

Subject Code	EE553
Subject Title	Railway Electronic Systems
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To provide overview knowledge of railway electronic systems including main control system, communication system and automatic fare collection system. 2. To acquire working knowledge on the design and maintenance of railway electronic systems. 3. To be aware of the trends in the technological development of railway electronic systems and key players in the industry.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) Acquire the operational roles of railway electronic systems including main control system, communication system and automatic fare collection system. b) Understand the operating principles of railway electronic systems, and how they are maintained. c) Acquire the principal design features and interface requirements of railway electronic systems. d) Acquire the technological developments of railway electronic systems and their trends in the railway industry. e) Acquire the key players in the railway electronic systems industry and their business prospects. f) Acquire the future integration of the railway electronic systems as part of the Internet of Things (IoT).
Subject Synopsis/ Indicative Syllabus	1. Operation of railway electronic system in the context of metro lines. 2. Operating principles and principal design features of railway electronic systems. 3. Asset maintenance of railway electronic systems. 4. Design, supply, installation, and testing and commissioning of railway electronic systems. 5. Integration of railway electronic systems with other railway systems. 6. Technological development trends and key players in the railway electronic system industry. 7. Case study – railway electronic systems in the MTR network.

Teaching/Learning Methodology

Subject matter experts in the field of railway electronic systems from MTR and other operators will be invited to share their knowledge with students through lectures and tutorials.

Teaching/Learning Methodology	Learning Outcomes					
	a	b	c	d	e	f
Lectures	✓	✓	✓	✓	✓	✓
Tutorials	✓	✓	✓	✓	✓	✓
Site Visits		✓	✓			

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be					
		a	b	c	d	e	f
1. Examination	60%	✓	✓	✓	✓	✓	✓
2. Assignments	15%	✓	✓	✓	✓	✓	✓
3. Projects	25%	✓	✓	✓	✓	✓	✓
Total	100 %						

Assignments: Students are required to 1) construct an interfacing schematic and explain each of key interfaces relating to the railway electronic systems and 2) suggest one application of IoT which may relate to railway electronic system and provide an outline of the suggested application. These are designed to assess learning outcomes (c) and (f).

Projects: Students demonstrate having acquired detail and updated knowledge on railway electronic systems through an extensive and intensive literature search exercise, digestion of the relevant information obtained and presenting the results appropriately in the project report. The students' understanding will also be tested through Q&A in a face-to-face session with the lecturer. These are designed to assess learning outcomes (d), (e) and (f)

Examination: Questions are designed to assess learning outcomes (a), (b), (c), (d), and (e). Students are required to answer questions that cover all of the learning outcomes.

Student Study Effort Expected

Class contact:	
▪ Lecture/ Tutorial	36 Hrs.
▪ Site visit	3 Hrs.
Other student study effort:	
▪ Self-study	42 Hrs.
▪ Project/Assignment	24 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Selected publications from technical journals and video clips to be circulated by the lecturers of the subject.

Subject Description Form

Subject Code	EE560
Subject Title	Metros in Hong Kong and China
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To provide students through lectures, site visits and exchanges with Metro personnel; an overview knowledge and an appreciation of Metro operations, business and projects, using systems in Hong Kong and China as illustrations.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. demonstrate an understanding of the fundamentals of metro operations and management b. acquire a comprehensive knowledge of key engineering systems in metros to pave the way for more advanced studies c. appreciate the key issues in the planning and implementation of metro projects.
Subject Synopsis/ Indicative Syllabus	1. <u>Introduction</u> a. Objectives and key attributes of Metros b. Major components of a Metro c. Role of Metros in public transport d. A survey of operating Metros in Hong Kong and China. e. Future development of Metros in Hong Kong and China. 2. <u>Key systems in Metro</u> a. Trains b. Trackwork and civil infrastructure c. Signalling, control and communication systems d. Power supply system e. Station facilities f. System integration and system assurance 3. <u>Metro Operation</u> a. Train operation b. Station operation c. Depot operation d. Asset maintenance e. Key performance indicators f. Safety and risk management 4. <u>Metro business</u> a. Customer services b. Non-fare business c. Fare policy and strategy 5. <u>Metro Project</u> a. Project planning b. Project implementation c. Funding of projects

Teaching/Learning Methodology

a) Lectures – 30 hours
b) Site visits
c) Tutorial/Discussion with Metro personnel – 9 hours

Core subject knowledge will be delivered in the lectures, site visits will enhance the students' understanding on the subject contents, while tutorials and discussion with Metro personnel will give more details on the real world practices.

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

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Mini project/assignments	40%	√	√	√
2. Examination	60%		√	√
Total	100%			

Candidates are expected to select a mini-project from the wealth of case studies to demonstrate their understanding of the metro systems. The examination covers both practical and theoretical aspects of the major issues to be considered in the design and planning of metro systems in both Hong Kong and Mainland.

Student Study Effort Expected

Class contact:	
▪ Lectures	30 Hrs.
▪ Tutorials	9 Hrs.
Other student study effort:	
▪ Site Visits	9 Hrs.
▪ Self-study	57 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Hirsch, R. (Ed), (2007), 'Managing Railway Operations and Maintenance: Best Practices from KCRC', University of Birmingham Press
2. Industry specific codes of practice, procedures, standards and manuals

July 2022

Subject Description Form

Subject Code	EE570
Subject Title	Design and Analysis of Smart Grids
Credit Value	3
Level	5
Pre-requisite / Co-requisite/ Exclusion	Nil
Objectives	1. To provide students with a comprehensive understanding on design and analysis of smart grids; 2. To ensure the students aware of the current state-of-the-art on design, operation and control of smart grid; 3. To acquire knowledge on the components in smart grids and their functions; and 4. To enable students to apply advanced analysis tools in planning and operation of smart grids.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Acquire in-depth understanding on recent development of power grids, i.e. smart grid; b. Apply advanced analysis tools in planning and operation of smart grids; and c. Acquire skills in presentation and interpretation of results in written form.
Subject Synopsis/ Indicative Syllabus	1. ***Introduction to smart grid (1.5 week)*****:** Overview of power system operation; Comparison between existing grid and smart grid; Objectives; Benefits; Challenges; Basic structure and functions of components. 2. ***Communications and measurement (1.5 weeks*****):** Latest technologies; Wide Area Monitoring Systems (WAMS), Phasor Measurement Units (PMU), Smart Meters, Smart Appliances, and Advanced Metering Infrastructure (AMI); GIS and Google Mapping Tools; Multiagent Systems Technology. 3. ***Micro-grid (2 weeks)*****:** Concept of micro-grid; design and analysis; distributed generation; distributed automation. 4. ***Renewable energy and storage (2 weeks)*****:** Renewable energy resources and options for smart grid including solar energy, wind energy, fuel cell, biomass etc.; Penetration and variability; Demand Response; Electric vehicles and plug-in hybrid; Battery energy storage systems. 5. ***Interoperability, standards and cyber security (2 week):*** State-of-the-art, Benefits, Challenges, Risks. 6. ***Analysis tools (3 weeks)*****:** Power/load flow studies; Static security assessment; State estimation and stability assessment; Reliability assessment; Decision support tools; Advanced optimization and control; Environmental impacts; Pathway for designing smart grid. 7. ***Application examples and its trends (1 week)*****:** Demonstration projects; Testbeds and benchmark systems; Future trends; Research, education and training.

Teaching/Learning Methodology

Lectures and tutorials are the primary means of conveying the concepts and theories. Mini-projects are designed to supplement the lecturing materials so that the students are encouraged to take extra readings and the latest development of the smart grids.

Teaching/Learning Methodology	Outcome		
	a	b	c
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
1. Examination	63%	√	√	
2. Class test	18%	√	√	
3. Mini-project	19%		√	√
Total	100%			

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

The outcomes on understanding on development of smart grid and application of advanced analysis tools are assessed by the usual means of examination and tests. Mini-projects and written reports assess those on analytical skills, problem-solving techniques and technical reporting.

Student Study Effort Expected

Class contact:	
▪ Lectures	36 Hrs.
▪ Tutorial	3 Hrs.
Other student study effort:	
▪ Self-study	50 Hrs.
▪ Mini-project	16 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. P. Sioshansi, “Smart Grid: Integrating Renewable, Distributed & Efficient Energy,” Elsevier Inc., 2012.
2. J.A. Momoh, “Smart Grid: Fundamentals of Design and Analysis,” 2012 IEEE, John Wiley & Sons, Inc., 2012.
3. Peter Fox-Penner, “Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities,” Island Press, 2010.

SUBJECT DESCRIPTION FORMS

Subjects offered by the

Department of Electronic & Information Engineering

Subjects Code	**Subject Title**
EIE509	Satellite Communications - Technology and Applications
EIE511	VLSI System Design
EIE515	Advanced Optical Communication Systems
EIE522	Pattern Recognition: Theory and Applications
EIE529	Digital Image Processing
EIE546	Video Technology
EIE553	Security in Data Communication
EIE557	Computational Intelligence and its Applications
EIE558	Speech Processing and Recognition
EIE560	Microelectronics Processing and Technologies
EIE563	Digital Audio Processing
EIE566	Wireless Communications
EIE567	Wireless Power Transfer Technologies
EIE568	IoT – Tools and Applications
EIE569	Sensor Networks
EIE570	Deep Learning with Photonics
EIE571	Photonic System Analysis
EIE572	Information Photonics
EIE573	Mobile Edge Computing
EIE575	Vehicular Communications and Inter-Networking Technologies
EIE577	Optoelectronic Devices
EIE579	Advanced Telecommunication Systems
EIE580	Radio Frequency and Microwave Integrated Circuits for Communication System Applications
EIE587	Channel Coding
EIE589	Wireless Data Network

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 multib*e*am 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 two presentations and write a report summarizing their findings.

Teaching/Learning Methodology	Intended Subject Learning Outcomes				
	a	b	c	d	e
Lectures	✓	✓			✓
Tutorials	✓	✓		✓	
Mini-project			✓		✓
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/	25%	✓	✓	✓	✓	
2. Tests	20%	✓	✓	✓	✓	
3. Mini-project	55%			✓		✓
Total	100%					

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

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

Mini-project requires the student to do further reading, search for information, keep abreast of current development, give presentations and write a report

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial/Presentation	36 Hrs.
▪ Site visit	3 Hrs.
Other student study effort:	
▪ Lecture: further reading, doing homework/ assignment	30 Hrs.
▪ Mini-project: studying, writing a report, preparing two presentations	38 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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Subject Description Form

Subject Code	EIE511
Subject Title	VLSI System Design
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Logic Design
Objectives	To provide an understanding of various aspects of VLSI system design. In particular, to look at how different design methodologies and styles are utilized to achieve high-performance, cost-effective integrated circuits.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. master the fundamental principles behind the design methodologies of digital systems in VLSI; b. know what the current state-of-the-art digital design technologies can offer; c. apply top-down, systematic design approach for high performance digital CMOS VLSI integrated circuit with HDL and electronic design automation software; d. design the digital VLSI systems to meet performance and time-to-market goals; e. derive feasible and efficient testing and design-for-testability structures to achieve high quality and short design turnaround.
Subject Synopsis/ Indicative Syllabus	**Part I: Fundamental Concepts** 1. Overview 1.1 Overview of different design methodologies. 1.2 Design styles (Gate Arrays, Standard Cells, Custom); future technology trends. 2. Semiconductor Technologies 2.1 Technology comparison - CMOS, BIPOLAR, NMOS, and Bipolar-CMOS. 2.2 Static and dynamic CMOS circuit design. 2.3 Basic elements of logic design. **Part 2: Design Methodology, Performance Evaluation and Testing** 3. Digital System Design 3.1 HDL design for arithmetic components: adders and related functions, binary counters, and multipliers. 3.2 HDL design for simple systems of computer arithmetic. 3.3 HDL design for real digital systems. 4. Major Design Issues 4.1 Logic levels, delay calculations, layout and parasitics. 4.2 Clocking methodologies, clock distribution and driving large load. 4.3 Layout consideration - importance of good floor-planning and its effect on overall chip performance. 4.4 Wiring strategies, device scaling, and power estimates; and low power design techniques. 4.5 Testability: Fault models and fault simulation. 5. Electronic Design Automation 5.1 Logic Synthesis and floor-planning. 5.2 Placement and routing.

Teaching/Learning Methodology

The theories and applications of various digital system design techniques will be discussed and explain in lectures. Laboratory sessions will be provided to strengthen students' understanding on the theories and hands-on design experiences on the applications. Students will also be requested to practise the implementation of a digital system in the project. Class discussion can help the students to have better understand of VLSI application among the discussions. Project can allow the students to design, implement and test a VLSI system.

Teaching/Learning Methodology	Intended Subject Learning Outcomes				
	a	b	c	d	e
Lectures	✓	✓	✓	✓	
Project			✓	✓	✓
Class discussion		✓	✓	✓	
Laboratory sessions			✓	✓	✓

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. Laboratory exercises	10%	✓		✓	✓	
2. Assignments	20%	✓	✓			
3. Project	30%	✓		✓	✓	
4. Tests	40%	✓	✓		✓	✓
Total	100%					

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

1. **Laboratory Exercises**: For each lab session, students will need to understand the fundamental concepts [Outcome (a)] before they can complete the lab exercises. Because the lab sessions involve the digital design technologies [Outcome (c)], students' ability to apply these technologies should be reflected based on the performance [Outcome (d)] of their design.
2. **Assignments:** Students will need to do the assignments in order to understand the fundamental concepts [Outcome (a)] and the current design methodologies [Outcome (b)] of digital VLSI system.
3. **Projects:** In the project, students will need to understand the fundamental concepts [Outcome (a)] before they can complete the project. Because the project involves the digital design technologies [Outcome (c)], students' ability to apply these technologies should be reflected based on the performance [Outcome (d)] of their design.
4. **Tests:** Students will need to answer questions about the fundamental concepts [Outcome (a)] of various design technologies and their applications [Outcome (b)]. Limitations, performance [Outcome (d)] and testing procedure [Outcome (e)] of current digital system design technologies will also be asked in the test.

Student Study Effort Expected

Class contact:	
▪ Lectures	26 Hrs.
▪ Laboratory exercises	13 Hrs.
Other student study effort:	
▪ Project	44 Hrs.
▪ Revision and completion of assignments	30 Hrs.

	Total student study effort	113 Hrs.
Reading List and References	1. W. Wolf, *Modern VLSI Design – System-on-Chip Design*, Prentice Hall International, 2002. 2. Kenneth L. Short, *VHDL for Engineers*, Pearson Education, 2009 3. S. Yalamanchili, *VHDL – A Starter's Guide*, 2nd edition, Prentice Hall International. 4. N. Weste, K. Eshraghian, *Principles of CMOS VLSI Design - A Systems Perspective*, 2nd edition, Addison-Wesley, 1993.	

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Subject Description Form

Subject Code	EIE515
Subject Title	Advanced Optical Communication Systems
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: Nil Mutual exclusions: EIE4449
Objectives	Objectives: The subject aims to introduce (i) Optical networking, principles and challenges: current and future optical networks. (ii) Enabling technologies: Principles and device physics of optical components that form the building blocks of optical networks (e.g., WDM); Transmission technology for optical networks. (iii) Optical communication networks
Intended Learning Outcomes	Upon completion of the subject, the student will be a. Equipped with the tools and ideas of selecting, designing, installing, testing and maintaining an optical system providing data communication in a broadband local access, metro or wide-area network. b. Understand the key components of optical communication networks. c. Be able to design a simple optical transmission link.
Subject Synopsis/ Indicative Syllabus	**Detailed subject contents:** 1. Basic Concepts in Optical Networks: Principles and Challenges 1.1 What is an optical network? 1.2 Optical networks: needs and challenges 2. Enabling Technologies 2.1 Optical fiber (fundamental principles) 2.2 Optical transmitters 2.3 Optical receivers and filters 2.4 Optical amplifiers 2.5 Optical transmission link design 2.6 Optical switching elements 3. Optical Link Design 3.1 Optical amplified multispan link design 3.2 OSNR and Q factor 3.3 Power penalty due to dispersion and fibre nonlinearity 3.4 Advanced modulation formats 3.5 Coherent detection systems 4. Optical Communication Networks 4.1 Optical access networks 4.1.1 PON technologies 4.1.2 Ethernet PON access network 4.1.3 Wavelength division multiplexing (WDM) PON 4.2 Optical Networking Elements 4.2.1 Optical switches and add/drop multiplexers

4.2.2 Reconfigurable add/drop multiplexer (ROADM)

Teaching/Learning Methodology

Method	Remarks
Lectures	Fundamental principles and key concepts of the subject are delivered to students.
Tutorials	Supplementary to lectures and are conducted with smaller class size if possible; Students will be able to clarify concepts and to have a deeper understanding of the lecture material; Problems and application examples are given and discussed.
Assignment	Students will be given an opportunity to learn some of important and related techniques.

Teaching/Learning Methodology	Intended Subject Learning Outcomes		
	a	b	c
Lectures	✓	✓	✓
Tutorials	✓	✓	✓
Assignment	✓	✓	✓

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
1. Test	25%	✓	✓	
2. Assignment	25%	✓	✓	✓
3. Examination	50%	✓	✓	✓
Total	100%			

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

1. **Test:** Students will need to answer questions about fundamental concepts of optical fiber communications, optical network technologies and their applications.
2. **Assignment:** Students will be given an assignment, which requires students to do further reading, search for information, keep a breast of current developments, write a report, and give an oral presentation.
3. **Examination:** Students will need to answer questions about concepts of optical fiber communications, optical network technologies, and also the components, designs and applications.

Student Study Effort Expected	Class contact:	
	▪ Lectures and Tutorials	33 Hrs.
	▪ Assignment and Test	6 Hrs.
	Other student study effort:	
	▪ Self-study	55 Hrs.
	▪ Report writing	15 Hrs.
	Total student study effort	109 Hrs.
Reading List and References	**References** 1. G. Keiser, Optical Fiber Communications, 5th ed., McGraw-Hill, 2015. 2. M Cvijetic, I B Djordjevic, Advanced Optical Communication Systems and Networks, Artech House, 2013. 3. John Senior, Optical Fiber Communications: Principles and Practice, 3rd ed., Pearson Education, 2009. 4. Jeff Hecht, Understanding Fiber Optics, 4th ed., Prentice-Hall, 2002.	

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Subject Description Form

Subject Code	EIE522
Subject Title	Pattern Recognition: Theory and Applications
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This course offers an up-to-date review of the state of the art in pattern recognition. In particular, it outlines the need for pattern recognition, its different algorithms, decision theoretic, syntactic, and neural network approaches including learning algorithms, and different classical image processing and character recognition techniques. The course will emphasize practical techniques for implementing useful pattern recognition systems. It will also provide a base for practice and progress in matters related to research.
Intended Learning Outcomes	Upon completion of the subject, students shall be able to a. Understand and analyze methods for automatic training of classification systems based on typical statistical, syntactic and neural network approaches; b. Understand common feature extraction methods for pattern recognition; c. Design systems and algorithms for pattern recognition; d. Implement typical pattern recognition algorithms in MATLAB; e. Present ideas and findings effectively; and f. Think critically and learn independently.
Subject Synopsis/ Indicative Syllabus	1. <u>Introduction</u> 1.1 The Subproblems of Pattern Recognition 1.2 Structure of a Pattern Recognition System 1.3 Patterns and Pattern Vectors 2. <u>Feature Extraction and Applications</u> 2.1 Edge-Detection Methods 2.2 Shape Characterization 2.3 Texture Analysis 2.4 Colour Features 2.5 People Detection and Face Recognition 3. <u>Statistical Approaches to Pattern Recognition</u> 3.1 Approaches to Developing StatPR Classifier 3.2 Bayesian Theorem and Bayesian Classifier 3.3 Supervised Learning Using Parametric & Nonparametric Approaches 3.4 Unsupervised Learning and Clustering 3.5 Case Studies 4. <u>Subspace Analysis</u> 4.1 Principal Component Analysis 4.2 Linear Discriminant Analysis 4.3 Applications to Face Detection and Recognition

5. Support Vector Machines
    - 5.1 SVM Principles
    - 5.2 Linear SVM
    - 5.3 Nonlinear SVM
    - 5.4 Applications of SVM

6. Random Forest
    - 6.1 Decision Tree
    - 6.2 Random-forest Training
    - 6.3 Forest Ensemble
    - 6.4 Applications of Random Forests

7. Neural Networks and Their Applications to Pattern Recognition
    - 7.1 Artificial Neural Networks: Architectures, Output Characteristics, and Learning Algorithms
    - 7.2 Neural Network Structures for Pattern Recognition
    - 7.3 Multilayer Feedforward Networks and Backpropagation Training Algorithms
    - 7.4 Unsupervised Feature Learning and Deep Learning
    - 7.5 Case Studies

Laboratory Exercises:

(1) Face Image Analysis and Representation Using Principal Component Analysis
(2) Design of Neural Network PR Systems

Teaching/Learning Methodology

Lecture (leaning outcomes a, b, and c)

- fundamental principles and key concepts of the subject are delivered to students;
- guidance on further readings, applications and implementation is given.

Tutorial (learning outcomes a, b, c and f)

- students will be able to clarify concepts and to have a deeper understanding of the lecture material;
- problems and application examples are given and discussed.

Laboratory exercises (learning outcomes a - f)

Students will make use of the software tools and MATLAB to develop simple pattern recognition systems.

Assignments (learning outcomes a – c , e, and f)

- end-of chapter type problems are used to evaluate students' ability in applying concepts and skills learnt in the classroom;
- students need to think critically and creatively in order to come with an alternate solution for an existing problem.

Teaching/Learning Methodology	Intended Subject Learning Outcomes					
	a	b	c	d	e	f
Lectures	✓	✓	✓			
Tutorials	✓	✓	✓			✓
Laboratories	✓	✓	✓	✓	✓	✓
Assignments	✓	✓	✓		✓	✓

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	f
1. Tests	25%	✓	✓	✓		✓	✓
2. Final examination	50%	✓	✓	✓		✓	✓
3. Assignments	10%	✓	✓	✓		✓	✓
4. Laboratories (including report writing)	15%	✓	✓	✓	✓	✓	✓
Total	100%						

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	7 Hrs.
▪ Laboratory	6 Hrs.
Other student study effort:	
▪ Self-learning	45 Hrs.
▪ Assignments, laboratory report writing	24 Hrs.
Total student study effort	108 Hrs.

Reading List and References

1. C.M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.
2. R.O. Duda, P.E. Hart and D.G. Stork, *Pattern Classification*, 2nd Edition, John Wiley, 2001.
3. R.C. Gonzalez and R.E. Wood, *Digital Image Processing*, 4th Edition, Pearson Prentice Hall, 2018.
4. C.C. Aggarwal, *Neural Networks and Deep Learning*, 1st Edition, Springer, 2018.
5. R. Schalkoff, *Pattern Recognition – Statistical, Structural & Neural Approaches*, John Wiley, 1992.
6. S.T. Bow, *Pattern Recognition and Image Preprocessing*, 2nd Edition, Marcel Dekker, 2002.
7. M. Sonka, V. Hlavac, and R. Boyle, *Image Processing, Analysis and Machine Vision*, 3rd Ed., Thompson Learning, 2008.
8. J.M. Zurada, *Introduction to Artificial Neural Systems*, West Publishing, 1992.
9. M. Nadler and E.P. Smith, *Pattern Recognition Engineering*, John Wiley, 1993.
10. I. Goodfellow, Y. Bengio and A. Courville, *Deep Learning*, MIT Press, 2016.
11. R.M. Bolle, *Guide to Biometrics*, Springer, 2010.
12. A. Webb, *Statistical Pattern Recognition*, 3rd Ed., Wiley-Blackwell, 2011.
13. Selected papers from Pattern Recognition, Pattern Recognition Letters, IEEE Transactions on Pattern Analysis and Machine Intelligence, and other journals on pattern recognition.

Subject Description Form

Subject Code	EIE529
Subject Title	Digital Image Processing
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Calculus, linear algebra and basic statistics. Some programming (preferably MATLAB). Basic understanding of Digital Signal Processing.
Objectives	This subject is to enable students to learn a number of important applications of digital image processing. After the completion of the subject, students should be able to appreciate and master some image and vision techniques for industrial applications. This subject is also suitable for students who are preparing to carry out research in related areas.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the fundamentals of image processing and associated techniques. b. Solve practical problems with basic image processing techniques. c. Design simple systems for realizing applications with basic image processing techniques.
Subject Synopsis/ Indicative Syllabus	1. Introduction: Digital image representation and visual perception. Review on the Fourier transform and linear time-invariant systems. Discrete Fourier analysis of multi-dimensional signals, multi-dimensional filtering. 2. Introduction to the Wavelet Transform: Discrete wavelet transform for one-dimensional and two-dimensional signals, choices of wavelet filters, applications of the wavelet transform in image processing. 3. Image Enhancement: Simple intensity transformation, histogram processing. Spatial filtering. Bilateral filtering. 4. Image Restoration: Degradation model, noise model. Wiener filter. Block matching method for image denoising. Deconvolution and inverse filtering, constrained least square method for image deblurring. Introduction to blind deconvolution. 5. Image Coding and Compression Techniques: Transform image coding, Karhunen-Loeve transform (KLT), discrete cosine transform (DCT), blocking effect. Scalar and vector quantization. Codeword assignment, entropy coding. Industrial standard: JPEG. 6. Image Segmentation: Optimum thresholding. Morphological watershed method. K-means clustering. Segmentation with superpixels. Graph cuts method. 7. Feature Extraction: Shape descriptors, Freeman chain code, Fourier descriptor. Region descriptors, feature vector and feature space, statistical approach for texture description. Scale-invariant feature transform (SIFT).

Teaching/Learning Methodology

Method	Remarks
Lectures	Fundamental principles and key concepts of the subject are delivered to students.
Tutorials	Students will be able to clarify concepts and have a deeper understanding of the lecture material; problems and application examples are given and discussed.
Laboratory sessions	Students will make use of the software MATLAB to simulate various image processing techniques and evaluate their performance.
Mini-Project	Students will do further reading, search for information, keep abreast of current development, share their findings with other classmates through presentations, and write a report.

Teaching/Learning Methodology	Intended Subject Learning Outcomes		
	a	b	c
Lectures	✓	✓	✓
Tutorials	✓	✓	✓
Laboratory sessions	✓	✓	✓
Mini-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
1. Assignments	15%	✓	✓	✓
2. Laboratory demonstration and reports	15%	✓	✓	✓
3. Test/Quizzes	40%	✓	✓	✓
4. Mini-Project	30%	✓	✓	✓
Total	100%			

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial/Laboratory	39 Hrs.
Other student study effort:	
▪ Homework, lab report, and self-study	36 Hrs.
▪ Mini-project: Studying, writing a report, and preparing presentations	30 Hrs.
Total student study effort	105 Hrs.

Reading List and

1. R.C. Gonzalez and P. Wintz, *Digital Image Processing*, 4th ed., Pearson, 2018.

References	2. R.C. Gonzalez, R. E. Woods and S. L. Eddins, *Digital Image Processing using Matlab*, Prentice Hall, 2004. 3. Bovik, *Handbook of Image and Video Processing*, Academic Press, 2000. 4. Selected Reading from recent issues of *IEEE Transactions on Acoustics, Speech, and Signal Processing, IEEE Transactions on Image Processing, etc*.

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Subject Description Form

Subject Code	EIE546
Subject Title	Video Technology
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: Nil Recommended background knowledge: The student is expected to have background knowledge of Digital Signal Processing, and some programming skills (preferably C++) in his undergraduate studies. Mutual exclusions: Nil
Objectives	Objectives: This subject provides an in-depth discussion on a wide range of important and current techniques on digital videos.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. describe the basic principles of video technologies, such as video coding, video standards, video surveillance, 3D videos, video communications, video processing for IoT applications; b. describe the operational principles of one or two advanced topics of video technology and give evaluations; c. perform literature survey; give professional report, analysis, and/or carry out practical realization of video processing algorithms; d. appreciate and take up the related engineering work on video technology, and e. carry out initial research work on video technology.
Subject Synopsis/ Indicative Syllabus	**Keyword syllabus:** 1. Revision on entropy coding and digital video: Huffman coding and arithmetic coding, digitization, raster scanning, luminance & chrominance, composite video, RGB and YUV formats. 2. Basic image coding techniques applied to videos: transform coding, zigzag scan and run-level code. 3. Video coding: Block based video coding, Integer DCT coding, inter- & intra-frames, quantization and entropy coding; hybrid video coding scheme; motion estimation and compensation, frame types, fast motion estimation, and quality control. 4. Advanced video coding, sub-pixel motion estimation, mode decision, rate-distortion control, interpolation filters, multiple reference frames, variable block size, concepts of Prediction Unit, Coding Unit and Transform Unit; concepts of QoE (Quality of Experience). 5. Video coding standards: H.261-4, MPEG-1, 2 and 4, Scalable video coding, levels and profiles, advanced and future standards: HEVC (H.265).

6. Video streaming, architecture for video streaming, video streaming considerations for Internet of Things (IoT); statistical characteristics of signals, Constant Bit-Rate (CBR) and Variable Bit-Rate (VBR); video transmission systems, Quality of Service (QOS) requirement for video transmission; Error control and error concealment for digital video communication.

Due to the limitation in time, only 1 or 2 of the following topics will be covered:

7. A brief review on analogue TV. Introduction to digital TV; High definition TV (HDTV), standards and current development.
8. An Introduction to 3D Video coding, depth coding, 3DV/FTV (free video TV).
9. Video Transcoding, Homogeneous and heterogeneous transcoding, the drift problem, spatial and temporal domain transcoding.
10. Video Surveillance: Basic set-up for video surveillance, background extraction, moving object extraction and detection. IoT applications with video analytics, object identification/tracking by template matching, HoG (Histogram of Oriented Gradients), and colour Histogram.

Laboratory Exercises

1. Laboratory Exercise 1: Image and video Processing under Visual C++ environment
   The objectives of this laboratory include: (i) to display images and videos using a Library, (ii) to read and write images/videos using Visual C++ Console Application, and (iii) to modify images at any pixel location using Visual C++ Console Application.

2. Laboratory Exercise 2: MPEG-4(Part10)/H.264 Verification Model
   This exercise is to let the student familiar with the 'MPEG-4 part10 (H.264) Verification Module', such that the student can understand MPEG-4 Part 10 better, evaluate its structure and make use of the verification model to develop further algorithms for its realization. Topics of specific attention include multiple reference frame coding, quarter-pixel and variable block size motion estimation, etc

Teaching/Learning Methodology

The theories and applications of video technology will be discussed and explained in lectures. Lab sessions will be provided to strengthen students' understanding. Students will also be requested to write a report on a given topic.

Teaching/Learning Methodology	Intended Subject Learning Outcomes				
	a	b	c	d	e
Lectures	✓	✓		✓	✓
Tutorials	✓	✓		✓	✓
Self-learning/report	✓	✓	✓	✓	✓
Laboratory exercise	✓	✓	✓	✓	✓

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. Continuous assessment	50%	✓	✓	✓	✓	✓
• Assignment	12%			✓		✓
• Tests	16%	✓	✓		✓	

• Quizzes	10%	✓	✓		✓	
• Laboratory Sessions	12%	✓	✓	✓	✓	✓
2. Examination	50%	✓	✓		✓	✓
Total	100%					

Student Study Effort Expected	**Class contact:**	
	▪ Lectures/Tutorial/Laboratory	39 Hrs.
	Other student study effort:	
	▪ Self study and Assignments	66 Hrs.
	Total student study effort Tutorials	105 Hrs.

Reading List and References

<u>Indicative reading list and references</u>:

1. A.M. Tekalp, *Digital Video Processing*, Prentice-Hall, 2015.
2. Madhuri A. Joshi, *Image and Video Compression: fundamentals, techniques and applications*, CRC Press, 2015.
3. I.E.G. Richardson*, H.264 and MPEG-4 Video Compression*, John Wiley & Sons, Ltd, 2003.
4. H. Sun, X. Chen and T. Chiang, *Digital Video Transcoding for Transmission and Storage*, CRC Press, 2005.
5. C.A. Poynton, *A Technical Introduction to Digital Video*, John Wiley & Sons, Inc., 1996.
6. F. Pereira and T. Ebrahimi, *The MPEG-4 Book*, Prentice Hall PTR, 2002.
7. A. Walsh and M. Bourges-Sevenier, *MPEG-4 Jump Start*, Prentice Hall PTR, 2002.
8. Selected Reading from recent issues of IEEE Transactions on Circuits and Systems for Video Technology and IEEE Transactions on Image Processing, between years 2008 to 2016.
9. H.246 JM and HEVC HM evaluation models, 2016.

Subject Description Form

Subject Code	EIE553
Subject Title	Security in Data Communication
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	The students are expected to have some basic knowledge about TCP/IP such as addressing, routing, layering. Extra materials will be provided for self-review before the commencement of the course on request for those who do not have the appropriate knowledge. Please contact the subject lecturers for details.
Objectives	This subject aims at providing senior students, practicing engineers and information system professionals, who will study network security for the first time, a solid foundation about information security in the context of data communication and networking. After attending this course, the students will master the basic principles of network and information security. They will also learn to apply these principles in various scenarios. They will be able to identify security problems in the context of data communication, apply basic principles to design and evaluate solutions to meet different security requirements in networking and particularly Internet of things applications.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **(1) Professional/academic knowledge and skills** a. Identify, formulate, and describe security issues and problems in the context of data communication. b. Understand and describe the basic theories and principles in network security. c. Analyze, design, and evaluate solutions to network security problems. **(2) Attributes for all-roundedness** d. Communicate effectively. e. Think critically and creatively. f. Assimilate new technological development in related field.
Subject Synopsis/ Indicative Syllabus	1. Overview of Security Challenges in Data Communication An introduction to the common security issues related to data communications, with identification on unique security characteristics of Internet of Things applications such as computational and power limits, system vulnerabilities, and high data volume. 2. Applied Cryptography for Data Communication Cryptographic tools for security models: cryptographic hash function for integrity, symmetric and asymmetric encryption for confidentiality, digital signature for authentication. 3. Security Standards and Solutions for Data Communication ISO 27001/2 and similar standards such as NIST SP 800, HIPAA, Public-Key Infrastructure (X.509), IP security (IPSec); firewall, virtual private network, authentication and access control. 4. Case studies of Internet of Things Security Threats and Solutions With a focus on the following Internet of Things technologies: Wi-Fi, Bluetooth, Low-power wide-area network, and 5G.

Teaching/Learning Methodology

Lectures and Tutorials are effective teaching methods:

1. To provide an overview of the subject contents.
2. To introduce, identify and describe common security issues in data communication.
3. To introduce the common approaches and solutions for ensuring data security.
4. To use feedbacks from students for gauging their progress

Assignments and Tests:

1. To supplement the teaching materials.
2. To foster a deeper understanding of the concepts.
3. To test the mastery of the subject matter by the students at different stages.

Case studies, lab sessions:

1. To ensure deep learning and real understanding of the students.
2. To cultivate students' problem-solving skills.
3. To foster deep understanding of the subject.

Teaching/Learning Methodology	Intended Subject Learning Outcomes					
	a	b	c	d	e	f
Lecture	✓	✓	✓		✓	✓
Tutorial	✓	✓	✓	✓	✓	✓
Test/Assignment	✓	✓	✓	✓	✓	
Case study, Labs				✓	✓	✓

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	f
1. Assignments	10%	✓	✓	✓	✓	✓	
2. Tests	10%	✓	✓	✓	✓		
3. Laboratory demonstration and reports	15%	✓	✓	✓	✓		
4. Mini project	15%	✓	✓	✓	✓	✓	✓
5. Examination	50%	✓	✓	✓	✓	✓	
Total	100%						

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	27 Hrs.
▪ Laboratory	12 Hrs.
Other student study effort:	
▪ Lecture: further reading, doing homework/ assignment, preparing for tests, examination	36 Hrs.
▪ Writing laboratory report~~s~~	10 Hrs.
▪ Mini-project: studying, writing report, giving presentation	20 Hrs.
Total student study effort	105 Hrs.

Reading List and References	***Text Book:*** 1. Network Security Essentials: Applications and Standards (6th Edition) 6th Edition, William Stallings, Pearson, August 2016. ***General References and standards:*** 2. Network Security, André Perez, Wiley (DDA), Hoboken, N.J. : Wiley, 2014. (PolyU Library Acc. No.: TK5105.59 .P47 2014, online access available) 3. IPsec virtual private network fundamentals, James Henry Carmouche, Indianapolis, Ind.: Cisco Press, 2007. (PolyU Library Call Number: TK5105.567 .C37 2007). 4. Firewall policies and VPN configurations, Anne Henmi, technical editor; Mark Lucas, Abhishek Singh, Chris Cantrell, Rockland, Mass.: Syngress, 2006. (PolyU Library Call Number: TK5105.59 .F478 2006) 5. Abusing the Internet of Things: Blackouts, Freakouts, and Stakeouts, Nitesh Dhanjani: O'Reilly Media; 1 edition, April 2015. 6. Practical Internet of Things Security, Brian Russell, and Drew Van Duren, Packt Publishing, June 2016. 7. IoT Penetration Testing Cookbook: Identify vulnerabilities and secure your smart devices, Aaron Guzman and Aditya Gupta, Packt Publishing, November 2017. 8. Wireless Communications Security: Solutions for the Internet of Things, Jyrki T. J. Penttinen, John Wiley & Sons, 2017.

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Subject Description Form

Subject Code	EIE557
Subject Title	Computational Intelligence and Its Applications
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	The subject aims to introduce students to (i) fundamentals of key intelligent systems technologies including knowledge-based systems, neural networks, fuzzy systems, and evolutionary computation, and (ii) practice in integration of intelligent systems technologies for engineering applications.
Intended Learning Outcomes	Upon completion of the subject, students shall be able to a. Gain a working knowledge of knowledge-based systems, neural networks, fuzzy systems, and evolutionary computation; b. Apply intelligent system technologies in a variety of engineering applications including IoT; c. Implement typical computational intelligence algorithms in MATLAB/Python; d. Present ideas and findings effectively; and e. Think critically and learn independently.
Subject Synopsis/ Indicative Syllabus	1. Introduction to Computational Intelligence 1.1 Intelligence machines 1.2 Computational intelligence paradigms 1.3 Data mining for IoT 2. Fuzzy Systems 2.1 Uncertainty management 2.2 Fuzzy sets and operations 2.3 Fuzzy rules and fuzzy inference 2.4 Fuzzy logic controller 2.5 Case study: fuzzy logic controller for washing machines 3 Artificial Neural Networks 3.1 Fundamental neurocomputing concepts: artificial neurons, activation functions, neural network architectures, learning rules 3.2 Supervised learning neural networks: multi-layer feedforward neural networks, simple recurrent neural networks, supervised learning algorithms 3.3 Deep neural networks and architectures 3.4 Deep learning algorithms and loss functions 3.5 Deep neural networks for face recognition and object detection 3.6 Case study: anomaly detection for video surveillance 4 Computational Intelligent Algorithms 4.1 Chromosomes, fitness functions, and selection mechanisms 4.2 Genetic algorithms: crossover and mutation 4.3 Computational swarm intelligence: particle swarm optimization 4.4 Computational swarm intelligence: ant colony optimization

4.5 Case study: travelling salesman problem

5 Hybrid Intelligent Systems
- 5.1 Neuro-fuzzy systems
- 5.2 Evolutionary neural networks
- 5.3 Applications to IoT

Teaching/Learning Methodology

Lecture/case studies (leaning outcomes a and b)

- fundamental principles and key concepts of the subject are delivered to students;
- guidance on further readings, applications and implementation is given.

The formal lectures will be accompanied by case studies of successful real-world engineering applications of intelligent systems technologies.

Tutorial (learning outcomes a and b)

- students will be able to clarify concepts and to have a deeper understanding of the lecture material;
- problems and application examples are given and discussed.

Laboratory exercises (learning outcomes a - e)

Students will make use of the software tools and MATLAB/Python to develop simple computational intelligence systems.

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

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. Test	20%	✓	✓			✓
2. Final examination	50%	✓	✓		✓	✓
3. Laboratories (including report writing)	15%	✓	✓	✓	✓	✓
4. Assignments	15%	✓	✓		✓	✓
Total	100%					

Student Study Effort Expected	Class contact:	
	▪ Lecture	26 Hrs.
	▪ Tutorial	7 Hrs.
	▪ Laboratory	6 Hrs.
	Other study efforts:	
	▪ Self-learning	48 Hrs.
	▪ Assignments, laboratory report writing	18 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	1. M. Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Pearson/Addison Wesley, 2011. 2. A.P. Engelbrecht, Computational Intelligence: An Introduction, 2nd Edition, John Wiley & Sons, 2007. 3. H.K. Lam, S.S.H. Ling, and H.T. Nguyen, Computational Intelligence and Its Applications: Evolutionary Computation, Fuzzy Logic, Neural Network and Support Vector Machine, Imperial College Press, 2011. 4. I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning, MIT Press, 2016. 5. C.C. Aggarwal, Neural Networks and Deep Learning, 1st Edition, Springer, 2018. 6. E. Turban, J. E. Aronson, T.-P. Liang, Decision Support Systems and Intelligent Systems, 8th Ed., Pearson Prentice Hall, 2015. 7. E. Cox, The Fuzzy Systems Handbook, Boston: AP Professional, 1998. 8. S. Russell and P. Norvig. Artificial Intelligence – A Modern Approach, Prentice Hall, 2010. 9. S. Haykin, Neural Networks – A Comprehensive Foundation, Prentice Hall, 1999. 10. N. Baba and L.C. Jain, Computational Intelligence in Games, Heidelberg; New York: Physica-Verlag, 2001. 11. F.F. Soulie and P. Gallinari (Editors), Industrial Applications of Neural Networks, Singapore; River Edge, NJ: World Scientific, 1998. 12. S. Chen (editor), Evolutionary computation in economics and finance, Heidelberg; New York: Physica-Verlag, 2002. 13. R.J. Jr., Bauer, Genetic Algorithms and Investment Strategies, John Wiley & Sons, 1994. 14. H.J. Zimmermann et al (Editors), Advances in Computational Intelligence and Learning: Methods and Applications, Boston: Kluwer Academic Publishers, 2002. 15. L.C. Jain and P. de Wilde (Editors), Practical Applications of Computational Intelligence Techniques, Boston: Kluwer Academic Publishers, 2001. 16. Selected papers on computational intelligence techniques for various applications including IoT.	

Subject Description Form

Subject Code	EIE558
Subject Title	Speech Processing and Recognition
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject aims to enable students to master the state-of-the-art theories and technologies behind various speech-related products and services, such as mobile phones, voice search, Internet phones, dialog systems, voice biometrics, and voice cloning. The course will cover theoretical foundations, algorithms, and practical issues of speech processing and recognition systems. The course emphasizes how recent advances in deep learning and deep neural networks revolutionize these systems. After completing the subject, students will understand what the current speech technologies can offer and be able to apply speech processing techniques to industrial and commercial applications. The course is suitable for students with a background in signal processing and statistics. It is also ideal for research students working in speech processing. Prior experience in speech processing is not necessary.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. master the fundamental principles behind voice-enable products and services; b. know what the current state-of-the-art speech technologies can offer; c. apply speech processing technologies to voice-enabled products and services; d. take the limitations of current speech technologies into consideration when deploying voice-enabled services.
Subject Synopsis/ Indicative Syllabus	**Part I: Fundamental Concepts** 1. Speech Production and Modelling 1.1 Physiology of speech generation; acoustic characteristics of speech sounds 1.2 Discrete-time speech production model 2. Speech Analysis and Parameterization 2.1 Short-time Fourier analysis; spectrograms 2.2 Linear prediction; cepstrum; LPCC; MFCC **Part II: Advanced Topics and Applications** 3. Speech Enhancement 3.1 Spectral subtraction; 3.2 DNN-based approaches 4. Speech Coding 4.1 Attributes of speech coders and coding standards 4.2 Waveform coding: PCM and ADPCM 4.3 Linear predictive coding: LPC and MELP 4.4 Analysis-by-synthesis coders: CELP and MPLPC 5. Machine Learning and Deep Learning 5.1 Gaussian mixture models 5.2 Support vector machines 5.3 Deep Learning and deep neural networks 5.4 Convolutional neural networks, ResNet, and DenseNet 6. Speech Recognition 6.1 Types of speech recognition 6.2 Hidden Markov models (HMM); language models; DNN-HMM 6.3 End-to-End speech recognition: Seq2Seq and CTC 6.4 Speaker adaptation: MAP; MLLR; DNN adaptation 7. Speaker Recognition

7.1 Types of speaker recognition
7.2 Speaker modelling: GMM-UBM and GMM-SVM
7.3 Speaker embedding: i-vectors; x-vectors; ResNet and DenseNet speaker embeddings
7.4 Scoring: LDA, PLDA, and cosine distance
7.5 Performance metrics: EER, minimum DCF and actual DCF

Teaching/Learning Methodology

The theories and applications of various speech technologies will be discussed and explained in lectures. Lab sessions will be provided to strengthen students' understanding on the theories and hands-on experiences. Students will also be requested to write an essay of a selected topic.

Teaching/Learning Methodology	Intended Subject Learning Outcomes			
	a	b	c	d
Lecture	✓	✓	✓	✓
Tutorial	✓			
Laboratory			✓	✓
Essay writing	✓	✓		

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. Laboratory reports	30%	✓		✓	
2. Quiz	10%	✓			
3. Essays	20%		✓		✓
4. Examination	40%	✓	✓		✓
Total	100%				

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

1. **Lab Reports**: For each lab session, students will need to understand the fundamental concepts [Outcome (a)] before they can complete the lab exercises and write a report. Because the lab sessions involve the application of speech technologies [Outcome (c)], students' ability to apply these technologies should be reflected in their reports.
2. **Quiz:** A quiz will be given to check students' understanding on the fundamental concepts.
3. **Essays:** Students will need to conduct surveys on various speech technologies, find out the limitations of these technologies [Outcome (d)], and determine what the current technologies can offer [Outcome (b)].
4. **Exam:** Students will need to answer questions about the fundamental concepts [Outcome (a)] of various speech technologies and their applications [Outcome (b)]. Limitations of current speech technologies [Outcome (d)] will also be asked in the exam.

Student Study Effort Expected

Class contact:	
▪ Lectures and tutorials	30 Hrs.
▪ Laboratory sessions	9 Hrs.
Other student study effort:	
▪ Writing essay	22 Hrs.
▪ Writing laboratory report and self learning	45 Hrs.
Total student study effort	106 Hrs.

Reading List and References

1. M.W. Mak and J.T. Chien, "*Machine Learning for Speaker Recognition*", Cambridge University Press, 2020.
2. Z. Bai and X.L. Zhang, "Speaker recognition based on deep learning: An overview," *Neural Networks*, vol. 140, pp. 65-99, 2021.

	3. T. Backstrom, *Speech Coding: With Code-Excited Linear Prediction*, Springer, 2017. 4. S. Watanabe and J.T. Chien, “*Bayesian Speech and Language Processing*”, Cambridge University Press, 2015. 5. J. Benesty, et al. *Speech Enhancement*, Academic Press, 2014. 6. Y. LeCun, Y. Bengio and G.E. Hinton, “*Deep Learning*”, Nature, vol. 521, pp. 436-444, May 2015. 7. T. Kinnunen and H. Z. Li, “An overview of text-independent speaker recognition: From features to supervectors,” *Speech Communication*, 2010. 8. J.R. Deller, J.G. Proakis, and J.H.L. Hansen, *Discrete-Time Processing of Speech Signals*, Macmillan Pub. Company, 2000. 9. L.R. Rabiner and B.H. Juang, *Fundamentals of Speech Recognition*, Prentice Hall, 1993. 10. S.Y. Kung, M.W. Mak and S.H. Lin, *Biometic Authentication: A Machine Learning Approac*h, Prentice Hall, 2005. 11. A.M. Kondoz, *Digital Speech: Coding for Low Bit Rate Communications Systems*, 2nd Edition, Wiley, 2004. 12. T.E. Quatieri, *Discrete-Time Speech Signal Processing*, Prentice Hall, 2002.

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Subject Description Form

Subject Code	EIE560
Subject Title	Microelectronics Processing and Technologies
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students are expected to have some basic knowledge in semiconductor technology and electronic material science. Extra reference materials will be provided for self-learning for those who do not have the appropriate knowledge. Please contact the subject lecturer for details.
Objectives	1. To introduce the basic knowledge of semiconductor microtechnology processing and Internet of Things (IoT) devices. 2. To provide a deep understanding of various thin-film deposition techniques, microfabrication techniques, and materials characterization. 3. To provide students with the knowledge of semiconductor device working mechanism, modern microelectronic device fabrication, device technology for IoT and advanced encapsulation techniques.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Category A: Professional/academic knowledge and skills a. Understand the fundamental knowledge of semiconductor and microelectronics processing. b. Understand the nature of the deposition process and how it determines the film properties for microelectronic fabrication. c. Be familiar with various thin-film deposition techniques, materials characterization, advanced encapsulation techniques and microfabrication techniques. d. Fundamental hands-on skill sets of thin-film deposition and processing, basic microelectronic/electronic device fabrication for IoT, and device encapsulation. e. Understand the fundamental knowledge of device technology for IoT. Category B: Attributes for all-roundedness f. Think critically and creatively. g. Achieve the ability to technical problems-solving
Subject Synopsis/ Indicative Syllabus	**Syllabus:** 1. Basic Concepts of Semiconductor Microtechnology 1.1 Semiconductors 1.2 The p-n Junction Diodes 1.3 Thin Film Technology 2. Lithography 2.1 Photolithographic Process 2.2 Etching Techniques 2.3 Photomask Fabrication 2.4 Exposure Systems and Sources 2.5 Optical and Electron Microscopy 3. Thermal Oxidation, Diffusion, and Ion Implantation 3.1 The Oxidation Process 3.2 Basic Diffusion Process 3.2.1 Junction Formation and Characterization

3.2.2 Generation-Depth and Impurity Profile Measurement

3.3 Ion Implantation

3.3.1 Implantation Technology

3.3.2 Channelling, Lattice Damage, and Annealing

3.3.3 Implantation-Related Process

4. Film Formation and Deposition

4.1 Evaporation

4.1.1 Kinetic Gas Theory

4.1.2 Filament, Electron-Beam, and Flash Evaporation

4.2 Sputtering

4.3 Chemical Vapor Deposition

4.4 Epitaxy

4.4.1 Vapor-Phase Epitaxy

4.4.2 Doping of Epitaxial Layers

4.4.3 Molecular-Beam Epitaxy

4.5 Materials Characterization and film analysis

4.5.1 Defects

4.5.2 Structure, Composition and Properties

5. Device Technology and Encapsulation for IoT

5.1 Introduction to IoT Devices

5.2 Sensing Technology

5.2.1 Photodiode for Optical Detection

5.2.2 Smart LED Spectrophotometer

5.2.3 Temperature and Strain Sensitive

5.2.4 Health Monitoring

5.3 Advanced Encapsulation

Laboratory Experiment:

1. Thin Film Deposition and Device Fabrication

Teaching/Learning Methodology

Teaching/Learning Methodology	Intended Subject Learning Outcomes						
	a	b	c	d	e	f	g
Lectures	✓	✓	✓		✓		
Tutorials	✓	✓	✓		✓	✓	
Laboratory/experiments	✓	✓	✓	✓	✓	✓	✓

Remarks:

The fundamental knowledge and key principles of the subject will be explained and delivered to students in lectures. Supplementary materials, application and problem examples will be presented and discussed in lectures and tutorials. In laboratory/experiments section, students will be required to design a simple procedure for thin-film deposition/processing and characterization or fabricate a simple functional component of IoT device or conduct a simple device encapsulation. Students are encouraged to solve technical problems and write a lab report, including introduction, experimental details, results, and summary.

Assessment Methods in Alignment with Intended Learning Outcomes

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

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)						
		a	b	c	d	e	f	g
1. Assignments	30%	✓	✓	✓		✓	✓	
2. Tests (quizzes and final test)	30%	✓	✓	✓		✓	✓	
3. Presentation	20%	✓	✓	✓	✓	✓	✓	
4. Lab report	20%	✓	✓	✓	✓	✓	✓	✓
Total	100%							

Assignments and Tests: Students will be given assignments, quizzes and final test about the fundamental knowledge and key principles of various thin-film deposition techniques, materials characterization, microfabrication techniques, and device encapsulation. These will assess the knowledge of this subject achieved by the students.

Presentation & Lab report: Students are required to give a course presentation, do experiments, and write lab reports. These will check students' critical thinking skills, hands-on skills and technical problem-solving skills.

Student Study Effort Expected

Class contact:	
▪ Lectures/Tutorials	27 Hrs.
▪ Assignments and Tests	3 Hrs.
▪ Laboratory/experiments	9 Hrs.
Other student study effort:	
▪ Self-study	50 Hrs.
▪ Lab report writing and Presentation	20 Hrs.
Total student study effort	109 Hrs.

Reading List and References

1. S.M. Sze; M.K. Lee, Semiconductor devices: physics and technology, 3rd edition, 2012.
2. Morgan, D. V.; K Board, An introduction to semiconductor microtechnology, 2nd edition, 1990.
3. Yasuura, Hiroto, et.al., Smart Sensors at the IoT Frontier, 2017.
4. Jaeger, Richard C., Introduction to microelectronic fabrication, 2nd edition, 2002.
5. Smith, Donald L., Thin-film deposition: principles and practice, 1995.
6. Peter M Martin, Handbook of deposition technologies for films and coatings: science, applications, and technology, 3rd edition, 2010.

Subject Description Form

Subject Code	EIE563
Subject Title	Digital Audio Processing
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Knowledge of digital signal processing. Calculus, linear algebra and basic statistics. Some programming (preferably MATLAB)
Objectives	This course focuses on digital audio processing techniques and their applications. This syllabus is designed to fill the gap between the hardcore theory of various digital signal processing techniques and their applications in various real-world digital audio products and services. Students are expected to be able to handle digital audio processing and design, and have a deep understanding of the topics in the field after completing this course successfully.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the fundamentals of audio processing and associated techniques. b. Solve practical problems with some basic audio processing techniques. c. Design simple systems for realizing some applications with some basic audio processing techniques.
Subject Synopsis/ Indicative Syllabus	1. <u>Fundamentals of DSP</u> Fourier transform; Time-frequency analysis; Multirate systems; Filter bands etc. 2. <u>Fundamentals of Digital Audio</u> Sampling; Dithering; Quantization; Dynamic Range; SNR; Technical terms in the field etc. 3. <u>Digital Audio Recording</u> Recording process; Input lowpass filtering; Sample-and-hold circuit; Oversampling; Analog-to-digital conversion; Dithering; Noise shaping; Post-processing. 4. <u>Digital Audio Compression</u> Critical bands; threshold of hearing; Amplitude masking; Temporal masking; Waveform coding; PCM, DPCM; Perceptual coding; Coding techniques: Subband coding and Transform coding; Codec examples. . 5. <u>Digital Audio Reproduction</u> Reproduction process; Model; Digital-to-audio Conversion; Sampling-and-hold circuit; Filtering; Oversampling; Noise shaping; Sigma-delta modulation; Equalization; Post-processing; Practical implementation issues. 6. <u>Digital Audio Restoration</u> Detection of Pops/Clicks/Pulses; Estimation of corrupted samples; Techniques: Prediction-error detection, LS gap filling, Bayesian approaches etc.; Background noise reduction; Short-time spectral attenuation etc. 7. <u>Case Study of System/Codecs</u> MP3; MP3-Pro; CD; DVD-Audio; AC-3; Dolby digital; SRS Surround system etc. 8. <u>Digital Audio watermarking</u> Time-domain techniques, frequency-domain techniques.

Teaching/Learning Methodology

Method	Remarks
Lectures	Fundamental principles and key concepts of the subject are delivered to students.
Tutorials	Supplementary to lectures and are conducted with smaller class size if possible; students will be able to clarify concepts and to have a deeper understanding of the lecture material; problems and application examples are given and discussed.
Laboratory sessions	Students will make use of the software MATLAB to simulate various image processing techniques and evaluate their performance.

Teaching/Learning Methodology	Intended Subject Learning Outcomes		
	a	b	c
Lectures	✓	✓	✓
Tutorials	✓	✓	✓
Laboratory sessions	✓	✓	✓

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
1. Test	20%	✓	✓	✓
2. Quiz	15%	✓	✓	✓
3. Laboratory assignments and reports	20%	✓	✓	✓
4. Examination	45%	✓	✓	✓
Total	100%			

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial (13 weeks, 3 hours per week)	39 Hrs.
Other student study effort:	
▪ Homework and self-study	66 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. K.C. Pohlmann, *Principles of Digital Audio*, 5th ed., McGraw-Hill, 2005.
2. K.C. Pohlmann, *Advanced Digital Audio*, SAMS, 1991.
3. S.J. Godsill and P.J.W. Rayner, *Digital Audio Restoration - A Statistical Model-Based Approach*, Springer-Verlag, London, 1998.
4. U. Zolzer, *Digital Audio Signal Processing*, Wiley, 1997.
5. Selected papers in IEEE Transactions and international journals.

Subject Description Form

Subject Code	EIE566
Subject Title	Wireless Communications
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	The students are expected to have some basic knowledge about digital communications. 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	1. To introduce the fundamental issues, concepts, and design principles in cellular and wireless communications. 2. To model how various channel-fading phenomena degrades a transmitted wireless signal. 3. To introduce various wireless standards and their potential applications to Internet of things.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Category A: Professional/academic knowledge and skills a. Understand and describe the physical-layer features of wireless communication systems and their potential applications to Internet of things. b. Understand the frequency-reuse concept in cellular communications, and to analyze its effects on interference and system capacity. c. Understand large-scale and small-scale fading-channel models, and to analyze their influence on the performance of a wireless communication system. Category B: Attributes for all-roundedness d. Communicate effectively. e. Think critically and creatively. f. Assimilate new technological development in related field.
Subject Synopsis/ Indicative Syllabus	1. Digital modulation schemes, multiplexing and multiple access schemes, duplexing Analog versus digital modulations. Phase shift keying (BPSK), frequency shift keying (FSK), amplitude shift keying (ASK), quadrature amplitude modulation (QAM). Frequency-division multiplexing (FDM) and multiple-access (FDMA), time-division multiplexing (TDM) and multiple-access (TDMA), code-division multiplexing (CDM) and multiple-access (CDMA), frequency hopping (FH) and direct sequence (DS) spreading, hybrid schemes. Simplex, half-duplex and full duplex, time division duplexing (TDD) and frequency division duplexing (FDD). 2. Cellular communication systems Cellular structure, frequency reuse, cell splitting, macrocell, microcell, picocell and femtocell. Channel assignment. Co-channel interference, adjacent-channel interference, system capacity, power control, call handoffs. 3. Macroscopic fading models for radiowave propagation Free-space radio-wave propagation. Reflection, diffraction, and scattering. Various path-loss models such as ground-reflection, log-distance, lognormal. 4. Microscopic fading models for radiowave propagation Rician and Rayleigh fading models. Doppler frequency, delay spread, coherence bandwidth, level crossing rate. Characterization of multipath phenomena. Fading effects due to multi-path time delay spread. Fading effects due to Doppler spread.

5. Wireless standards, advanced modulation schemes, and Internet of Things (IoT)

   Global Mobile Communication (GSM), 3G, 4G Long-Term Evolution (LTE), Wi-fi, Zigbee, narrow-band IoT, LoRa technology, orthogonal frequency-division multiplexing (OFDM), orthogonal frequency-division multiple access (OFDMA), single-carrier FDMA (SC-FDMA), multiple antenna operation, multiple-input multiple-output (MIMO) transceiver.

Teaching/Learning Methodology

The physical-layer characteristics of a digital communication system will be described and explained in lectures. Channel characteristics will be presented in lectures and tutorials. Performance of a digital communication system under different channel conditions will be simulated with Matlab programs. Students will also be required to study one or more wireless communication systems, share their findings with other classmates through presentations and write a report summarizing their findings.

Teaching/Learning Methodology	Intended Subject Learning 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 (Please tick as appropriate)					
		a	b	c	d	e	f
1. Assignments	30%	✓	✓	✓		✓	✓
2. Test	40%	✓	✓	✓			
3. Mini-project	30%			✓	✓		
Total	100%						

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

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

Mini-project requires the student to do further reading, search for information, keep abreast of current development, give presentations and write a report.

Student Study Effort Expected

Class contact:	
▪ Lectures/Test	33 Hrs.
▪ Presentation	6 Hrs.
Other student study effort:	
▪ Further reading, doing homework/assignment and preparing for tests	30 Hrs.
▪ Mini-project: studying, writing a report, and preparing presentations	40 Hrs.
Total student study effort	109 Hrs.

Reading List and References

1. A. Goldsmith, *Wireless Communications*, Cambridge University Press, 2005.
2. Andreas F. Molisch, *Wireless Communications,* Wiley – IEEE, 2nd ed., 2010.
3. A. Ghosh, J. Zhang, J. G. Andrews, and R. Muhamed, *Fundamentals of LTE*, Prentice-Hall, 2010.

	4. IEEE and other publications.

Subject Description Form

Subject Code	EIE567
Subject Title	Wireless Power Transfer Technologies
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	The student is expected to have knowledge in basic electricity, electronics, circuits, and ability to analyze problems using computer tools.
Objectives	From mobile, cable-free re-charging of portable devices, notebooks and electric vehicles to delivering power to lighting systems, wireless power transfer (WPT) technologies offer convenient power supply solutions to consumer products and large infrastructures. This course explains the fundamental principles and latest advances in WPT and illustrates key applications of this emergent technology. The key objectives are to introduce: 1. The fundamental principles of WPT for cable-free transfer of power. 2. Theories for inductive power transfer (IPT) based on the coupled inductor model and low-order circuit compensation. 3. Specific converter topologies for lighting and battery charging applications. 4. Technology trends in the adoption of WPT for key consumer applications.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **(1) Professional/academic knowledge and skills** a. Understand the characteristics of power transfer through coupled inductors and the significance of leakage inductance b. Analyze and design appropriate compensation circuits and efficient power converters for WPT applications c. Understand technical requirements for applications involving solid-state loads and battery loads using WPT technologies d. Appreciate the factors affecting adoption of WPT in consumer applications including lightings, charging of smartphones and electric vehicles. **(2) Attributes for all-roundedness** e. Communicate effectively f. Think critically and creatively
Subject Synopsis/ Indicative Syllabus	**Syllabus:** 1. <u>Basic Circuit Theory</u> Review of transformers. Leakage inductance. Circuit compensation principles. Low-order compensations; series and parallel compensations. Resonance and operating frequency. Efficiency equation. 2. <u>Power Converters Fundamentals</u> DC-DC converters. AC-DC converters and inverters. PWM and soft switching principles. Basic topologies with transformers. Input, output and transfer characteristics of power converters. Incorporation of leaky transformer. Control methods.

3. <u>Compensation Configurations</u>
   Types of compensation for inductor power transfer. Characteristics for various termination requirements. Design for load-independence output voltage and output current. Efficiency optimization.

4. <u>Applications</u>
   Circuit requirements for various loading conditions. Characteristics of LED loads, resistors and battery loads. Appropriate compensation design. Lighting systems. Battery charging profiles. Electric vehicle charging. Energy efficiency metric for charging.

5. <u>Technology Trends</u>
   Demand for safe power transfer and durable operation. Portable and smart devices. Mobile communication devices. IoT devices and systems. Sensors. Solid-state lighting development. Battery technologies. Electric vehicle development. Renewable source integration trends. Future trends and demand for wireless power transfer.

Teaching/Learning Methodology

This course emphasizes fundamental understanding of the principles and design procedure of wireless power transfer systems as well as the various parameters involved in the optimization of wireless power transfer systems. Selected examples will help students learn the salient aspects of the technologies and the key design constraints. Case studies of specific consumer applications will reinforce understanding of the basic principles and inspire thoughts on future applications.

Teaching/Learning Methodology	Intended Subject Learning Outcomes					
	a	b	c	d	e	f
Lecture	✓	✓	✓			
Tutorial	✓	✓			✓	✓
Case Study			✓	✓	✓	✓

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	f
1. Assignments	30%	✓	✓	✓		✓	✓
2. Test	20%		✓	✓	✓	✓	✓
3. Project proposal, report and viva examination	10% 20% 20%		✓	✓	✓	✓	✓
Total	100%						

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

Assignments allow students to reinforce their understanding of the basic theories and design principles. Since MSc students are mostly mature technical personnel, engineers and managers, the course must be relevant to their needs. Each student has different background and career needs. Hard memorization of a fixed set of theories and facts is not useful. It is important that students are able to extract useful contents relevant to their profession, and being mature students, they know best what are relevant and useful for them. Thus, instead of taking a written exam, students are given the opportunity to define and formulate their case studies under the guidance of the instructor and to pursue a detailed study and analysis of a topic that is strongly relevant to their experience and needs. The nature of case study may range from deep technology survey, innovative system design, to detailed circuit analysis at research level, catering individual needs. The case study project requires students to do further reading, search for information, keep abreast of current development, develop a proposal for specific application, give a presentation and write a complete report.

Student Study Effort Required	Class contact:	
	▪ Lecture/Tutorial	21 Hours
	▪ Case study – presentations and discussions	15 Hours
	▪ Test	3 Hours
	Other student study effort:	
	▪ Lecture: further reading, doing homework/ assignment	42 Hours
	▪ Tutorial/Project: design, writing a report	30 Hours
	Total student study effort	111 Hours

Reading List and References

Text books:

1. C. T. Rim and C. Mi, *Wireless Power Transfer for Electric Vehicles and Mobile Devices*, New York: IEEE Press-Wiley, 2017.
2. J. I. Agbinya, *Wireless Power Transfer*, River Publishers, 2015.

References:

1. Z. Huang, S. C. Wong, and C. K. Tse, "Design of a single-stage inductive-power-transfer converter for efficient EV battery charging," *IEEE Transactions on Vehicular Technology,* vol. 66, no. 7, pp. 5808-5821, July 2017.
2. L. Xu, Q. Chen, X. Ren, S. C. Wong, and C. K. Tse, "Self-oscillating resonant converter with contactless power transfer and integrated current sensing transformer," *IEEE Transactions on Power Electronics,* vol. 32, no. 6, pp. 4839-4851, June 2017.
3. W. Zhang, S. C. Wong, C. K. Tse, and Q. Chen, "Load-independent duality of current and voltage outputs of a series or parallel compensated inductive power transfer converter with optimized efficiency," *IEEE Journal of Emerging and Selected Topics in Power Electronics,* vol. 3, no. 1, pp. 137-146, March 2015.
4. J. Hou, Q. Chen. X. Ren, X. Ruan, S. C. Wong, and C. K. Tse, "Precise characteristics analysis of series/series-parallel compensated contactless resonant converter," *IEEE Journal of Emerging and Selected Topics in Power Electronics,* vol. 3, no. 1, 101-110, March 2015.
5. J. Hou, Q. Chen, S. C. Wong, C. K. Tse, and X. Ruan, "Analysis and control of series/series-parallel compensated resonant converters for contactless power transfer," *IEEE Journal of Emerging and Selected Topics in Power Electronics,*vol. 3, no. 1, pp. 124-136, March 2015.

Subject Description Form

Subject Code	EIE568
Subject Title	IoT – Tools and Applications
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	The students are expected to have some basic knowledge on computer hardware and software.
Objectives	1. To provide an overview on IoT tools and applications including sensing devices, actuation, processing and communications. 2. To introduce hands-on IoT concepts including sensing, actuation, and communication through lab exercises with IoT development kits.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **(1) Professional/academic knowledge and skills** a. Understand key IoT concepts on sensing devices, actuation, processing and communications b. Apply skills on prototyping IoT products and applications **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 to Internet of Things (IoT) - Historical background of IoT - The IoT system stack: Sensors, edge computing, networking, cloud computing - How IoT could enable innovative products and services 2. Electronics for IoT - Overview of electronic signals (including sampling and Nyquist theorem) - General Purpose Input/Output (GPIO) and Pulse Width Modulation (PWM) - ADC and DAC concepts - Microcontrollers and computers for IoT (e.g., Arduino, Raspberry Pi, etc.) 3. Sensors for IoT - An overview of sensors commonly used in IoT applications - Sampling frequency and bandwidth requirements for different sensors - Interfacing common sensors and actuators in IoT development kits 4. Software and Data Analytics for IoT - Libraries of development kits and example uses (e.g., for Arduino) - Selection of development programming languages for different IoT services - Web server and web services (e.g., ThingsBoard, MQTT/HTTP) - Data analytics with machine learning techniques (e.g., Python, Anaconda) 5. Low Power Wide Area Networks (LPWAN) - Transmission of latency-sensitive real-time data and reliable signaling data - Protocols for exchanging information among different IoT devices - IoT communication protocols: Sigfox, LoRa, NB-IoT, etc. 6. Internet of Things Capstone - To consolidate and apply knowledge learnt in the subject with an IoT project

Teaching/Learning Methodology

The theories and applications of IoT will be described and explained in lectures. Tutorial and lab sessions will be conducted to cultivate students' hands-on skills on prototyping IoT products and applications based on IoT development kits. Finally, the subject will be consolidated with a hands-on IoT project. Students will also learn to present their developed applications and summarize their findings through a presentation and a written report.

Teaching/Learning Methodology	Intended Subject Learning Outcomes				
	a	b	c	d	e
Lecture	✓				
Tutorial and Lab	✓	✓		✓	
Mini-project	✓	✓	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

(should this be "Alignment of Assessment and Intended Subject 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	20%	✓		✓	✓	
2. Test/Quizzes	20%	✓		✓	✓	✓
3. Lab	20%		✓		✓	✓
4. Mini-project	40%	✓	✓	✓	✓	✓
Total	100%					

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

Assignments and test/quizzes let students review the taught materials, do further reading for deeper learning and apply the learnt materials to solving problems.

Lab exercises and the mini-project require students to do further reading, search for information, keep abreast of current IoT development, develop their own IoT prototypes, give a presentation and write a report.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	24 Hrs.
▪ Laboratory sessions	15 Hrs.
Other student study effort:	
▪ Lecture: further reading, doing homework /assignment	72 Hrs.
Total student study effort	111 Hrs.

Reading List and References

1. R. Buyya, A. V. Dastjerdi, *Internet of Things: Principles and Paradigms*, Cambridge, MA, 2016.
2. James, A., Seth, A., & Mukhopadhyay, S. (2022). *IoT System Design : Project Based Approach* (1st ed. 2022.. ed., Smart Sensors, Measurement and Instrumentation, 41). Cham: Springer International Publishing : Imprint:

	Springer. (Full text available at: SpringerNature Complete eBooks via PolyU Library) 3. Tamboli, A. (2019). *Build your own IoT platform : Develop a fully flexible and scalable Internet of Things platform in 24 hours*. New York, NY]: Apress. (Full text available at: SpringerNature Complete eBooks via PolyU Library) <u>Others</u>: 4. IEEE Transactions and other journals.

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Subject Description Form

Subject Code	EIE569
Subject Title	Sensor Networks
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	The students are expected to have some basic knowledge about circuits and IP networks.
Objectives	1. To introduce the fundamental issues, concepts, and design criteria in sensor networks. 2. To understand the key concepts towards the integration of sensor networks and Internet of Things (IoT). 3. To understand hardware, communication stack, and middleware technologies utilized in sensor networks for IoT. 4. To investigate the applications of sensor networks for IoT in smart cities.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **(1) Professional/academic knowledge and skills** a. Understand sensing/actuation methods, communication stack, middleware technologies and applications of current and emerging sensor networks for IoT. **(2) Attributes for all-roundedness** b. Communicate effectively. c. Think critically and creatively. d. Assimilate new technological development in related fields.
Subject Synopsis/ Indicative Syllabus	1. Sensing and actuation 1.1. Sensors and actuators 1.2. Sensing data acquisition 1.3. Actuator controls 1.4. Sensors/actuators interfaces, standards, and protocols 2. Communication networks 2.1. Optical fiber and wireless communication fundamentals 2.2. Energy and communication models 2.3. Topologies 2.4. Routing 2.5. Scheduling 2.6. Transceivers interfaces, standards, and protocols 3. Middleware technologies 3.1. Detection and coverage 3.2. Localization and tracking 3.3. Data compression and fusion 3.4. Compressive sensing 4. Applications 4.1. Smart grid systems

4.2. Sensing as a service (SaaS)
4.3. Mobile sensor networks (MSNs)
4.4. Vehicular ad hoc networks (VANETs)

Teaching/Learning Methodology

This course aims to provide students with a theoretical understanding of sensor networks, in particular about their design criteria and limitations when applying in IoT applications. The course is taking a bottom-up approach, which begins with sensing, processing, and communication hardware, followed by data aggregation/dissemination topologies and performance-aware middleware, and finally concluded with real-life IoT applications. It will explain the unique characteristics of sensor networks from conventional optical fiber networks and Ad-Hoc mobile networks, and further elaborate the new challenges introduced by IoT systems. Throughout the course, students will be presented with various algorithms/protocols/standards in sensor networks/IoT, together with the rationales behind their designs. Upon completion, students will be able to design, implement, and evaluate their own hardware, algorithms, middleware, and applications for sensor networks in IoT.

Teaching/Learning Methodology	Intended Subject Learning Outcomes			
	a	b	c	d
Lecture	✓			
Tutorial	✓		✓	
Presentation / Case study	✓	✓	✓	✓

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. Midterm test	10%	✓	✓	✓	✓
2. Assignments	10%	✓	✓	✓	✓
3. Case study	10%	✓	✓	✓	✓
2. Final examination	70%	✓	✓	✓	✓
Total	100%				

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

Assignments let students review the taught materials, do further reading for deeper learning and apply the learnt materials to solve problems in sensor networks for IoT.

Case study requires the student to do further reading, search for information, keep abreast of current development, give a presentation and write a report.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	33 Hrs.
▪ Case study – presentations and discussions	6 Hrs.
Other student study effort:	
▪ Self-reading, doing homework/assignment	72 Hrs.

	Total student study effort	111 Hrs.
Reading List and References	1. Pethuru Raj and Anupama C. Raman, *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*, CRC Press, 2017 2. Fawzi Behmann and Wu Kwok, *Collaborative Internet of Things (C-IoT): For Future Smart Connected Life and Business*, John Wiley and Sons, 2015 3. G.P. Agrawal, *Fiber-optic communication systems*, Wiley, 2010 4. Shizhuo Yin, Paul B. Ruffin, Francis T.S. Yu, *Fiber Optic Sensors*, CRC Press, 2008 5. W. Dargie and C. Poellabauer, *Fundamentals of Wireless Sensor Networks: Theory and Practice*, John Wiley and Sons, 2010 6. I.F. Akyildiz, M.C. Vuran, *Wireless Sensor Networks*, John Wiley and Sons, 2010 7. Holger Karl, Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley and Sons, 2005 8. D.P. Agrawal and Q. Zeng, *Introduction to Wireless and Mobile Systems*, Cengage Learning, 2016	

Subject Description Form

Subject Code	EIE570
Subject Title	Deep Learning with Photonics
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	N/A
Objectives	1. To introduce the fundamental concepts, and design principles in deep learning and optoelectronic devices. 2. To introduce the state-of-the-art modelling methods in deep learning and photonic devices. Rebuild photonic neural networks with the frontier papers of the scientific community.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: <u>Category A: Professional/academic knowledge and skills</u> a. Understand and describe the physical-layer features of neural network structures. b. Understand the fundamental concepts/laws in photonics devices. c. Understand why the combination of the two disciplines will have great potentials for next generation information technology. <u>Category B: Attributes for all-roundedness</u> d. Communicate effectively. e. Think critically and creatively. f. Assimilate new technological development in related field.
Subject Synopsis/ Indicative Syllabus	1. Primer on Deep Learning (DL) 1-1 The overview and organization of the course 1-2 Matrix and Linear regression 1-3 Gradient descent 1-4 The cost function 1-5 Supervised Learning & Unsupervised Learning <u>Exercise1</u>: Install the DL environments <u>Exercise2</u>: Demonstration of file & matrix operation 2. Implementation of the neural network 2-1 Introduction of TensorFlow (TF) 2-2 Neural Networks Part 1: Setting up the Architecture 2-3 Neural Networks Part 2: Setting up the Data and the Loss pre-processing 2-4 Neural Networks Part 3: Learning and Evaluation 2-5 Neural Networks Part 4: Minimal Neural Network Case Study <u>Exercise3</u>: Install and Build the TF network <u>Exercise4</u>: Demonstrate handwriting number recognition 3. Primer on photonic devices 3-1 Fundamental optical laws

3-2 Diffractive grating and lens
3-3 Mach-Zhender Interferometer (MZI) array matrix
3-4 MicroRing Resonator (MRR) array matrix
3-5 Nonlinear devices
Exercise5: Simulation of the diffractive grating and lens
Exercise6: Simulation of MZI and MRR

4. Case study I: Inverse design for photonic devices
    4-1 Inverse design principles
    4-2 Direct Binary Search (DPS) method
    4-3 Adjoined method
    4-4 The forward & backward simulation
    4-5 The prediction of optical waveguide modal information
    Exercise7: Inverse design the beam splitter with DBS method
    Exercise8: Inverse design the beam splitter with adjoin method
    Exercise9: Demonstration of inverse design for optical waveguide design
5. Case study II: All-optical Diffractive Deep Neural Networks (D2NN)
    5-1 The diffraction formula
    5-2 The diffractive neural network configuration
    5-3 The forward & backward propagation
    5-4 The cost function
    5-5 The training & validation procedure
    Exercise10: Build the D2NN with TF
    Exercise11: Demonstration of D2NN for handwriting number recognition

Teaching/Learning Methodology

The physical-layer characteristics of all-optical deep neural networks will be described and explained in lectures. Advantages of photonic computation will be presented in lectures. Modelling of photonic deep learning systems will be conducted during the class through the exercises. Students will also be required to study one photonic deep learning systems, share their findings with other classmates through presentations.

Teaching/Learning Methodology	Intended Subject Learning Outcomes					
	a	b	c	d	e	f
Lectures	✓	✓	✓		✓	
Exercises	✓	✓	✓	✓	✓	✓
Case study and presentation	✓	✓	✓	✓	✓	✓

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	f
1. Assignments	20%	✓	✓			✓	
2. Exercises	30%	✓	✓	✓	✓	✓	✓
3. Mini projects	20%	✓	✓	✓		✓	
4. Tests	30%	✓	✓	✓		✓	✓
Total	100%						

	Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: **Assignments:** let students review the taught materials, do further reading for deeper learning and understand better of the taught knowledge. Students may find these reading useful and will practice the obtained knowledge in the associated exercises and mini projects. **Exercises:** Exercises are designated based on projects to evaluate whether the students are proficient in the taught knowledge to solve the practical problem. Students need to bring a laptop to the classroom and may conduct literature research on the topics. Mutual discussions are encouraged in order to summarize the findings in a presentation. **Mini projects:** Students will need to finish the given mini projects during the class. Students can share their ideas and views about photonic neural networks through discussions. **Tests:** Tests will evaluate student’s understanding and usage of deep learning with photonics.	
Student Study Effort Expected	Class contact:	
	▪ Lectures/Tutorials	26 Hrs.
	▪ Case study and report	13 Hrs.
	Other student study effort:	
	▪ Further reading, doing homework/assignment and preparing for the subject.	66 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	1. Prucnal, P. , Shastri, B. (2017) Neuromorphic Photonics. CRC Press, https://doi.org/10.1201/9781315370590. 2. Yao, K., Unni, R. & Zheng, Y. (2019). Intelligent nanophotonics: merging photonics and artificial intelligence at the nanoscale. Nanophotonics, 8(3), pp. 339-366. Retrieved 21 Mar. 2020, from doi:10.1515/nanoph-2018-0183 3. Ferreira de Lima, T., Shastri, B., Tait, A., et al. (2017). Progress in neuromorphic photonics. Nanophotonics, 6(3), pp. 577-599. Retrieved 21 Mar. 2020, from doi:10.1515/nanoph-2016-013 4. Molesky, S., Lin, Z., Piggott, A.Y. et al. Inverse design in nanophotonics. Nature Photonics 12, 659–670 (2018). https://doi.org/10.1038/s41566-018-0246-9	

Subject Description Form

Subject Code	EIE571
Subject Title	Photonic System Analysis
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	N/A
Objectives	1. Understand the principles and techniques of photonic device and system analysis, simulation and modeling 2. Learn to obtain optical characteristics of photonic devices and systems through computer simulation.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Category A: Professional/academic knowledge and skills a. Understand how to analyze and design photonic devices and systems through modeling and simulation. b. Learn to use simulation methods to build up the database for the design of photonic devices and systems. Category B: Attributes for all-roundedness c. Communicate effectively. d. Think critically and creatively. e. Assimilate new technological development in the related field.
Subject Synopsis/ Indicative Syllabus	**1. Fundamental concepts** 1-1. Basic concepts of optics 1-2. Polarization 1-3. Size versus light wavelength 1-4. Common photonic system analysis techniques **2. Photonic simulation** 2-1. Simulation parameters 2-2. Create 2D/3D model of photonic simulation 2-3. Material import for photonic simulation 2-4. Boundary conditions **3. Meshing techniques** 3-1. Mesh types 3-2. Boundary layer meshing 3-3. Automatic re-meshing **4. Simulation solver and result verification** 4-1. Visualization of simulated results 4-2. Analysis of simulation data **5. Case study: simulation of photonic device**

Teaching/Learning Methodology

Analysis, simulation and modeling of photonic devices and systems will be described and demonstrated in this subject. Students will be guided through laboratory exercises related to the materials taught in each session. The laboratory exercises should be finished during the class. Students will be given the opportunity to study some design examples in the field and share their findings with other classmates through presentations and reports. Students are requested to design a mini project of photonic devices by using the photonic simulation method.

Teaching/Learning Methodology	Intended Subject Learning Outcomes				
	a	b	c	d	e
Lectures	✓	✓		✓	✓
Laboratory exercises	✓	✓		✓	✓
Case study/report	✓	✓	✓	✓	✓
Mini 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	e
1. Assignments	20%	✓	✓		✓	✓
2. Laboratory exercises	40%	✓	✓		✓	✓
3. Mini project	10%	✓	✓	✓	✓	✓
4. Tests	30%	✓	✓			
Total	100%					

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

Assignments: Students will need to review the taught materials and some of the photonics simulation design examples, give a presentation, and write a report. Students can learn more in-depth and understand the current developments of photonics simulation.

Laboratory exercises: For each session, students will need to complete the lab exercises and write a report. Through the lab exercises, students can practice and be proficient in the operating of photonic simulation.

Mini project: Students have to design a photonic device project by photonic simulation, give a presentation, and write a report.

Tests: Students will need to answer questions about the fundamentals and technologies of photonic system analysis.

Student Study Effort Expected

Class contact:	
▪ Lectures/Tutorial	26Hrs.
▪ Laboratory exercises	13Hrs.
Other student study effort:	

	▪ Assignments and mini project	66 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	1. Layla S. Mayboudi, Geometry Creation and Import With COMSOL Multiphysics (Multiphysics Modeling Series), 2019. 2. Slawomir Sujecki, *Photonics Modelling and Design*, 2014. 3. Merhzad Tabatabaian, *COMSOL5 for Engineers,* 2015. 4. Sophocles Orfanidis, *Electromagnetic Waves and Antennas*, 2016. 5. Levent Sevgi, *Electromagnetic Modeling and Simulation*, 2014.	

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Subject Description Form

Subject Code	EIE572
Subject Title	Information Photonics
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	N/A
Objectives	1. To learn the fundamental principle of information photonics. 2. To understand processes to control and manipulate the photonic information. 3. To know the working principle and applications of the modern information photonics devices and systems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Category A: Professional/academic knowledge and skills a. Learn the fundamental principles of information photonics. b. Understand the knowledge about practical information photonic components and systems, and an overview of applications of information photonics. Category B: 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. Information Communication. 2. Introduction to Photonics. 3. Vision, Visual Perception, and Computer vision. 4. Photonic Sources and Detectors for Information Processing. 5. Photonic Devices for Modulation, Storage and Display. 6. Photonics in Transform Domain Information Processing. 7. Low-Level Photonic Information Processing. 8. Photonics in Networking and Communication. 9. Photonic Computing. 10. Photonic Pattern Recognition and Intelligent Processing. 11. Nanophotonic Information System. 12. Quantum Information Processing.
Teaching/Learning Methodology	This subject aims to provide students with fundamental and practical understanding of information photonics. The concepts and principles of information photonics will be described and explained in this subject. The information photonic components and systems will be introduced and the engineering working principle of them will be explained. Students will be required to study some application cases about the advanced information photonics, and share their findings with other classmates through presentations and write a report summarizing their findings.

Teaching/Learning Methodology	Intended Subject Learning Outcomes				
	a	b	c	d	e
Lecture	✓	✓		✓	✓
Tutorial	✓	✓	✓	✓	✓
Presentation / Case study	✓	✓	✓	✓	✓

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. Homeworks/Assignments	30%	✓	✓		✓	✓
2. Midterm test	20%	✓	✓			
3. Case study and presentation	20%	✓	✓	✓	✓	✓
4. Final examination	30%	✓	✓		✓	✓
Total	100%					

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

Homework, tests and case study let students review the taught materials, do further reading for deeper learning and apply the learnt materials to solve the problems in Information Photonics.

Case study requires the student to do further reading, search for information, keep abreast of current developments in Information Photonics, give a presentation and write a report.

Final examination requires students to answer questions about the fundamentals and technologies of information photonics.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	33Hrs.
▪ Case study – presentations and discussions	6 Hrs.
Other student study effort:	
▪ Homework/assignment and further case study, presentation preparation.	66 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Bahaa E.A. Saleh, Fundamentals of Photonics, 3rd (2019).
2. Asit Kumar Datta and Soumika Munshi, Information Photonics: Fundamentals, Technologies, and Applications (2017).
3. Georg A Reider, Photonics An Introduction (2016).
4. David George Voelz, Computational Fourier Optics:a MATLAB tutorial (SPIE Tutorial Texts Vol. TT89)
5. Sandipan Dey, Image Processing Masterclass with Python 50+ Solutions and Techniques Solving Complex Digital Image Processing Challenges

Subject Description Form

Subject Code	EIE573
Subject Title	Mobile Edge Computing
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students are expected to have some basic knowledge in wireless communication and mobile computing. Extra materials will be provided for self-learning for those who do not have the appropriate knowledge. Please contact the subject lecturer for details.
Objectives	1. To introduce fundamental concepts and design principles of mobile edge computing (MEC), as well as supporting technologies. 2. To introduce MEC hardware platforms and standardization. 3. To introduce applications that are enabled by MEC.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Category A: Professional/academic knowledge and skills a. To understand the basic architecture and benefits of MEC. b. To understand computation offloading, joint communication and computation resource management for MEC. c. To understand standardization and use scenarios of MEC. Category B: Attributes for all-roundedness d. Communicate effectively. e. Think critically and creatively. f. Assimilate new technological development in related field.
Subject Synopsis/ Indicative Syllabus	1. MEC Basics: Key features of MEC; Mobile Cloud Computing vs. MEC; Advantages of MEC; Market and ecosystem of MEC. 2. Wireless Communication for MEC: Wireless channel models; Cellular network structure; multiuser communication systems; basics of 5G networks. 3. Computation Basics for MEC: Mobile computing; Computation task models; Virtual machine; CPU/GPU computing platforms. 4. Computation Offloading: Different offloading modes; single-user offloading, multi-user offloading. 5. Communication and Computation Resource Management: Joint radio and computation resource allocation; MEC server scheduling; Multiuser cooperative edge computing. 6. MEC hardware platform, standardization: MEC network architecture; Standardization of MEC in 5G; Security and privacy issues in MEC. 7. MEC application scenarios: Video stream analysis, Internet of Things; AR/VR; Internet of Vehicles; edge AI.

Teaching/Learning Methodology

The basic features and architecture of MEC will be described and explained in lectures. Supporting techniques, including computation offloading, communication and computation resource management, will be presented in lectures and tutorials. The standardization and use scenarios of MEC will be introduced in lectures. Students will also be required to study one technical problem or application case of MEC, share their findings with other classmates through presentations and write a report summarizing their findings.

Teaching/Learning Methodology	Intended Subject Learning 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 (Please tick as appropriate)					
		a	b	c	d	e	f
1. Assignments	30%	✓	✓	✓		✓	✓
2. Test	40%	✓	✓	✓			
3. Mini-project	30%				✓		✓
Total	100%						

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

Assignments and test let students review the taught materials, do further reading for deeper learning and apply the learnt materials to solving practical problems in MEC systems.

Mini-project requires the student to do further reading, search for information, keep abreast of current development, give presentations and write a report.

Student Study Effort Expected

Class contact:	
▪ Lectures/Tutorials	36 Hrs.
▪ Test	3 Hrs.
Other student study effort:	
▪ Self-study	66 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. *Multi-Access Edge Computing in Action*, by Dario Sabella, Alex Reznik, Rui Frazao, CRC Press, 2019, ISBN: 978-0367173944.
2. *Edge Computing: A Primer*, by Jie Cao, Quan Zhang, Weisong Shi, SpringerBriefs in Computer Science, 2018, ISBN 978-3-030-02082-8.
3. Y. Mao, C. You, J. Zhang, K. Huang, and K. B. Letaief, “A survey on mobile edge computing: The communication perspective,” *IEEE Commun. Surveys Tuts.*, vol. 19, no. 4, pp. 2322-2358, 4th Quart. 2017.
4. W. Shi, J. Cao, Q. Zhang, Y. Li, and L. Xu, “Edge computing: Vision and challenges,” *IEEE Internet Things J.*, vol. 3, no. 5, pp. 637–646, Oct. 2016.
5. Z. Zhou, X. Chen, E. Li, L. Zeng, K. Luo, and J. Zhang, “Edge intelligence: Paving the last mile of artificial intelligence with edge computing,” *Proc. IEEE*, vol. 107, no.

	8, pp. 1738–1762, Aug. 2019. 6. J. Zhang and K. B. Letaief, “Mobile edge intelligence and computing for the Internet of Vehicles,” *Proc. IEEE*, vol. 108, no. 2, pp. 246–261, Feb. 2020.

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. <u>Introduction</u> Basic principles and challenges, past and ongoing VANET activities 2. <u>Cooperative Vehicular Safety Applications</u> Enabling technologies, cooperative system architecture, safety applications 3. <u>Vehicular Mobility Modeling</u> Random models, flow and traffic models, behavioral models, trace and survey-based models, joint transport and communication simulations 4. <u>Physical Layer Considerations for Vehicular Communications</u> Signal propagation, Doppler spread and its impact on OFDM systems 5. <u>MAC Layer of Vehicular Communication Networks</u> Proposed MAC approaches and standards, IEEE 802.11p 6. <u>VANET Routing protocols</u> Opportunistic packet forwarding, topology-based routing, geographic routing 7. <u>Emerging VANET Applications</u> Limitations, example applications, communication paradigms, message coding and composition, data aggregation 8. <u>Standards and Regulations</u> 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.

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.

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Subject Description Form

Subject Code	EIE577
Subject Title	Optoelectronic Devices
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	The aim of this course is to introduce to the students to the fundamentals of semiconductor optoelectronic devices. These include pn junctions, light emitting diodes (LEDs) and solar cells. These devices have found important commercial applications. Upon completion of the subject, the students will be able to understand: 1. wave mechanics; 2. principles of semiconductor materials; 3. operating principles of PN junctions; 4. operating principles of LEDs; and 5. principles of semiconductor solar cells and photodetectors.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. understand the principles of semiconductor materials including some basic ideas of quantum mechanics; b. understand the operating principles of semiconductor optoelectronic devices; c. fabricate semiconductor devices.
Subject Synopsis/ Indicative Syllabus	1. Elements of Wave Mechanics The Bohr atom. Wave-particle duality. General Formulation. Particle in a 1-D box. 2. Basic Energy Band Theory The Bloch theorem. Kronig-Penny model. Energy bands and Brillouin zones. Particle motion and effective mass. E-*k* diagrams. Band gap energy 3. Semiconductor fundamentals Basics of electrical and optical properties of semiconductor materials. P-N junctions. 4. Semiconductor LEDS Operation principles of LEDs. Human vision, photometry and colorimetry. White solid-state lamps – phosphor conversion versus multichip LEDs, Display fundamentals. 5. Solar Cells and photodetectors Operation principles of solar cells. Silicon-based solar cells, compound semiconductor based solar cells.

Teaching/Learning Methodology

The basic principles of semiconductor, quantum mechanics, and the operating principles of semiconductor optoelectronic devices will be discussed and explained in lectures. Lab sessions will be organized for students to experience the fabrication processes for a basic pn junction photovoltaic cell. Students will write an essay of a topic selected by the student himself/herself. At the end of the semester each student has to give a 15 to 20-minute presentation on his/her selected topic.

Teaching/Learning Methodology	Intended Subject Learning Outcomes		
	a	b	c
Lectures	✓	✓	
Laboratory		✓	✓
Term paper	✓	✓	

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
1. Homework & Quizzes	20%	✓	✓	
2. Laboratory	20%		✓	✓
3. Mid-term test	30%	✓	✓	
4. Term paper and presentation	30%	✓	✓	
Total	100%			

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

1. **Laboratory**: Students will learn the semiconductor devices fabrication process in the laboratory sessions. The laboratory reports will reflect their understanding of the processes. [Outcomes (b) and (c)]
2. **Term Paper and Presentation:** Students will need to conduct literature research on different optoelectronic devices, investigate the operating principles of the devices and to summarize the findings in a paper. [Outcomes (a) and (b)]
3. **Homework & Quizzes:** The homework and quizzes will cover the fundamental quantum mechanics, physics of semiconductor materials and devices. [Outcomes (a) and (b)]
4. **Mid-term test:** The mid-terms will mainly cover the fundamental quantum mechanics, physics of semiconductor materials and devices principles. [Outcomes (a) and (b)]

Student Study Effort Expected

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	4 Hrs.
▪ Laboratory	9 Hrs.
Other student study effort:	
▪ Self-study	39 Hrs.
▪ Laboratory reports	10 Hrs.
▪ Term paper	20 Hrs.
Total student study effort	108 Hrs.

Reading List and References	1. Advanced Semiconductor Fundamentals, 2nd Edition. Robert F. Pierret, Prentice Hall, 2003. 2. Semiconductor Devices – Physics and Technology. 3rd Edition. S.M. Sze & M.K. Lee. John Wiley & Sons, Inc. 2012. 3. The Physics of Solar Cells. J. Nelson. Imperial College Press. 2003 4. Physics of Semiconductor Devices, S.M. Sze, Kwok K. Ng, 3rd Edition. John Wiley & Sons, Inc. 2007 5. Fundamentals of solid-state lighting: LEDs, OLEDs, and their applications in illumination and displays. Vinod Kumar Khanna. CRC Press 2014

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Subject Description Form

Subject Code	EIE579
Subject Title	Advanced Telecommunication Systems
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	The students are expected to have some basic knowledge about digital communication and signal processing. Extra materials will be provided for self-learning before the commencement of the course on request for those who do not have the necessary background.
Objectives	Modern wireless communication is a field in which theoretical ideas have had an unusually powerful impact on system design and practice. The basis of the theory was developed in 1948 by Claude Shannon, and is called information theory. Amazingly and surprisingly, Shannon theory stated that reliable communication without any error is possible over a noisy channel. By the mid 1970's, mainstream systems using information theoretic ideas began to be widely implemented because of the increasing number of engineers who understood both information theory and communication system practice. Since then, wireless communication technologies have been more and more powerful. For example, in the first-generation (1G) cellular systems, the phones can only be used for a call with very poor quality. Now, the fifth-generation (5G) cellular systems can even support 4K live streaming in virtual reality (VR). It is thus important to understand how the connection between communication theory and engineering design leads to the success of the current communication systems. The objectives of this course are two-fold. First, this course will equip the students with the classic digital communication theory, which is the basis of the current communication systems. Second, this course will provide specific 5G applications in broadband communication and Internet of Things (IoT) such that the students can understand how to utilize the communication theory in modern communication systems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **(1) Professional/academic knowledge and skills** a. Understand the basic principle for sending information reliably over the noisy channels. b. Understand the basic modules of transmitters in digital communication, e.g., coding, modulation, etc. c. Understand the basic modules of receivers in digital communication, e.g., decoding, demodulation, etc. d. Understand the application of digital communication in 5G broadband communication. e. Understand the application of digital communication in 5G-assisted IoT. **(2) Attributes for all-roundedness** f. Communicate effectively. g. Think critically and creatively. h. Learn the skill of teamwork. i. Assimilate new technological development in related field.

Subject Synopsis/ Indicative Syllabus

1. Basis of digital communication
    - 1.1 Ways to measure information and Huffman code
    - 1.2 A brief introduction to Shannon capacity
    - 1.3 Geometric representation of signals
2. Uncoded communication systems
    - 2.1 Decoding strategies at the receiver
    - 2.2 Error probability analysis
    - 2.3 Digital modulation principles
3. Coded communication systems
    - 3.1 Introduction of codes
    - 3.2 Decoding strategies at the receiver
    - 3.3 Error probability analysis
    - 3.4 Convolutional codes
4. Case study 1: Broadband communication in 5G
    - 4.1 Massive MIMO (multiple-input multiple-output)
    - 4.2 Cloud RAN (radio access network)
5. Case study 2: IoT in 5G
    - 5.1 Ultra-reliable low-latency communication and its applications
    - 5.2 Massive machine-type communication and its applications

Teaching/Learning Methodology

The basic principles of modern communication systems for reliable communications over noise channels will be described and explained in lectures. Key communication modules, e.g., modulation/demodulation, coding/decoding, etc., will be introduced. Performance of a digital communication system under the studied modulation/demodulation schemes and coding/decoding schemes will be simulated with Matlab or other programs. Students will also be required to study one digital communication technique and its application in modern systems, share their findings with other classmates through presentations and write a report summarizing their findings.

Teaching/Learning Methodology	Intended Subject Learning Outcomes								
	a	b	c	d	e	f	g	h	i
Lecture	✓	✓	✓	✓	✓		✓		✓
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	g	h	i
Assignments	30%	✓	✓	✓	✓	✓		✓		
Quizzes	10%	✓	✓	✓	✓	✓		✓		
Mid-Term Test	20%	✓	✓	✓	✓	✓		✓		
Final-Project	40%	✓					✓	✓	✓	✓
Total	100%									

Explanation of the appropriateness of the assessment methods in assessing the intended

	learning outcomes: Assignments and tests let students review the taught materials, do further reading for deeper learning and apply the learnt materials to modern communication systems.. Mini-project requires the students to do further reading, search for information, keep abreast of current development, give presentations and write a report.	
Student Study Effort Expected	Class contact:	
	▪ Lecture/Tutorial/Tests	36 Hrs.
	▪ Presentation	3 Hrs.
	Other student study effort:	
	▪ Lecture: further reading, doing homework/ Assignment	30 Hrs.
	▪ Final-project: studying, writing a report, giving presentations	40 Hrs.
	Total student study effort	109 Hrs.
Reading List and References	1. S. Haykin, *Communication Systems* (5th Edition), John Wiley & Sons, 2009. 2. J. G. Proakis and M. Salehi, *Digital communications* (5nd Edition), McGraw-Hill Education, 2007. 3. Robert G. Gallager, *Principles of Digital Communication*, Cambridge University Press, 2008. 4. E. Dahlman, S. Parkvall, and J. Skold, *5G NR: The Next Generation Wireless Access Technology*, New York, NY, USA: Academic, 2018. 5. O. Liberg, *et al.*, *Cellular Internet of Things: From Massive Deployments to Critical 5G Applications* (2nd edition), Academic Press, 2019.	

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Subject Description Form

Subject Code	EIE580
Subject Title	Radio Frequency and Microwave Integrated Circuits for Communication System Applications
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To study and understand the operating principles and design schemes of radio frequency and microwave integrated circuits for communication system applications.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Establish and develop the overall knowledge of RF and microwave integrated circuits and devices for wireless communication applications b. Model and analyze the performances of communication circuits and subsystems with practical design parameters c. Design and evaluate the building blocks of communication systems such as wireless transmitter and receiver.
Subject Synopsis/ Indicative Syllabus	1. <u>Overview of Communication Systems and Review of Transmission Line Theory</u> Wireless and radiofrequency systems, communication techniques, receiver and transmitter architectures, waveguides and transmission lines, Smith chart, S-parameters, passive (linear) components, and active (non-linear) circuits. 2. <u>Passive and Linear Components</u> Lumped-element and transmission line elements, impedance transformers, impedance matching techniques, directional couplers, resonators, low-pass, bandpass, bandstop and high-pass filters, diplexers and multiplexers, circulators and isolators. 3. <u>Active and Nonlinear Circuits</u> Diodes and transistors, thermal noise and noise figure, nonlinear and intermodulation distortions, IP3, nonlinear analysis, dynamic range, two- and three-terminal devices, oscillators and frequency synthesizer, low-noise amplifier (LNA), power amplifier (PA), single-ended and balanced mixers 4. <u>Wireless Communication Front-End Subsystems</u> Antenna, modulators, demodulators, communication devices, radar techniques, radiofrequency identification (RFID) techniques, low-noise system design, power amplifier design, linearization techniques, and system simulation.

Teaching/Learning Methodology

Through the lectures and tutorials, students can develop basic knowledge of RF and microwave integrated circuits as well as techniques for analyzing the performance of communication circuits.

Through the mini-project, student can apply the basic knowledge and analytical technique to design and evaluate the building blocks of communication systems.

Teaching/Learning Methodology	Intended Subject Learning Outcomes		
	a	b	c
Lectures	✓	✓	
Tutorials	✓	✓	
Laboratory sessions	✓	✓	✓

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
1. Continuous assessment				
Mid-semester test	15%	✓	✓	✓
End-of-semester test	15%	✓	✓	✓
Laboratory work on simulation package	10%		✓	✓
Laboratory work on RF passive circuits	10%		✓	✓
Laboratory work on RF mixers	10%		✓	✓
2. Examination	40%	✓	✓	✓
Total	100%			

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

The basic knowledge and modeling of RF and microwave integrated circuits can be assessed through examination, test and laboratory exercises.

The design and evaluation techniques for RF and microwave integrated circuited can be assessed through the laboratory exercises.

Student Study Effort Expected	Class contact:	
	■ Lecture	18 Hrs.
	■ Tutorial	9 Hrs.
	■ Laboratory session	12 Hrs.
	Other student study effort:	
	■ Self-study	66 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	1. Bogdanov, G and Ludwig, R.*RF Circuit Design: Theory & Applications*, 2nd edition, Pearson Education Inc., Upper Saddle River, NJ, USA, 2009. ISBN : 978-0-13 135505-7 2. Bowick, C.*RF Circuit Design,* 2nd edition, Newnes, , Burlington, MA, USA, 2008. ISBN : 978-0-7506-8518-4 3. Yip, P.*"High Frequency Circuit Design and Measurements"* Chapman and Hall, London, UK, 1990. ISBN : 0-412-34160-3 4. Pozer, D."*Microwave Engineering*" 2nd edition, John Wiley & Sons, New York, USA, 1998. ISBN : 0-471-17096-8 5. Liao, S. Y. "*Microwave Circuit Analysis and Amplifier Design*", 3rd Edition, Prentice Hall, New Jersey, 1987. ISBN : 0-135-81786-2	

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Subject Description Form

Subject Code	EIE587
Subject Title	Channel Coding
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	The students are expected to have some basic knowledge about digital communications. 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	The subject aims to introduce (i) the constraints in the design of channel codes (ii) the characteristics of block codes and convolutional codes (iii) capacity-approaching channel codes including turbo codes and low-density parity-check codes (iv) some applications of channel codes
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **(1) Professional/academic knowledge and skills** a. select, design and evaluate channel codes. **(2) Attributes for all-roundedness** b. Communicate effectively. c. Think critically and creatively. d. Assimilate new technological development in a related field.
Subject Synopsis/ Indicative Syllabus	1. Introduction 1.1 Elements of a typical digital communication system 1.2 Types of channel Additive-white-Gaussian-noise channel, binary erasure channel, binary symmetric channel, power-limited channel, bandwidth-limited channel 1.3 Channel capacity and Shannon's coding theorem 1.4 Error detection and error correction Forward error correction 1.5 Selection of coding schemes Power and bandwidth, error performance, code rate, coding gain, data structure, data rate, hardware complexity/cost, latency 1.6 Galois Field arithmetic and vector spaces 2. Linear Block Codes 2.1 Parity checks 2.2 Systematic codes and generator matrices 2.3 Parity-check matrix, parity-check equations and graphical representation 3. Convolutional Codes 3.1 Encoder Constraint length, memory, generator matrix, state diagram, code tree and trellis 4. Decoder 4.1 Maximum-likelihood (ML) decoding, maximum a posteriori (MAP) decoding 4.2 Hard decision decoder and soft decision decoder 5. Turbo Codes 5.1 Encoder 5.2 Decoder

Iterative MAP decoder, extrinsic information transfer chart (EXIT chart)
5.3 Error floor

6. Low-Density Parity-Check (LDPC) Codes
    6.1 LDPC block codes and LDPC convolutional codes
    Random codes, structured codes and quasi-cyclic LDPC (QC-LDPC) codes
    6.2 Iterative decoding algorithms and implementation design
    Sum-product algorithm (SPA), min-sum algorithm (MSA), quantized SPA and quantized MSA
    6.3 Cycles, girth, trapping sets and error floor
7. Applications
    7.1 Deep space communications
    7.2 5G wireless communications
    7.3 Wifi
    7.4 Case studies

Teaching/Learning Methodology

The theories, working principles and examples of channel coding will be described and explained in lectures. Applications and case studies will help the students to learn not only the theoretical material but also to understand the practical issues.
Computer simulations will allow student to evaluate and compare the performance of different channel coding schemes.

Teaching/Learning Methodology	Intended Subject Learning Outcomes			
	a	b	c	d
Lectures	✓		✓	✓
Tutorials	✓		✓	
Simulation	✓	✓	✓	
Case study	✓	✓	✓	✓

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. Assignments	25%	✓	✓	✓	
2. Test	25%	✓	✓		
3. Simulation	20%	✓	✓	✓	
4. Case study	30%	✓	✓		✓
Total	100%				

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

Assignments and test let students review the taught materials, do further reading for deeper learning and apply the learnt materials to solving channel coding problems.

The simulation experiment provides a deeper understanding of the channel encoding/decoding algorithms.

Case study requires the student to do further reading, search for information, keep abreast of current development, give a presentation and write a report.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	30 Hrs.
▪ Simulation/Case study	9 Hrs.

	Other student study effort:	
	▪ Lecture: further reading, doing homework/ assignment	18 Hrs.
	▪ Simulation: further studying and writing a report	18 Hrs.
	▪ Case study: studying, writing a report, giving one presentation	32 Hrs.
	Total student study effort	107 Hrs.
Reading List and References	1. William Ryan and Shu Lin, *Channel Codes: Classical and Modern*, Cambridge University Press, 2009. 2. Bernard Sklar, *Digital Communications: Fundamentals and Applications*, second edition, Prentice Hall, 2004. 3. Shu Lin and Daniel J. Costello Jr., *Error Control Coding*, second edition, Prentice Hall, 2004. 4. Peter Sweeney, *Error Control Coding*, John Wiley & Sons, 2002. 5. Andre Neubaue, Jurgen Freudenberger and Volker Kuhn, *Coding Theory: Algorithms, Architectures and Applications*, John Wiley & Sons, 2007. 6. Tom Richardson and Ruediger Urbanke, *Modern Coding Theory*, Cambridge University Press, 2008. 7. Yuan Jiang, A Practical Guide to Error-control Coding Using Matlab, Artech House, 2010. 8. Nicholas L. Pappas, Error Correction Code Design, CreateSpace Independent Publishing Platform, 2015. 9. IEEE publications: http://ieeexplore.ieee.org/, ieee802.org/16/tge/	

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Subject Description Form

Subject Code	EIE589
Subject Title	Wireless Data Network
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	The students are expected to have some basic knowledge about IP networks.
Objectives	1. To introduce the fundamental issues, concepts, and design principles in wireless data networks and systems. 2. To understand the key concepts towards 4G and 5G Wireless and the convergence of cellular network and the Internet. 3. To introduce Low-Power Wide-Area Networks for Internet of Things (IoT). 4. To understand software defined network and network function virtualization.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: **(1) Professional/academic knowledge and skills** a. Understand network topology, layered architecture and protocols of current and emerging wireless data network systems and their standards. **(2) Attributes for all-roundedness** b. Communicate effectively. c. Think critically and creatively. d. Assimilate new technological development in related field.
Subject Synopsis/ Indicative Syllabus	1. Convergence of cellular network and the Internet 1.1. Network edge: wireless technologies 1.2. Network core: the Internet structure 1.3. Layered Internet protocol stack 2. Data plane on network layer 2.1. Overview of the data plane and the control plane on network layer 2.2. What is inside a router 2.3. Generalized Forwarding 3. Control plane on network layer 3.1. IPv4 and IPv6 addresses 3.2. Routing protocols 3.3. Software-defined networking 4. Modern wireless networks 4.1. Elements of 4G LTE architecture 4.2. Elements of 5G NR architecture 4.3. Elements of WiFi architecture 4.4. Low-power wide-area networks for Internet of Things (IoT) 5. Physical-layer techniques 5.1. Fundamentals of physical layer 5.2. Bandwidth utilization

5.3. Error detection & correction
5.4. Channel coding
5.5. Data link control and media access control

Teaching/Learning Methodology

Internet and wireless networks are taught with emphasis on fundamental understanding of the architecture, components, and protocols. The fundamentals of Internet are taught with network-layer and physical-layer techniques, such as IPv4 versus IPv6 protocols, routing protocols, software-defined networking, error detection & correction, channel coding, data link control and media access control, etc. The latest developments towards 5G Wireless standards are explained. These examples will help students not only to learn the theoretical material but also to understand the practical issues. The students will be able to understand the challenges associated with the latest generations of wireless networks and get an insight into new techniques under development.

Teaching/Learning Methodology	Intended Subject Learning Outcomes			
	a	b	c	d
Lecture	✓			
Tutorial	✓		✓	
Case study	✓	✓	✓	✓

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. Midterm test	20%	✓	✓	✓	✓
2. Assignments	10%	✓	✓	✓	✓
3. Case study	10%	✓	✓	✓	✓
3. Final examination	60%	✓	✓	✓	✓
Total	100%				

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

Assignments let students review the taught materials, do further reading for deeper learning and apply the learnt materials to solving circuit design problems.

Case study requires students to do further reading, search for information, keep abreast of current development, and write a report.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	33 Hrs.
▪ Case study – presentations and discussions	6 Hrs.
Other student study effort:	
▪ Further reading, doing homework /assignments	72 Hrs.
Total student study effort	111 Hrs.

Reading List and References	1. “Computer Networking: A Top-Down Approach”, 8th ed., J. F. Kurose and K. W. Ross, Pearson, 2020 2. “5G System Design”, Wan Lei, Anthony C.K. Soong, Liu Jianghua, Wu Yong, Brian Classon, Weimin Xiao, David Mazzarese, Zhao Yang, Tony Saboorian, Springer, 2020 3. “5G Mobile Communications”, Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, Springer, 2017 4. “Wireless Communications: Principles, Theory and Methodology”, Keith Q.T. Zhang, Wiley, 2016 5. “Data Communications and Networking”, Behrouz A. Forouzan, McGraw-Hill, 2013 6. “Introduction to Wireless and Mobile Systems”, D.P. Agrawal and Q. Zeng, Cengage Learning, 2016 7. “Optical Communications in the 5G Era”, Xiang Liu, Elsevier, 2022 8. 3GPP standards: http://www.3gpp.org 9. IETF rfc in IPv6 and transition from IPv4 to IPv6: http://tools.ietf.org/html/rfcxxxx

July 2022

SUBJECT DESCRIPTION FORMS

Subjects offered by the

Department of Mechanical Engineering

Subjects Code	**Subject Title**
ME534	Engineering Acoustics
ME536	Vibration and Structure-borne Noise
ME540	Fuels and Engines
ME548	Computer Aided Product Analysis
ME552	Integrated Engineering Design
ME556	Advanced Combustion Systems
ME557	CFD and Thermofluid System Design
ME558	Advanced Materials and Structural Design
ME559	Advanced Environmental and Transportation Noise Control
ME564	Principles and Design of Air Pollution Control Devices
ME565	Prevention and Control of Vehicular Emission
ME566	Industrial and Environmental Measurement Technology
ME567	Advanced Control Technology
ME569	Thermal System Design and Management
ME570	Advanced Product Mechatronics
ME571	Corrosion Control
ME572	Design for Sustainable Development
ME573	Project on Product Design and Management
ME574	Product Noise Control
ME576	Turbulent Flows and Aerodynamics
ME577	Advanced Aircraft Structures
ME578	Aircraft Design
ME579	Aircraft Noise and Aeroacoustics

Subject Description Form

Subject Code	ME534
Subject Title	Engineering Acoustics
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Dynamics and Thermofluids.
Objectives	To provide the ingredients for students to acquire a sound background in modern acoustics and control of noise.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of physical characteristics of sound, noise radiation mechanism and phenomena of sound propagation; b. apply their knowledge, skills and hand-on experience to measure and analyse the content of sound and design the noise control system; c. extend their knowledge of noise radiation mechanism and noise control principles to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Fundamentals of Acoustics:*** Physical characteristics and acoustic phenomena; noise effect on human beings; noise pollution; human ear; subjective response to noise; wave propagation in media; wave speed, energy and intensity; power and radiation from sources; modeling of wave phenomena; Euler's equation of motion; wave equation and Helmholtz equation. ***Wave Propagation with the Presence of Boundaries:*** Reflection at rigid and impedance boundaries; transmission through interfaces; reactive silencers; wave reflection inside enclosures and acoustic modes. ***Noise Analysis:*** Quantitative measures of sound; frequency content of sounds; acoustic scales; data acquisition and acoustic measurement; digital sampling; signal processing; frequency analysis. ***Noise Sources:*** Flow-induced noises; Von Karman vortices; turbulence noise; jet noise; structural acoustics and vibrations; acoustic structural coupling; elementary sound radiators; and sound source. ***Noise Control:*** Noise attenuation; active noise cancellation; abatement of sound propagation; estimation of barrier insertion loss; acoustical properties of sound absorbing materials and measurement; damping and absorption; viscoelastic damping treatment; impedance of wall structures; calculation of noise level inside a room; transmission and acoustic isolation.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for engineering acoustics.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	

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. Homework assignment	20%	√	√	√	√
2. Test	20%	√	√		
3. Case study report and presentation or laboratory	10%	√	√	√	√
4. Examination	50%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.50 × End of Subject Examination + 0.50 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/ Case study/ Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Textbooks:

1. Hansen C. H. and Snyder S. D., *Active Control of Noise and Vibration*, Spon, latest eidtion.
2. Pierce A. D., *Acoustics*, Acoustic Society of America, latest edition.

	3. Kleppe J. A., *Engineering Application of Acoustics*, Artech House, latest edition. 4. Everest F. A., *The Master Handbook of Acoustics*, Tab Books Inc., latest edition. 5. Bies D. A. and Hansen C. H., *Engineering Noise Control*, Spon, latest edition. 6. Norton M. P., Fundamentals of *Noise and Vibration Analysis for Engineers*, Cambridge University Press, latest edition. 7. Kinsler L. E. et al, *Fundamentals of acoustics*, Wiley, latest edition. Journals: • The Journal of the Acoustical Society of America, Acoustical Society of America. • Journal of Sound and Vibration, Academic Press. • Acustica united with Acta Acustica, S. Hirzel Verlag. • Applied Acoustics, Elsevier Applied Science.

Subject Description Form

Subject Code	ME536
Subject Title	Vibrations and Structure-borne Noise
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Dynamics. Exclusion: ME6101 Advanced Theory and Methods in Vibration Analysis
Objectives	To provide the students an in-depth study in vibration analysis and measurement, and to equip the students with the ability for treating the general vibration problems related to noise abatement at source.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of the noise radiation and vibration mechanism, the relation between noise and vibration and vibration control; b. apply their knowledge, skills and hand-on experience to measure and analyse the content of vibration and design the vibration control system; c. extend their knowledge of the analysis of structural vibration and sound radiation to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Noise Pollution Control at Source:*** Relation between vibration and noise vibration as noise sources; classification of analysis of machinery vibrations. ***Vibration Control:*** Sources of vibration; vibration basics; vibration analysis of continuous structures; vibration isolation and absorption; passive and active vibration control. ***Experimental Assessment of Vibrations:*** Basic measurement system; signal processing; modal parameter identification; time-domain and frequency-domain vibration analysis. ***Noise Generated by Vibrating Structures and Control:*** Elementary noise radiators; noise radiation by machine; noise source identification; sound intensity measurement; identification of noise source; noise radiation and transmission; design principles for noise reduction. ***Typical Laboratory Experiments:*** • Structural modal testing • Vibration control • Measurement of sound intensity

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for vibrations and structure-borne noise.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	√

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. Homework assignment	20%	√	√	√	√
2. Test	20%	√	√		
3. Case study report and presentation	10%	√	√	√	
4. Examination	50%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.50 × End of Subject Examination + 0.50 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. They are aimed at evaluating the progress of student study, assisting them in self-monitoring of fulfilling the respective subject learning outcomes, and enhancing the integration of the knowledge learnt.

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	24 Hrs.
▪ Tutorial/Case study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	42 Hrs.
▪ Case study report preparation and presentation	24 Hrs.
Total student study effort	105 Hrs.

Reading List and References	1. Rao S. S., *Mechanical Vibrations*, Third Edition, Addison-Wesley, latest edition. 2. Thomson W. T, *Theory of Vibration with Applications*, Prentice Hall, latest edition. 3. Dimarogonas A., *Vibration for Engineers, Second Edition*, Prentice-Hall, latest edition. 4. Ewins D.J., *Modal Testing: Theory and Practice*, Research Studies Press Ltd., John Wiley, latest edition. 5. Barron R., *Engineering Condition Monitoring*: Practice, Methods and Applications, Addison Wesley Longman, latest edition. 6. Lyon R. H., *Machinery Noise and Diagnostics*, Butterworths, latest edition. 7. Junger M. C. and Feit D., Sound, Structures and Their Interaction, ASA, latest edition.

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Subject Description Form

Subject Code	ME540
Subject Title	Fuels and Engines
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Thermofluids. Exclusion: ME5106 Green Automotive Engine Technology
Objectives	To provide students with knowledge of fuel quality and engine technology effects on emissions.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. have the knowledge of fuel thermochemistry and fuel quality effects on emissions, engine technologies, engine combustion-related emissions and control technologies; b. extend their knowledge of fuels and engines to different situations of engineering context and professional practice; and c. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Fuels:*** Fuels and their characteristics; hydrocarbon chemistry; automotive, alternative and aviation fuels; fuel cell; fuel quality; fuel effects on emissions. ***Engines:*** Engine cycles and operating parameters; compression ignition, spark-ignition, liquefied petroleum gas, natural gas and aircraft jet engines. ***Heat and Mass Transfer in Engines:*** Engine cooling systems; engine energy balance; finite heat release in engine cycles; cylinder heat transfer measurements; heat transfer modeling; heat transfer correlations; radiation heat transfer. ***Air, Fuel and Exhaust Flow in Engines:*** Valve flow, intake and exhaust flow; fluid flow in the cylinder; turbulent flow; superchargers and turbochargers; fuel injectors. ***Combustion-related Emissions and Control Technologies in Engines:*** Review of current and projected engine emissions concerns and legislative requirements; steady-state and transient emissions; fuel supply system and electronic control for engines; exhaust after treatment. ***Engine Testing and Control:*** Dynamometers; fuel and air flow measurement; exhaust gas and particulate emission analysis; residual fraction; pressure-volume measurement and combustion analysis; vehicle emission testing; engine sensors and actuators in vehicles; engine control systems; effect of ambient pressure and temperature.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for fuels and engines.
3. Technical/practical examples and problems will be raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes		
	a	b	c
1. Lecture	√	√	√
2. Tutorial	√	√	
3. Homework assignment	√	√	
4. Case study report and presentation	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Homework assignment	20%	√	√	
2. Test	20%	√	√	
3. Case study report and presentation	10%	√	√	√
4. Examination	50%	√	√	
Total	100%			

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

Overall Assessment:

0.50 × End of Subject Examination + 0.50 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, interim test, and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Bosch R.G., *Gasoline-Engine Management*, Bosch, latest edition.
2. Bosch R.G., *Diesel-Engine Management*, Bosch, latest edition.
3. Elvers B., *Handbook of Fuels*, Wiley-Vch, latest edition.
4. European Conference of Ministers of Transport, *Vehicle Emission Reductions*, OECD, latest edition.
5. Ferguson C.R. and Kirkpatrick A. T., *Internal Combustion Engines*, John Wiley & Sons Inc., latest edition,

6. Guibet J.C., *Fuels and Engines- Technology, Energy and Environment*, Vol. 1 & 2, Technip, Paris, latest edition.
7. Hoag K.L., *Vehicular Engine Design*, Springer-Verlag, latest edition.
8. Klingenberg H., *Automobile Exhaust Emission Testing*, Springer, latest edition.
9. Pulkrabek W.W., *Engineering Fundamentals of the Internal Combustion Engine*, Pearson Prentice Hall, latest edition.
10. Sher E., *Handbook of Air Pollution from Internal Combustion Engines*, Academic Press, latest edition.

Journals/Magazines:

- Atmospheric Environment, Elsevier Science Ltd.
- Automotive Engineering International (Chinese Edition), Society of Automotive Engineers International, USA.
- Energy and Fuels, American Chemical Society Publications, USA.
- Fuel, Elsevier Science Ltd.
- Journal of Automobile Engineering, Institution of Mechanical Engineers, UK.
- SAE Technical Papers & Automotive Engineering International Magazine, Society of Automotive Engineers International, USA.
- Transport Research Part D: Transport and Environment, Elsevier Science Ltd.

Subject Description Form

<table>
<tr><td>Subject Code</td><td>ME548</td></tr>
<tr><td>Subject Title</td><td>Computer Aided Product Analysis</td></tr>
<tr><td>Credit Value</td><td>3</td></tr>
<tr><td>Level</td><td>5</td></tr>
<tr><td>Pre-requisite/ Co-requisite/ Exclusion</td><td>Students should have basic knowledge in Mechanical Engineering; Building Service Engineering; Civil & Structural Engineering; Manufacturing Engineering; Product Design & Engineering.</td></tr>
<tr><td>Objectives</td><td>To provide students with good understanding of the CAD and CAE technologies. The subject covers computer aided analysis, integration of CAD and CAE, and virtual engineering.</td></tr>
<tr><td>Intended Learning Outcomes</td><td>Upon completion of the subject, students will be able to:
a. possess knowledge in the area of principle and formulations of finite element method, computer aided design and engineering;
b. analyze static and dynamic stress and strain behaviors of structures and products using CAD and CAE techniques;
c. apply their knowledge and skills to design and develop new products; and
d. have recognition of the need for, and an ability to engage in life-long learning.</td></tr>
<tr><td>Subject Synopsis/ Indicative Syllabus</td><td><i>Geometric Modeling Systems:</i> Wireframe modeling systems; surface modeling systems; solid modeling systems.
<i>Computer Aided Analysis:</i> Introduction to finite element analysis; finite element software; automatic mesh generation; node connection approach; topology decomposition approach; geometry decomposition approaches; grid-based approach; mapped element approach; improvement of mesh quality; case study.
<i>Finite Element Models of Aircraft Structure:</i> Truss elements; Beam elements; Plate elements; and Shell elements.
<i>Structural Optimization:</i> Sizing optimization; shape optimization; topology optimization; case study.
<i>Virtual Engineering:</i> Definition of virtual engineering; components of virtual engineering; virtual design; digital simulation; virtual prototyping; product lifecycle management.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for computer aided analysis.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.
<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="4">Intended subject learning outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td></tr>
<tr><td>1. Lecture</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Tutorial</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>3. Homework assignment</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>4. Case study report and presentation</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
</table>
</td></tr>
</table>

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. Homework assignment	25%	√	√	√	√
2. Test	10%	√	√	√	√
3. Project report and presentation	25%	√	√	√	√
4. Examination	40%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.40 × End of Subject Examination + 0.60 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and project report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case Study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	42 Hrs.
▪ Case study report preparation and presentation	24 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Lee K., *Principles of CAD/CAM/CAE Systems*, Addison Wesley, latest edition.
2. Law A. M. and Kelton D. W., *Simulation Modeling and Analysis*, McGraw-Hill, latest edition.
3. Przemieniecki, J. S., Finite Element Structural Analysis, New Concepts, AIAA, latest edition.
4. Donaldson, B. K., Analysis of Aircraft Structures, An Introduction, Cambridge University Press. Latest edition.

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Subject Description Form

Subject Code	ME552
Subject Title	Integrated Engineering Design
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have a good foundation in mechanical sciences.
Objectives	To provide the students with practical experiences in the consecutive stages in design, analysis and development of a new product; to introduce various important considerations in product design and development, and their integration with critical engineering analysis in producing a new product; to introduce project management techniques in producing a new product.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of engineering design and product development process; b. be able to apply their knowledge and contribute to professional competence, including ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability; c. work as an effect team member and have the readiness in assuming a leadership role in a design project; d. think holistically, critically, strategically and creatively in dealing with complex problems and situations pertinent to a design project. e. have a good mastery of critical and creative thinking skills and generate practical and innovative solutions to novel problems; and f. have an ability to recognize the need and engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Conceptual Product Design:*** Customer needs and market situation; technical and business concerns; environmental issues; cultural and social issues; aesthetic and semantic issues; establish product function; visualization skills and CAD. ***Engineering Analysis of Design:*** Benchmarking and establishing engineering specifications of the product; design concept selection; product embodiment: design refining and system modeling; analytical and numerical model solutions; design for manufacture and assembly; CAE and optimization. ***Product Development Techniques:*** Goals of prototyping; types and uses of prototypes; rapid prototyping techniques; physical models and experimentation.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for integrated engineering design.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes					
	a	b	c	d	e	f
1. Lecture	√	√	√	√	√	√
2. Tutorial	√	√	√	√	√	√
3. Homework assignment	√	√	√	√	√	√
4. Case study report and presentation	√	√	√	√	√	√

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. Homework assignment	20%	√	√	√	√	√	√
2. Test	20%	√	√		√	√	√
3. Case study report and presentation	20%	√	√	√	√	√	√
4. Examination	40%	√	√	√	√	√	√
Total	100%						

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

Overall Assessment:

0.40 × End of Subject Examination + 0.60 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References	1. Pahl G. and Beitz W., *Engineering Design*, Springer-Verlag, latest edition. 2. Ulrich K. and Eppinger S., *Product Design and Development*, McGraw-Hill, latest edition. 3. Otto K. and Wood K., Product Design: *Techniques in Reverse Engineering and New Product Development*, Prentice Hall, latest edition. 4. Clausing D., *Quality Function Deployment*, MIT Press, latest edition. 5. Crawford C. M. and Di Benedetto C.A., *New Product Management*, McGraw-Hill, latest edition. 6. Cooper R. G., Winning at *New Products: Accelerating the Process from Idea to Launch*, Perseus Books, latest edition. 7. Buchanan R. et al., *The Idea of Design*, MIT Press, latest edition. 8. Adams J. L., *Conceptual Blockbusting: a Guide to Better Ideas*, Addison-Wesley, latest edition.

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Subject Description Form

Subject Code	ME556
Subject Title	Advanced Combustion Systems
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Thermofluids. Exclusion: ME541 Combustion Systems and Air Pollution Control
Objectives	To provide knowledge about the constructions and operation principles, as well as the techniques for performance evaluation of the domestic and industrial combustion systems, which are commonly used in Hong Kong and the surrounding regions; to provide knowledge about the flame and combustion characteristics, and the emissions associated with these combustion systems; to provide knowledge about the thermal modelling techniques of industrial furnace, the design method of industrial chimney and the techniques to predict the dispersion from chimney.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills and be able to contribute to their professional competence in the area of combustion systems (including combustion, heat transfer and emissions); b. think holistically and critically in solving complex problems and situations pertaining to their professional practice; c. have recognition of the need for, and an ability to engage in life-long learning; d. increase their awareness of the local and global environmental issues, existing regulation and policies, as well as the state-of-the-art technologies.
Subject Synopsis/ Indicative Syllabus	***Flame:*** Premixed and diffusion flames; flame structures and characteristics; effect of fuel types; laminar and turbulent flames; effects of equivalence ratio and Reynolds number; flame stability; effect of combustion on emissions. ***Domestic Gas-fired Appliances***: Applications; flame and fuel types; design criteria of burner/appliance; heating efficiency assessment; emissions and safety. ***Industrial Furnaces:*** Gas-fired, oil-fired and coal-fired industrial furnaces; burning of gaseous, liquid and solid fuels in furnaces; burners and atomizers; stoker-fired and pulverized-fired furnaces; types of emissions and their control; measurement and analysis of flue gases; handling equipment; selection of combustion equipment. ***Thermal Modeling of Furnaces:*** Heat transfer mechanisms in furnaces; forced convection and gaseous radiation in furnaces; Hottel's zonal method; single gas zone and plug-flow regions; energy balance in furnaces; modeling of combustion products for gaseous radiation calculations. ***Chimneys and Flues:*** Function and operation problems of chimney; design criteria; chimney sizing and thermal insulation; construction and linings; modeling of dispersion of emissions from chimney.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for advanced combustion systems.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	√

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. Homework assignment	20%	√	√	√	√
2. Test	20%	√	√		√
3. Case study report and presentation	10%	√	√	√	√
4. Examination	50%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.50 × End of Subject Examination + 0.50 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Borman G. L. and Ragland K. W., *Combustion Engineering*, McGraw-Hill, latest edition.
2. Turns S. R., *An Introduction to Combustion: Concepts and Applications*, McGraw-Hill, latest edition.
3. CIBSE, *Combustion Systems*, CIBSE Guide, Section B13, latest edition.
4. Rogers G. and Mayhew Y., *Engineering Thermodynamics* – Work and Heat Transfer, 4th edition, Longman, latest edition.
5. Modest M. F., *Radiative Heat Transfer*, McGraw-Hill, latest edition.

Subject Description Form

Subject Code	ME557
Subject Title	CFD and Thermofluid System Design
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Thermofluids Exclusion: ME549 Computational Fluid Dynamics and Its Applications
Objectives	To provide students with knowledge of computational fluid dynamics and numerical heat transfer; to make the students have the ability to model and solve the practical problems in industry.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of computational fluid dynamics and numerical heat transfer, be able to apply their knowledge and skills in designing and developing products or engineering systems; b. think critically and holistically in dealing with real CFD problems, and generate practical solutions; and c. recognize the need for, and engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Introduction to Numerical Methods:*** Governing equations of fluid flow and heat transfer; finite element method; finite difference method; finite volume method; lattice Boltzmann method and other numerical techniques. ***Numerical Techniques:*** Steady and unsteady solution; influence of relaxation factors; stability and convergence; explicit and implicit methods. ***Boundary Conditions:*** Boundary conditions for internal flow; boundary conditions for external flow; boundary conditions for thermal problem. ***Mesh Generation:*** Types of the mesh; 2D mesh; 3D mesh; mesh refinement and optimization; mesh generation using software. ***Viscous Models:*** Laminar model; inviscid model; Spalart-Allmaras model (1 equation); k-epsilon model (2 equations); Reynolds stress model; Large Eddy Simulation model. ***Case Study – Fan and Impeller Design***: Airfoil and cascade; impeller simulation; vorticity analysis; fan efficient analysis. ***Case Study – Thermal Management of Electronic Equipment:*** Conjugated heat transfer in electronic package design; cooling electronic equipment by natural convection; optimum heat transfer; flow around cylinders. ***Case Study – Room Ventilation Design:*** Diffuser design; diffuser arrangement design; air quality evaluation.

<table>
<tr>
<td>Teaching/Learning Methodology</td>
<td>
1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for CFD and thermofluid system design.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.
<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="3">Intended subject learning outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td></tr>
<tr><td>1. Lecture</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Tutorial</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>3. Homework assignment</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>4. Case study report and presentation</td><td>√</td><td>√</td><td>√</td></tr>
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</td>
</tr>
<tr>
<td>Assessment Methods in Alignment with Intended Learning Outcomes</td>
<td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="3">Intended subject learning outcomes to be assessed</td></tr>
<tr><td>a</td><td>b</td><td>c</td></tr>
<tr><td>1. Homework assignment</td><td>20%</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Test</td><td>20%</td><td>√</td><td>√</td><td></td></tr>
<tr><td>3. Case study report and Presentation</td><td>20%</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>4. Examination</td><td>40%</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Total</td><td>100%</td><td colspan="3"></td></tr>
</table>
Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
Overall Assessment:
0.40 × End of Subject Examination + 0.60 × Continuous Assessment
The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.
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.
</td>
</tr>
<tr>
<td>Student Study Effort Expected</td>
<td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture</td><td>21 Hrs.</td></tr>
<tr><td>▪ Tutorial/Case study</td><td>18 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Self Study</td><td>45 Hrs.</td></tr>
<tr><td>▪ Case study report preparation and presentation</td><td>21 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>105 Hrs.</td></tr>
</table>
</td>
</tr>
<tr>
<td>Reading List and References</td>
<td>
1. Fletcher C. A. J., <i>Computational Techniques for Fluid Dynamics: A Solutions Manual</i>, Springer-Verlag, latest edition.
2. Reddy J. N. and Gartling D. K., <i>The Finite Element Method in Heat Transfer and Fluid Dynamics</i>, Boca Raton, Fla., CRC Press, latest edition.
3. Anderson J. D., <i>Computational Fluid Dynamics</i>, McGraw-Hill, latest edition.
</td>
</tr>
</table>

	4. Versteeg H. K. & Malalasekera W., *An Introduction to Computational Fluid Dynamics*, Longman, latest edition. 5. Rao, S. S**.,** *The finite element method in engineering*, Pergamon Press, latest edition. 6. Shaw C. T., Using Computational Fluid Dynamics, Prentice Hall, latest edition.

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Subject Description Form

Subject Code	ME558
Subject Title	Advanced Materials and Structural Design
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Mathematics, Engineering Materials, and Solid Mechanics. Exclusion: ME550 Materials and Smart Structural Design
Objectives	To provide students with knowledge of the mechanical behaviour, manufacturing process and utilizations of advanced composite materials, smart materials and structures, and nano-materials for product design and development with a special emphasize on aircraft applications.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. understand the mechanics of advanced composite materials, especially the mechanics of a lamina and laminates, including failure mechanisms; b. possess the state-of-the-art knowledge on smart materials and smart structure design; c. recognize the importance of nano-materials in advanced technology; and d. understand the application of advanced composites, smart materials, smart structures, and nano-materials in aircraft design.
Subject Synopsis/ Indicative Syllabus	***Advanced Composite Materials:*** Composite constituents; principles of fibre-reinforced composites; mechanics of a lamina; mechanics of laminates, tooling and manufacturing processes; failure criteria for composites; aircraft applications and related design issues. ***Piezoelectric Materials:*** The fundamental mechanisms of piezoelectric materials and major applications, Curie temperature, concept of piezoelectric moduli and applications of these moduli in design of sensors and actuators, smart structure design issues. ***Shape Memory Alloys (SMA):*** Phenomena & mechanisms of temperature controlled shape memory effect, critical temperatures, stress effect on critical temperatures, mechanical properties of SMA at different phases and temperatures, shape memory and superelasticity, modeling of the effects of temperature and stress, special design considerations at joints, continuum vs. discrete applications of SMA, major impediments to applications of SMA. ***Nanomaterials:*** Nano-materials for product design; mechanical and thermal properties of nano-composite materials. ***Smart Structures:*** Introduction to smart structures; fibre-optic sensors; integrated sensing, controlling and actuating techniques. Selected applications of smart structures in aircraft design. ***Laboratory Works:*** • Mechanical properties of shape memory alloys. • Strain measurement of composite structures using embedded fibre-optic sensors.
Teaching/Learning Methodology	1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, mini-project or case study and examination. 2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for advanced materials and structural design. 3. Technical/practical examples and problems are raised and discussed in class/tutorial

sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√		√
4. Mini-project/Case study report and presentation		√	√	√

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. Homework assignment	20%	√	√		√
2. Test	15%	√			
3. Mini-project/Case study report and presentation	15%		√	√	√
4. Examination	50%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.50 × End of Subject Examination + 0.50 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, mini-project or case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case Study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	42 Hrs.
▪ Mini-project/Case study report preparation and presentation	24 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Alan Baker, Stuart Dutton and Donald Kelly, *Composite Materials for Aircraft Structures,* AIAA, latest edition.
2. Ronald F. Gibson, *Principles of Composite Material Mechanics*, McGRAL-HILL, latest edition.
3. Srinivasan A. V. and McFarland D. M., *Smart Structures*, Cambridge University Press, latest edition.
4. Banks H. T., Smith R. C. and Wang Y., *Smart Material Structures*, John Wiley & Sons, latest edition.
5. Nanostructured Materials - Processing, Properties, and Applications, edited by Carl C. Koch, William Andrew Publishing, latest edition.

Subject Description Form

Subject Code	ME559
Subject Title	Advanced Environmental and Transportation Noise Control
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Thermofluids and Noise. Some working experience in industry or environmental sectors is desirable. Exclusion: ME535 Industrial and Transportation Noise Control
Objectives	To provide students with knowledge of practical and systematic approach to control noise due to environmental and transportation noise sources.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of physical parameters of sound in transportation and the assessment method; b. apply their knowledge, skills and hand-on experience to measure, calculate and assess the noise level in transportation and keeping aware of the environmental issues, existing regulation and policies concerning noise control; c. extend their knowledge of sound prediction and noise assessment to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Road Traffic Noise:*** Traffic noise indices; calculation of road traffic noise (CRTN) – prediction procedures; the measurement of road traffic noise; the standard drive past test; assessment of noise and vibration impacts due to road traffic. ***Control of Vehicle Noise:*** Identification of noise sources; strategies for controlling vehicle noise; porous pavement for reducing tyre noise; acoustical performance of traffic noise barriers; absorptive barriers; in-situ determination of the acoustical performance of roadside barriers. ***Aircraft Noise:*** Aircraft noise indices; noise certification; aircraft noise sources; the integrated noise model (INM) for aircraft noise prediction; Nordic guidelines for calculation of air traffic noise. ***Rail Transport Noise:*** Railway noise indices; sources of train noise; prediction of train noise – calculation of rail noise (CRN); strategies of controlling rail noise; vibration from railways and its control; measurement techniques.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for advanced environmental and transportation noise control.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	

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. Homework assignment	20%	√	√	√	√
2. Test	20%	√	√		
3. Case study report and presentation	20%	√	√	√	
4. Examination	40%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.40 × End of Subject Examination + 0.60 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case study	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.

	Total student study effort	105 Hrs.
Reading List and References	1. Bies D. A. and Hansen C. H., *Engineering Noise Control – Theory and Practice,* E&FN Spon, latest edition. 2. Bell, L. H. *Industrial Noise Control – Fundamentals and Applications*, Marcel Dekker Inc., latest edition. 3. Institute of Acoustics, *Diploma in Acoustics and Noise Control – Tutored Distance Learning Programme, Transportation Noise Unit 1 and Unit 2*. 4. Nelson P. M. (Ed.), *Transportation noise Reference Book*, Butterworths, latest edition.	

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Subject Description Form

Subject Code	ME564
Subject Title	Principles and Design of Air Pollution Control Devices
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Thermofluids and Air Pollution. Exclusion: ME539 Treatments of Dust, Fume and Wastewater
Objectives	To provide the student with an in-depth understanding of the working principles and design features of air pollution control devices.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of air pollution control; b. apply their knowledge, skills and hand-on experience to evaluate different methods for reducing gaseous emission and reducing particulate emission; c. extend their knowledge of air pollution control to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Nature of Gaseous and Particulate Pollutants in Air:*** Nature and composition of the atmosphere. Sources of air pollutants. Common gaseous pollutants in air and their chemical properties. Common particulates in air. Physical and chemical properties of aerosols. ***Principles and Design of Gaseous Pollution Control Devices:*** Processes for removal of pollutant gases and vapours. Adsorption: adsorption material, breakthrough time, adsorption zone velocity, regeneration. Absorption: packed bed scrubber, mass transfer process, NTU and HTU. Catalytic converter: catalysts, catalyst requirements for different applications, typical catalytic reactions for reducing pollutants. Design of absorber, absorber and catalytic converter. ***Principles and Design of Particulate Control Devices:*** Motion of particles: drag forces, equations of particle motion, settling velocity. Filters: surface filter and depth filter, filtering mechanisms, determination of filtering efficiencies. Cyclones: axial flow and tangential flow cyclones, equations governing motion of particles in the cyclone, determination of collection efficiency. Electrostatic precipitation: principle of electrostatic precipitation, equations governing motion of particles in electrostatic precipitator, determination of collection efficiency. Air purifiers: analysis of the design and function of air purifiers.
Teaching/Learning Methodology	1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test and examination. 2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for air pollution control devices. 3. Technical/practical examples and problems will be raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√

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. Homework assignment	15%	√	√	√	√
2. Test	35%	√	√		√
3. Examination	50%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.50 × End of Subject Examination + 0.50 × Continuous Assessment

The continuous assessment will consist of two components: homework assignments and test. 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.

The examination will be 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	24 Hrs.
▪ Tutorial/Case study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Heinsohn R. J. and Kabel R. L., *Sources and Control of Air Pollution*, Prentice Hall, latest edition.
2. Nevers N. D., *Air Pollution Control Engineering*, McGraw-Hill, latest edition.
3. Toole-O'Neil B., *Dry Scrubbing Technology for Flue Gas Desulfurization*, Kluwer Academic Publisher, latest edition.
4. Lewandowski, D. A., *Design of Thermal Oxidation Systems for Volatile Organic Compounds*, Lewis Publishers, latest edition.
5. Dickenson, T. C., *Filters and Filtration Handbook*, 4th edition, Elsevier Advanced Technology, latest edition.
6. Crittenden B. and Thomas, W. J., *Adsorption Technology and Design*, Butterworth Heinemann, latest edition.

Journals

- Aerosol Science and Technology
- AICHE Journal
- Environmental Technology
- Journal of Aerosol Science
- Separation Science and Technology

Subject Description Form

Subject Code	ME565
Subject Title	Prevention and Control of Vehicular Emissions
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Thermofluids and Air Pollution.
Objectives	To provide students with in-depth knowledge in prevention and control of vehicular emissions.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess the knowledge of vehicle emission trends and control, transport and dispersion of vehicle-generated emissions, and advanced engine technologies and devices for vehicular emission reduction; b. extend their knowledge of prevention and control of vehicular emissions to different situations of engineering context and professional practice; and c. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Vehicle Emission Trends:*** Background. Environmental and health aspects associated with motor vehicle emissions; worldwide emissions control programmes. ***Atmospheric Transport and Dispersion of Air Pollutants Associated with Vehicular Emissions:*** Definition of transport and dispersion; meteorological parameters; scales of motion; theory of transport and dispersion in open highway and urban street canyons. ***Vehicular Emissions:*** Driving cycle and behavior; driving cycles for emission testing; development of driving cycle; vehicle emission testing on chassis dynamometers; testing procedures; effect of driving mode and driving behavior on vehicle emissions; analysis of vehicle emission test data. ***Advanced Engine Technology for Vehicular Emission Reduction:*** Advanced design features of gasoline engines: lean burn combustion, gasoline direction injection; advanced design features of diesel engines: air-handling system, fuel handling system and combustion system; Homogeneous charge compression ignition engine. ***Advanced Aftertreatment Devices for Vehicular Emission Reduction:*** Catalytic converter with preheating; lean NOx catalyst and NOx absorber; continuously regenerative trap; selective catalytic reduction (SCR) of NOx; SCR-Trap system; non-thermal plasma.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for prevention and control of vehicular emissions.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes		
	a	b	c
1. Lecture	√	√	√
2. Tutorial	√	√	
3. Homework assignment	√	√	
4. Case study report and presentation	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Homework assignment	20%	√	√	
2. Test	20%	√	√	
3. Case study report and presentation	10%	√	√	√
4. Examination	50%	√	√	
Total	100%			

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

Overall Assessment:

0.50 × End of Subject Examination + 0.50 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References	1. Eastwood P., *Critical Topics in Exhaust Gas Aftertreatment*, Research Studies Press Ltd., latest edition. 2. European Conference of Ministers of Transport, *Vehicle Emission Reductions*, OECD, latest edition. 3. Heck R. M., Farrauto R. J. and Guklati S. T., *Catalytic Air Pollution Control-Commercial Technology*, John Wiley & Sons, Inc., latest edition. 4. IMechE Seminar Publication, *Future Engine and System Technology*, Professional Engineering Publishing Limited, latest edition. 5. Khare M. and Sharma P., *Modelling Urban Vehicle Emissions*, WIT Press, Southampton, latest edition. Journals: 1. Atmospheric Environment, Elsevier Science Ltd. 2. Journal of Aerosol Science, Elsevier Science Ltd. 3. SAE Technical Paper, Society of Automotive Engineers International, USA. 4. The Science of the Total Environment, Elsevier Science Ltd. 5. Transport Research Part D: Transport and Environment, Elsevier Science Ltd. 6. Journal of the Air and Waste Management Association, Air & Waste Management Association

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Subject Description Form

Subject Code	ME566
Subject Title	Industrial and Environmental Measurement Technology
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Mechanical Engineering; Building Services; Civil & Structural Engineering, Manufacture Engineering. Some working experience in industries is desirable.
Objectives	To provide students with knowledge of advanced measurement technology and applications in industry.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of random data analysis, various measurement techniques, including flow, temperature / heat, force, etc; b. apply their knowledge, skills and hand-on experience, gained from the subject, to the measurement of flow systems and data analysis; c. extend their knowledge of mechanical engineering to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Random Signal Analysis:*** Probability density function, time-average, variance, skewness and kurtosis of signals; auto-correlation and cross-correlation functions; power spectral density function of a signal; spectral phase and coherence between two random signals; ensemble averaging technique. ***Flow Measurement:*** Thermal anemometers; laser Doppler velocimetry; particle imaging velocimetry; flow visualization techniques. ***Temperature and Heat Measurements:*** Fibre-optic grating sensors; constant current anemometer and thermocouples; surface temperature sensing with thermochromic liquid crystals and laser interferometry. ***Vibration Measurement:*** Vibration measurement system; fibre-optic Bragg grating sensors, transducers, piezoelectric accelerometers, force transducers, laser vibrometers, strain gauge, electromechanical shakers and hammers.
Teaching/Learning Methodology	1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination. 2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for industrial and environmental measurement technology. 3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	

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. Homework assignment	20%	√	√	√	√
2. Test	20%	√	√		
3. Case study report and presentation	20%	√	√	√	
4. Examination	40%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.40 × End of Subject Examination + 0.60 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Goldstein R. J., *Fluid Mechanics Measurements*, Taylor & Francis, latest edition.
2. Beckwith, T. G., Marangoni R. D. and Lienhard J. H., *Mechanical Measurements,* Addison-Wesley Publishing Company, latest edition.
3. Bendat J. S. and Piersol A. G., *Engineering Applications of Correlation and Spectral Analysis*, John Wiley & Sons, Inc. latest edition.

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Subject Description Form

Subject Code	ME567
Subject Title	Advanced Control Technology
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in System Dynamics and Control, Industrial Automation, and Mechatronics. Some working experience in Control and Automation is desirable.
Objectives	To provide students with a good understanding of advanced control technology and its applications in mechanical engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of advanced control technology and its application to different mechanical systems; b. apply their knowledge, skills and hand-on experience to design, develop, manufacture, and analyze mechanical systems with advanced control features or functions for desired needs; c. extend their knowledge of advanced control technology and its application to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Analog Control:*** Controller design using state-space methods; causality of feedback systems; controllability and observability of linear systems. ***Optimal Control:*** Motivation of optimal feedback controller design; linear quadratic optimal control; elementary theory of nonlinear feedback control; feedback linearization control. ***Digital Control:*** Introductory digital control; sampled-data systems; anti-alias filters; sample rate selection; discrete-time systems and z-transform; digital controller design. ***Microcomputer Implementation:*** Microcomputer implementation of controllers; introduction to system identification; self-tuning control; control of twin-rotor system; control of an inverted pendulum.
Teaching/Learning Methodology	1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination. 2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for advanced control technology. 3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	

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. Homework assignment	30%	√	√	√	√
2. Case study/Lab report and presentation	10%	√	√	√	
3. Examination	60%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.60 × End of Subject Examination + 0.40 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case study/Laboratary	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Bryson A. E., *Applied Linear Optimal Control: Examples and Algorithms,* New York, N.Y.: Cambridge University Press, latest edition.
2. Dorsey, John. *Continuous and Discrete Control Systems: Modeling, Identification, Design, and Implementation*, Boston: McGraw-Hill, latest edition.
3. Kisačanin, Branislav, *Linear Control Systems: with Solved Problems and MATLAB Examples,* New York : Kluwer Academic/Plenum Publishers, latest edition.

Subject Description Form

Subject Code	ME569
Subject Title	Thermal System Design and Management
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Thermofluids.
Objectives	To provide students with knowledge of advanced thermal technology; and make students have the ability to solve practical problems in industry.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of heat transfer and thermal sciences, be able to apply their knowledge and skills in designing and developing products or engineering systems; b. think critically and holistically in dealing with real thermal and energy problems, and generate practical solutions; and c. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Review of Heat Transfer:*** Steady and unsteady conduction; forced and natural convection, and radiation. ***Heat Pipe:*** Theory of heat pipe; types of the heat pipe; heat pipe design and manufacturing; heat pipe applications. ***Cooling of Electronic Equipment:*** Cooling load of electronic equipment; thermal environment; conduction cooling, convection cooling and liquid cooling. ***Heating and Cooling of Buildings:*** Thermal comfort; design conditions for heating and cooling; heat gain from people; lights and appliances; solar heat gain; infiltration heat load and weatherizing. ***Refrigeration and Freezing of Foods:*** Control of microorganisms in foods; thermal properties of foods; refrigeration of fruits, vegetables and cut flowers; refrigeration of meats, poultry and fish; refrigeration of eggs, milk and bakery products; refrigeration load of cold storage rooms; transportation of refrigerated foods. ***Solar Energy:*** Solar irradiation, solar energy conversion, solar energy collector.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for thermal system design and management.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes		
	a	b	c
1. Lecture	√	√	√
2. Tutorial	√	√	√
3. Homework assignment	√	√	√
4. Case study report and Presentation	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Homework assignment	20%	√	√	√
2. Test	20%	√	√	
3. Case study report and presentation	20%	√	√	√
4. Examination	40%	√	√	√
Total	100%			

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

Overall Assessment:

0.40 × End of Subject Examination + 0.60 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case study	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Cengel Y. A., *Heat Transfer*, McGraw-Hill, latest edition.
2. Rohsenow W. M., Hartnett J. P. and Ganić E. N., *Handbook of Heat Transfer Applications*, New York: McGraw-Hill, latest edition.
3. Incropera F. P. and DeWitt D. P., *Fundamentals of Heat and Mass Transfer*, John Wiley & Sons, Inc. latest edition.

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Subject Description Form

Subject Code	ME570
Subject Title	Advanced Product Mechatronics
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in fundamentals of system dynamics and automatic control, familiar with control systems, computer language in Matlab. Exclusion: ME553 Product Mechatronics
Objectives	To provide students with knowledge of designing and analyzing intelligent product embedded with microcontrollers. Students will learn to integrate sensors, microcontrollers, and actuators to design intelligent products.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of advanced mechatronics in product design and analysis; b. apply their knowledge, skills and hand-on experience to design, develop, manufacture, and analyze new products with advanced mechantronics features or functions for desired needs; c. extend their knowledge of advanced mechatronics to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Mechatronic System:*** Configuration of mechatronic systems; sensors and transducers, and signal conditioning circuits; actuators: electrical, mechanical and pneumatic; drivers; measurement and guidance of moving parts. ***Signal Processing Techniques:*** Analog and digital filters; Nyquist sampling theorem; controller design and implementation; data converters (analog-to-digital, digital-to-analog); microcontrollers and their applications; interfacing and power sources. ***Mechatronic System Analysis:*** Design and implementation; problem definition; system requirement; integration and design criteria. ***Typical Case Studies and Projects of Mechatronic Systems:*** • Design of a home security system • Analysis and design of auto-focusing in a camera lens system • Skip control of a CD player • Programming and control of robots or CNC machines • Application of mechatronics to the design of smart toys or products • Intelligent control of home appliances • Integration of ultrasonic sensors, infrared sensors, actuators, and a • microcontroller in an AGV system. • Mechatronic systems with multiple microcontrollers ***Typical Laboratory Experiments:*** • Implementation and tuning of DC motor and stepper motor controllers • Implementation of an ultrasonic sensor system • Interfacing between microcontrollers (serial or parallel)

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for advanced product mechatronics.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	√

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. Homework assignment	20%	√	√	√	√
2. Test, case study report and presentation	20%	√	√		√
3. Examination	60%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.60 × End of Subject Examination + 0.40 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case study	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References	Textbooks: 1. *Design with Microprocessors for Mechanical Engineers* by Stiffler, McGraw-Hill 2. *Introduction to Mechatronics and Measurement Systems*, by Alciatore and Histand, McGraw-Hill 3. *Mechatronics,* by Necsulescu, Prentice Hall 4. *Mechatronics - Electromechanics and Controlmechanics*, by Mill, Springer-Verlag 5. *Mechatronics - Electronic Control Systems in Mechanical Engineering*, by Bolton, Addison Wesley 6. *Mechatronics - Electronics in Products and Processes*, by Bradley, et al., Chapman and Hall 7. *Mechatronics - Mechanical System Interfacing*, by Auslander and Kempf, Prentice Hall 8. *Mechatronics System Design*, by Shetty and Kolk, PWS Publishing Journals: 1. *Transactions on Mechatronics*, IEEE and ASME 2. *Transactions on Industrial Electronics*, IEEE 3. *Transactions on Instrumentation and Measurement*, IEEE

Subject Description Form

Subject Code	ME571
Subject Title	Corrosion Control
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Engineering Materials. Exclusion: ME538 Corrosion Controls in Pollution Management
Objectives	To provide students with comprehensive knowledge about corrosion/ materials degradation and preventive methodologies.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of metal corrosion and protection technology; b. think critically and holistically in dealing with real corrosion problems, and generate practical solutions; and c. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Significance of Corrosion and Materials Degradation:*** Definitions and forms of corrosion and materials degradation; implications to economy and human society. ***Oxidation & Its Control:*** Oxidation at elevated temperature; thermodynamics and kinetics of oxidation; oxide structures; oxidation rate; effects of alloying; high temperature alloys and coatings for oxidation control. ***Corrosion Theory:*** Structure of water and aqueous solution; concept of pH; thermodynamics of corrosion; electrodes and electrode potentials; Nernst equation; corrosion products and passivity; classification of corrosion; corrosion rate. ***Metallurgical Cells and Environmental Cells:*** Effect of purity and crystal defects; galvanic corrosion; dealloying; stress cell and concentration cells; effect of velocity and temperature; crevice corrosion; pitting; microbial corrosion. ***Corrosive-mechanical Interaction:*** Erosion corrosion; corrosive wear; corrosion fatigue; hydrogen damage; stress corrosion cracking. ***Protective Coatings:*** Surface preparation; electrodeposition; hot-dip coatings; conversion coatings; paint coatings for metals. ***Corrosion Control of Common Metals:*** Iron and steels; aluminium and its alloys. ***Corrosion Control in Aviation:*** Airframes; gas turbine engines. ***Corrosion Control in Automobile:*** Automobile bodies, engines, and bright trim. ***Corrosion Control in Food Processing:*** Tinplate for food and beverage cans; dairy industries; brewing. ***Corrosion Control in Building Construction:*** Structures of buildings; cladding; metal roofs; siding and flashing; pumping and central heating; timber; leisure pool. ***Materials Selection and Design for Corrosion Control*** **Laboratory works:** • AFM examination of surface morphology • Corrosion rate measurement of steel • Oxidation kinetics of copper

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for corrosion control.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes		
	a	b	c
1. Lecture	√	√	√
2. Tutorial	√	√	√
3. Homework assignment	√	√	√
4. Case study report and presentation	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Homework assignment	20%	√	√	√
2. Test	20%	√	√	
3. Case study report and presentation	10%	√	√	√
4. Examination	50%	√	√	√
Total	100%			

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

Overall Assessment:

0.50 × End of Subject Examination + 0.50 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	42 Hrs.
▪ Case study report preparation and presentation	24 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. David Talbot and James Talbot (1998), "*Corrosion Science and Technology*", *H749.H34B78*, latest edition.
2. Denny A. Jones (1996), *"Principles and Prevention of Corrosion", TA462.J59,* latest edition.
3. Mars G. Fontana (1986), *"Corrosion Engineering", TA418.74.F6*, latest edition.
4. J.C. Scully (1990), *"The Fundamentals of Corrosion", TA462.S39*, latest edition.
5. Samuel A. Bradford (2001), *"Corrosion Control", TA462.B648*, latest edition.

Subject Description Form

<table>
<tr><td>Subject Code</td><td>ME572</td></tr>
<tr><td>Subject Title</td><td>Design for Sustainable Development</td></tr>
<tr><td>Credit Value</td><td>3</td></tr>
<tr><td>Level</td><td>5</td></tr>
<tr><td>Pre-requisite/ Co-requisite/ Exclusion</td><td>Students should have basic knowledge in engineering and applied sciences.</td></tr>
<tr><td>Objectives</td><td>To provide students with knowledge of design for sustainable development.</td></tr>
<tr><td>Intended Learning Outcomes</td><td>Upon completion of the subject, students will be able to:
a. possess the knowledge of environmental issues in the manufacturing environment, environmental management system and design for environment;
b. apply their knowledge, skills and hand-on experience to design for environment; and
c. have recognition of the need for, and an ability to engage in life-long learning.</td></tr>
<tr><td>Subject Synopsis/ Indicative Syllabus</td><td><i>Introduction to Environmental Issues in the Manufacturing Environment:</i> Global environmental issues; environmental issues in the manufacturing environment: air quality, water quality and hazardous waste issues; impact on our environment and health hazards; sustainable development.
<i>Environmental Management System:</i> Environmental management standards; development of ISO 14000 series; design and implementation of environmental management system; environmental auditing, environmental performance, life cycle assessment, and environmental labels and declarations; environmental products declarations.
<i>Design for Environment:</i> Introduction to design for environment; product life cycle; eco-design and traditional design; sustainable product design; integrated product and process design and development; eco-design strategies; packaging and distribution. materials recycling.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>
<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="3">Intended subject learning outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td></tr>
<tr><td>1. Lecture</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Tutorial</td><td>√</td><td>√</td><td></td></tr>
<tr><td>3. Homework assignment</td><td>√</td><td>√</td><td></td></tr>
<tr><td>4. Case study report and presentation</td><td>√</td><td>√</td><td>√</td></tr>
</table>
1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for design for sustainable development.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.</td></tr>
</table>

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Homework assignment	15%	√	√	
2. Test	20%	√	√	
3. Case study report and presentation	15%	√	√	√
4. Examination	50%	√	√	
Total	100%			

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

Overall Assessment:

0.50 × End of Subject Examination + 0.50 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case study	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Allen D.T. and Shonnard D.R., *Green Engineering- Environmentally Conscious Design of Chemical Processes*, Prentice Hall, latest edition.
2. Azapagic A. and Perdan S., *Sustainable Development in Practice.* John Wiley, latest edition.
3. Block M.R., *Effective Implementation of ISO 14001*, ASQ Quality Press, latest edition.
4. Fiksel J., *Design for Environment: Creating Eco-Efficient Products and Processes*, McGraw Hill, latest edition.
5. Giudice F., Rosa G.L. and Risitano A., *Product Design for the Environment: A Life Cycle Approach*, CRC Press, latest edition.
6. Goosen M.F.A., Schaffner, F.C., Laboy-Nieves, E.N. and Abdelhadi, A.H., *Environmental Management, Sustainable Development and Human Health*, CRC Press, latest edition.
7. Kinsella J. and McCully, A.D., *Handbook for Implementing an ISO 14001 Environmental Management System: a Practical Approach*, Shaw Environmental, latest edition.
8. Morris A.S., *ISO14000 Environmental Management Standards- Engineering and Financial Aspects*, John Wiley & Sons Ltd., latest edition.
9. Piper L., Ryding S.O. and Henricson C., *Continual Improvement with ISO14000*, IOS Press, latest edition.
10. Sheldon C. and Yoxon M., *Environmental Management Systems: a Step-by-Step Guide to Implementation and Maintenance*, Earthscan, latest edition.
11. Wright R.T., *Environmental Science: Toward a Sustainable Future*, Pearson/Prentice Hall, latest edition.

Journals:

	• International Journal of Sustainable Development and Planning, WIT Press. • International Journal of Sustainable Engineering, Taylor & Francis. • Sustainable Development, Wiley InterScience. • The Journal of Sustainable Product Design, Springer.

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Subject Description Form

Subject Code	ME573
Subject Title	Project on Product Design and Management
Credit Value	3
Level	5
Pre-requisite / Co-requisite/ Exclusion	Students should have basic knowledge in Engineering and Applied Sciences.
Objectives	The subject helps student to learn, through a capstone project, how to carry out market analysis and how to manage a project. Through this project, the student will develop teamwork skills and product development abilities.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Think critically and holistically in dealing with product design project with real products, and generate realizable solutions. b. Possess state-of-the-art knowledge and skills in the area of project on product design and management.
Subject Synopsis/ Indicative Syllabus	***Overview of Marketing:*** Market needs research; dynamic marketing environment; identification and selection of markets; price determination and pricing strategies; knowledge of user requirements. ***New Product Management:*** Product life cycle; product life management; user-centered and market-driven approaches; team dynamics, budget, specifications and time management techniques; quality assurance and ISO. risk management. ***Capstone Project:*** A group product design project. *Capstone project assessment:* • Feasibility study report; • Creativity, design considerations, analysis and work accomplishment; • Group discussion on the progress (Peer evaluation is required.) • An interim group oral presentation. • A formal written group report and an oral presentation at the end of the study, effort of every member in the same project group should be clearly acknowledged.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, assignments, and group product design project.
2. The continuous assessment is aimed at providing students with integrated knowledge required for product design and management.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes	
	a	b
1. Lectures	√	√
2. Tutorials	√	√
3. Assignments	√	√
4. Group product design project	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed	
		a	
1. Group assessment (Interim oral presentation & report, final project report & oral presentation)	50%	√	√
2. Individual assessment (Project proposal, conceptual designs, final oral presentation, peer assessment, test)	50% (30% for the Test)	√	√
Total	100%		

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

Overall Assessment: 1.0 □ Continuous Assessment

The subject learning outcomes are achieved through a group product design project undertaken by the students. Each group consists of 3 to 4 students. Both individual and group level contributions are necessary to complete the project. The assessments are done based on the written reports, oral presentations and assignments submitted by the students periodically. The evaluations and the feedback provided will help the students in self-monitoring and fulfilling the respective subject learning outcomes, and enhancing the integration of the knowledge learnt.

Student Study Effort Expected

Class contact:	
• Lecture	16 Hrs.
• Tutorial/Consultation	23 Hrs.
Other student study effort:	
• Self Study/Group activities	45 Hrs.
• Project report preparation and presentation	21 Hrs.

	Total student study effort	105 Hrs.
Reading List and References	Textbook: 1. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, McGraw-Hill, 2008. References: 1. George E. Dieter and Linda C. Schmidt, Engineering Design, McGraw- Hill, 2009. 2. Product realization [electronic resource]: a comprehensive approach/Mileta M. Tomovic, Shaoping Wang, (http://www.springerlink.com/content/978-0-387-09481-6) 3. E-Book: Project management in new product development [electronic resource]/Burce T. Barkley, Sr. (http://lib.myilibrary.com/browse/open.asp?id=110947&loc=)	

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Subject Description Form

Subject Code	ME574
Subject Title	Product Noise Control
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Dynamics and Thermofluids.
Objectives	To provide the advanced knowledge of noise radiation mechanisms including the vibration of moving parts and flow induced noise. The principle and methodology of noise control, in particular during designing a product, are then demonstrated with a few of examples.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of noise radiation mechanisms and noise/vibration control principles; b. apply their knowledge, skills and hand-on experience to design, develop, manufacture, and analyze new products by considering noise/vibration control and keeping aware of the environmental issues, existing regulation and policies concerning noise control; c. extend their knowledge of noise radiation mechanism and noise/vibration control principles to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Acoustic Quality of Products:*** Basics of sound radiation; hearing and hearing loss; A-weighting; Characterization of sound sources and sound propagation; ISO standards of noise source testing for typical products and industrial facilities, use of anechoic and reverberation chambers. ***Basic Sources of Product Noise:*** Mechanisms, estimates and measurement of noise radiated by a variety of mechanical equipment such as fans, blowers, compressors, pumps, cooling towers, turbines and jets; flow-induced noise. ***Noise Abatement Techniques and Applications:*** Sound absorption by fibrous materials, sound reflection by impedance discontinuities, active noise control; noise isolation, enclosures, control of flow noise in fans, pumps and compressors, silencers/mufflers and other control of noise along its propagation path. ***Vibration Control and Applications:*** Structural response to excitation, vibration and flutter of engineering structure; active and passive vibration control and suppression; structural vibration control for engineering products, including bridge, aircraft, etc.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for product noise control.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	

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. Homework assignment	20%	√	√	√	√
2. Test	20%	√	√		
3. Case study report and presentation	10%	√	√	√	
4. Examination	50%	√	√	√	√
Total	100%				

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

Overall Assessment:

$$0.50 \times \text{End of Subject Examination} + 0.50 \times \text{Continuous Assessment}$$

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Beranek L. L. and Ver I. L. (editors), *Noise and Vibration Control Engineering, principles and applications*. New York: Wiley, latest edition.

	2. Pierce A. D., *Acoustics: An Introduction to its Physical Principles and Applications*. Woodbury, N.Y. : Acoustical Society of America, latest edition. 3. Fahy F., *Sound Intensity*. London : E & FN Spon, latest edition. 4. Koopmann G. H., *Designing Quiet Structures: A Sound Power Minimization Approach*. San Diego : Academic Press, latest edition. 5. Crocker M. J. (editor), *Handbook of Acoustics*. New York : Wiley, latest edition.

July 2022

Subject Description Form

Subject Code	ME576
Subject Title	Turbulent Flows and Aerodynamics
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in fundamental fluid mechanics. Exclusion: ME568 Flow System Design and Analysis
Objectives	To provide students with knowledge of advanced fluid mechanics and aerodynamics knowledge.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge in the area of advanced fluid dynamics, typical engineering flows and aerodynamics; b. apply their knowledge, skills and hand-on experience, gained from the subject, to the design and analysis of engineering flow and aeronautical systems; c. extend their knowledge of mechanical engineering to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***A Review of Kinematics and Dynamics of Flow Fields:*** Eulerian and Lanrangian descriptions; rotational and irrotational flows; acceleration of a fluid particle; Euler's equation; Bernoulli's equation; conservation equations of mass; momentum and energy. ***Time-averaged Conservation Equations:*** Reynolds-averaged equations of mass; momentum and energy conservations; turbulence modelling: large-eddy simulation, eddy-viscosity hypothesis, mixing length models and two equation transport models. ***Typical Turbulent Flows:*** Wakes of bluff bodies, plane and round jets, mixing layers, boundary layers, pipe and channel flows. ***Compressible Flows:*** Subsonic compressible flows. Transonic, supersonic and hypersonic flows. Stagnation properties; one-dimensional isentropic flow; isentropic flow through nozzles; shock waves and expansion waves. ***Aerodynamic Characteristic of Airfoils and Wings:*** Vortex street; vortex street in thin-airfoil theory; properties of the symmetrical airfoil; properties of the cambered airfoil; flapped airfoil. Wings of finite span: lift, drag, lift/drag ratio.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for flow and aerodynamic system design and analysis.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	

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. Homework assignment	20%	√	√	√	√
2. Case study report and presentation	20%	√	√	√	
3. Examination	60%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.60 × End of Subject Examination + 0.40 × Continuous Assessment

The continuous assessment consists of three components: homework assignments and case study report & presentation. 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.

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	24 Hrs.
▪ Tutorial/Case study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and

1. Cengel Y A, Cimbala J M, *Fluid Mechanics: Fundamentals and Applications*. McGraw Hill, latest edition.

References	2. Kuethe A M, Chow C-Y, *Fundamentals of Aerodynamics: Bases of Aerodynamic Design*, John Wiley & Sons, Inc. latest edition. 3. Rathakrishnan E, *Gas Dynamics*, PHI Learning Private Ltd., latest edition.

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Subject Description Form

<table>
<tr><td>Subject Code</td><td>ME577</td></tr>
<tr><td>Subject Title</td><td>Advanced Aircraft Structures</td></tr>
<tr><td>Credit Value</td><td>3</td></tr>
<tr><td>Level</td><td>5</td></tr>
<tr><td>Pre-requisite/
Co-requisite/
Exclusion</td><td>Exclusion: AAE5202 Advanced Aircraft Structures and Materials</td></tr>
<tr><td>Objectives</td><td>To provide students the key knowledge relevant to the structures and composite materials in aircraft; to provide students with tools of stress analysis to formulate and solve engineering problems in aircraft structures.</td></tr>
<tr><td>Intended Learning Outcomes</td><td>Upon completion of the subject, students will be able to:
a. demonstrate a good understanding of key aspects of aircraft structures, components and systems;
b. analyze an aircraft structure subject to a combined state of loading using stress analysis tools;
c. apply failure criteria to analyze an aircraft structure subject to loading;
d. formulate and solve problems concerning compression/tension, bending, torsion and buckling in aircraft structures;
e. understand mechanical behaviors of composites used in aircraft;
f. analyze the effects of various loads or displacement boundary conditions on aircraft structures; and
g. gain appreciation of the wide design flexibility composites in aircraft.</td></tr>
<tr><td>Subject Synopsis/
Indicative Syllabus</td><td><i>Characteristics of Aircraft Structures and Materials:</i> Structural elements in aircraft. Wing, fuselage, tail and landing gear. Aircraft materials.
<i>Elasticity:</i> Stress and strain. Equations of equilibrium. Principal stresses. Linear stress-strain relations. Elastic strain energy. St. Venant’s principle. Thin plate theory.
<i>Loads Applied on Aircraft:</i> Compression/tension. Torsion. Bending. Closed single-cell thin-walled sections. Transverse shear stress. Flexural shear in thin-walled sections and in open thin-walled section. Buckling of columns. Aircraft structures under combined loading.
<i>Failure Criteria for Isotropic Materials:</i> Strength criteria for brittle materials. Yield criteria for ductile materials. Fracture mechanics. Stress intensity factor. Fatigue.
<i>Aircraft Composites:</i> Classification and characteristics of composite materials. Mechanical behavior of composite materials. Interface properties. Processing and Fabrication techniques for aircraft composites. Analysis of Lamina and Laminates Failures of composites.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>Lectures are used to deliver the fundamental knowledge in relation to aircraft structures and composites (outcomes a to g).
Tutorials are used to illustrate the application of fundamental knowledge to practical situations (outcomes a to g).
<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="7">Intended subject learning outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td></tr>
<tr><td>Lecture</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Tutorial</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
</table>
</td></tr>
</table>

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	g
1. Examination	50%	√	√	√	√	√	√	√
2. Assignment and test	50%	√	√	√	√	√	√	√
Total	100%							

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

Overall Assessment:

0.50 × End of Subject Examination + 0.50 × Continuous Assessment

Examination is adopted to assess students on the overall understanding and the ability of applying the concepts. It is supplemented by continuous assessment including assignments and closed-book tests. The continuous assessment is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus.

All assigned homework inclusive of any computer problems should be worked independently. It is the students' responsibilities to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a zero score will be assigned.

Student Study Effort Expected

Class contact:	
▪ Lecture	24 Hrs.
▪ Tutorial/Case Study	15 Hrs.
Other student study effort:	
▪ Course work	42 Hrs.
▪ Self-study	25 Hrs.
Total student study effort	106 Hrs.

Reading List and References

1. C.T. Sun, Mechanics of Aircraft Structures, John Wiley & Sons, 1998.
2. T.H.G. Megson, Aircraft Structures for Engineering Students, Elsevier, 2007.
3. R.F. Gibson, Principles of Composite Material Mechanics, McGraw-Hill International Editions, 1994.
4. I. Moir and A.G. Seabridge, Design and Development of Aircraft Systems – An Introduction, AIAA Education Series, 2004.

July 2022

Subject Description Form

Subject Code	ME578
Subject Title	Aircraft Design
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Exclusion: AAE5203 Aircraft Design and Certification
Objectives	To provide students with the key knowledge relevant to the process and principle of flight vehicle design, and the capacity to formulate the design requirements for a flight vehicle using modern engineering tools; to provide students with the opportunity to conduct flight vehicle system design studies from aerodynamics, propulsion, structure, stability, and performance perspectives; to develop management skills in teamwork and develop skills in carrying out detailed design tasks.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. understand fundamental concepts and constraints during a flight vehicle design process; b. evaluate common flight vehicle configurations; c. design and layout flight vehicle major components; d. understand aerodynamic, structural and engine characteristics; e. identify key design features of different types of flight vehicles; f. design and sizing flight vehicles that meets certain requirements; g. develop a simple design program; h. understand airworthiness and safety;
Subject Synopsis/ Indicative Syllabus	***Introduction to Aircraft Design:*** Design method and basic requirements. Evolution of aircraft design and its performance: a brief history. Overview of aircraft design cycle and process. ***Aircraft Configuration:*** Advantages and drawbacks of conventional and alternative configurations. Considerations for special aircraft. Primary considerations for fuselage, wing, and tail design. ***Jet propulsion:*** Basic considerations in the analysis of jet propulsion. Gas-turbine engines. Inter-cooling. Reheating. Regeneration. Ideal jet-propulsion cycles. Modifications to turbojet engines. ***Aerodynamic consideration of aircraft design:*** Fundamentals of aerodynamics. Flow separation. Friction and pressure drag. Parallel flow over flat plate and wings. Airfoils. Finite wings. Drag and lift. Lift-to-drag ratio. Dependence of lift and drag on the angle of attack. Flapped airfoils. End effects of wing tips. Induced drag. ***Structural consideration of aircraft design:*** Fundamentals of aerospace structures. Airframe basics. Aerospace materials. Stiffened panels. Trusses. Buckling. ***Sizing and Costing:*** Internal layout. Structures and weight. Geometry constraints. Sizing equation. Weight fraction method. Weight and balance. Cost analysis. Elements of life-cycle cost. Cost-estimating methods. Operations and maintenance

costs. Cost measures of merit.

Main Components Selection and Design: Selection and design of main components such as fuselage, wing, tail, and landing gear. Calculation and design of control surfaces such as aileron, elevator, and rudder.

Airworthiness and Safety: Airworthiness requirements. Load factor determination. Aircraft safety. Airframe loads. Designing against fatigue. Prediction of aircraft fatigue life.

Project practice: A design project will be carried out for students to learn the aircraft design process through practice.

Teaching/Learning Methodology

Lectures are used to deliver the fundamental knowledge in relation to aircraft design (outcomes a to h).

Tutorials are used to illustrate the application of fundamental knowledge to practical situations (outcomes a to h).

Teaching/Learning Methodology	Intended subject learning outcomes							
	a	b	c	d	e	f	g	h
Lecture	√	√	√	√	√	√	√	√
Tutorial	√	√	√	√	√	√	√	√
Final examination	√	√		√	√			√
Design 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	g	h
1. Design project 1	25 %	√	√			√		√	
2. Design project 2	25 %			√	√		√		√
3. Design project presentation	10 %	√	√	√	√	√	√	√	√
4. Final examination	40 %	√	√		√	√			√
Total	100 %								

Overall Assessment:
0.6 x Continuous Assessment + 0.4 x End of Subject Examination

The group project is used to assess all aspects of the course content as well as the students' capacities of self-learning and problem-solving and effective communication skill in English so as to fulfill the requirements of being aircraft design engineers.

Student Study Effort Expected

Class contact:	
▪ Lecture	24 Hrs.
▪ Tutorial/Case Study	15 Hrs.
Other student study effort:	
▪ Course work	42 Hrs.
▪ Self-study	25 Hrs.
Total student study effort	106 Hrs.

Reading List and References	1. D. Raymer, Aircraft Design: A Conceptual Approach. American Institute of Aeronautics and Astronautics, Inc., 2018. 2. S.A. Brandt, *et al*., Introduction to Aeronautics: A Design Perspective, American Institute of Aeronautics and Astronautics Inc., 2015. 3. J. Anderson, Introduction to Flight. McGraw Hill, 2015.

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Subject Description Form

<table>
<tr><td>Subject Code</td><td>ME579</td></tr>
<tr><td>Subject Title</td><td>Aircraft Noise and Aeroacoustics</td></tr>
<tr><td>Credit Value</td><td>3</td></tr>
<tr><td>Level</td><td>5</td></tr>
<tr><td>Pre-requisite/
Co-requisite/
Exclusion</td><td>Students must have fundamental knowledge in fluid mechanics or aerodynamics.
Fundamental knowledge in acoustics is preferred.</td></tr>
<tr><td>Objectives</td><td>To provide students in-depth knowledge of the noise generation mechanisms of aircraft noise and its environmental issues. Analysis using aeroacoustic theory will be introduced.</td></tr>
<tr><td>Intended Learning Outcomes</td><td>Upon completion of the subject, students will be able to:
a. possess state-of-the-art knowledge and skills in the area of aircraft noise;
b. apply their knowledge, skills and hand-on experience to analyze the noise generation of key aircraft components, its radiation and environmental consequences;
c. extend their ability to integrate various noise suppression techniques in achieving quiet design and operation of aircraft ; and
d. have recognition of the need for, and an ability to engage in life-long learning.</td></tr>
<tr><td>Subject Synopsis/ Indicative Syllabus</td><td><i>Noise Radiation from Aircraft:</i> Aircraft noise descriptors. Human response to aircraft noise. Actions against aircraft noise. Noise certification and regulation.
<i>Introduction to Aeroacoustic Theory:</i> Equation of linear acoustics. Free-space Green’s function. Acoustics of point sources. Lighthill’s acoustic analogy and its extensions. Acoustics of turbulence near a rigid body. Radiation from compact and non-compact sources. Fuselage dynamics and cabin noise.
<i>Noise Source Mechanisms:</i> Airframe noise. Propeller noise. Fan and compressor noise. Turbine noise. Jet noise. Combustor noise. Interior noise.
<i>Noise Control:</i> Noise control at sources. Cabin noise control. Quiet aircraft design and operational characteristics. Quiet airport operation.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for understanding and analysis of aircraft noise.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.
<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="4">Intended subject learning outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td></tr>
<tr><td>1. Lecture</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Tutorial</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>3. Homework assignment</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>4. Case study report and presentation</td><td>√</td><td>√</td><td>√</td><td></td></tr>
</table>
</td></tr>
<tr><td>Assessment Methods in Alignment with</td><td>
<table>
<tr><td>Specific assessment methods/tasks</td><td>% weighting</td><td>Intended subject learning outcomes to be assessed</td></tr>
</table>
</td></tr>
</table>

Intended Learning Outcomes

		a	b	c	d
1. Homework assignment	20%	√	√	√	√
2. Test	20%	√	√		
3. Case study report and presentation or Laboratory	10%	√	√	√	√
4. Examination	50%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.50 × End of Subject Examination + 0.50 × Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. 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.

The examination is used to assess the knowledge acquired by the students for understanding and analysing 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	24 Hrs.
▪ Tutorial/Case study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Textbooks:

1. Crighton, D. G., Dowling, A. P., Ffowcs Williams, J. E., Heckl, M., Leppington, F. G., *Modern Methods in Analytical Acoustics – Lecture Notes*, Springer, latest edition.
2. Goldstein, M. E., *Aeroacoustics*, McGraw-Hill, latest edition.
3. Howe, M. S., *Theory of Vortex Sound*, Cambridge University Press, latest edition.
4. Hubbard, H. H. (Ed.), *Aeroacoustics of Flight Vehicles – Theory and Practice*, *Vols. 1 & 2*, Acoustical Society of America, latest edition.
5. Nelson, P. M. (Ed.), *Transportation Noise Reference Book*, Butterworths, latest edition.
6. Pierce, A. D., *Acoustics – An Introduction to Its Physical Principles and Applications*, Acoustical Society of America, latest edition.
7. Smith, M. J. T., *Aircraft Noise*, Cambridge University Press, latest edition.

Journals:

1. *AIAA Journal*, American Institute of Aeronautics and Astronautics.
2. *International Journal of Aeroacoustics,* Multi-Science.
3. *Journal of the Acoustical Society of America*, Acoustical Society of America.
4. *Journal of Sound and Vibration*, Academic Press.

Appendix

REGULATIONS
of
Postgraduate Scheme in Engineering

September 2022

TABLE OF CONTENTS

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Note: The academic regulations described in this document are based on the information known as of August 2022. They are subject to review and changes from time to time. Students will be informed of the changes as and when appropriate. Important information relating to students' studies is also published in the Student Handbook (website: https://www.polyu.edu.hk/ar/students-in-taught-programmes/student-handbook/).

For ease of reading only the masculine pronoun has been used throughout this booklet. Women staff members and students should not take the omission of 'she', 'her' or 'hers' as being other than an editorial convenience.

SCHEME REGULATIONS

1. The Nature of the Postgraduate Scheme Education

1.1 The Postgraduate Scheme in Engineering (hereafter called “the Scheme”) has been designed to establish a structure whereby graduates in employment can construct individual programmes of postgraduate study which will meet their own needs particular to their employment and are professionally coherent but still allow freedom to pursue interests by selecting from a wide variety of available subjects. Students progress by accumulating credits for each subject passed. Successful completion of an acceptable programme of subjects will lead to a PolyU postgraduate award.

1.2 Depending on needs, a student's selected programme of study can be designed for one or more of the following:

1.2.1 an in-depth treatment of an area beyond the student's first degree level in the same area;

1.2.2 updating of the knowledge of those engaged in a field especially where the discipline at undergraduate level is subject to rapid expansion or change;

1.2.3 a re-orientation or conversion to areas new to the student (in that it is in an area not directly related to the student's first degree); and

1.2.4 a synthesis and integration of a number of disciplines or subjects, particularly if the combination cannot be pursued adequately at undergraduate level.

2. A Student's Programme of Study

2.1 On admission, students are registered on a Master’s Degree (MSc). Students satisfactorily completing a set of subjects in accordance with the given regulations for a specific award will be eligible for a Postgraduate Diploma (PgD) exit award or a Master's degree award with that specific award title. Students are required to accumulate 18 and 30 credits in order to be eligible for a PgD exit award and a Master’s degree award with a specific award title respectively. Students may be given credit transfer for appropriate study they have earlier successfully undertaken at postgraduate level (See Section 5).

2.2 Unless stated otherwise, a Master’s degree consists of a dissertation component, which is normally worth 9 credits. A non-dissertation option is available to students who, instead of doing the dissertation, can take taught subjects with total credits equal to that of a dissertation.

2.3 The Scheme provides an option for students to engage in a full-time (9 credits or more per semester) or part-time study load (less than 9 credits per semester). Full-time students normally take 3 to 5 subjects in a semester, and part-time students usually take 2 subjects. Students may have their study load vary from semester to semester which will accordingly affect their entitlement to University's services.

2.4 The subjects are mostly run in the evenings/on weekends, but some elective subjects may be made available during the day. Classes can also be arranged with such alternatives as full-time weekends or full-time weekdays.

3. The Subject

3.1 The syllabus and/or level of treatment for all subjects in the Scheme is postgraduate in standard. Each subject offered is subject to a process of review and approval which looks for the achievement of an appropriate standard in terms of subject matter, teaching approach and professional standing of the subject teachers. The aim is the provision of the best possible programme in each field presented by subject teachers who are expert in the field rather than offering a multiplicity of programmes by different departments covering similar material. Teaching methods for each subject will vary to suit the nature of the material. However, all subjects require a similar amount of student effort. All subjects are first and foremost designed for students with experience and are of high standard in terms of relevance to modern practice, up-to-date content and intellectual challenge.

3.2 The size of the standard subject which is the building block of the Scheme is defined in terms of the approximate total time which would need to be spent by an average postgraduate student. The effort required of a student on one subject is equivalent to 4 weeks of full-time study, i.e. a total of about 105 hours (which includes class-contact time). On passing (i.e. obtaining a grade "D" or above) a standard subject, the student earns 3 credits. Exceptionally, there can be subjects which are not equivalent to 3 credits.

4. Pre-requisites, Co-requisites, Exclusions and Exemptions

4.1 Certain subjects can be specified as "pre-requisites" for a particular subject, in which case the subject titles and code numbers of the pre-requisites will be specified in the subject description form. Students would not be allowed to take that subject unless they have completed and passed the pre-requisite subjects, or unless they have obtained express approval from the subject teacher.

4.2 By definition, a subject and its co-requisite must be taken in the same semester.

4.3 In the case that two subjects overlap significantly in content, they can each be specified as ‘Exclusion’ of each other. Students having completed one of these subjects will not be allowed to take the ‘Exclusion’ subject. Exclusions, if completed, will not be counted towards award requirement.

4.4 Students may be exempted from taking any specified subjects if they have successfully completed similar subjects previously in another programme or have demonstrated the level of proficiency/ability to the satisfaction of the subject offering Department. Subject exemption is normally decided by the subject offering Department. If students are exempted from taking a specified subject, the credits associated with the exempted subject will not be counted towards meeting the award requirements (except for exemptions granted at admission stage). It will therefore be necessary for the students to consult the programme offering Department and take another subject in order to satisfy the credit requirement for the award.

5. Credit Transfer

5.1 At the discretion of the subject offering Department and on the recommendation of the Chairman of Award Committee, students admitted to the Scheme may be given credit for previous postgraduate study. A fee will be charged for credits successfully transferred. Transferred credits may not normally be counted towards more than one degree[1].

5.2 Normally, the grades achieved in subjects taken as part of a PolyU postgraduate award for which credit transfer is approved may contribute towards the students' Grade Point Average (GPA). Grades achieved for postgraduate study which was not part of a PolyU programme will not contribute towards the students' GPA (credit transfer without the grade carried). The credits transferred will count towards the credit requirement for the award. All credit transfers approved will take effect only in the semester for which they are approved. A student who applies for transfer of credits during the re-enrolment or add/drop period for a particular semester will only be eligible for graduation at the end of that semester, even if the granting of the credit transfer will immediately enable the student to satisfy the total credit requirement for the award.

5.3 The validity period of subjects earned is eight years from the year of attainment, i.e. the year in which the subject is completed, unless otherwise specified by the department responsible for the content of the subject. Credits earned from previous study should remain valid at the time when the student applies for transfer of credits. For exceptional cases such as those stated in 5.3.1 to 5.3.3 below, subject offering departments shall have the discretion to approve the transfer of credits which have exceeded the validity period of subject credits on a case-by-case basis. All such exceptional cases must be reported to the Faculty Board with full justification.

5.3.1 Mature learners for whom their previous studies were mostly completed a long time before their admission to PolyU, but who have working experience which would have kept them actively involved in the relevant area of study. The flexibility to be granted to these students based on academic comparability of subjects is in line with the policy of the University in promoting life-long learning.

5.3.2 Students for whom the expiry of validity of credits is beyond their control such as medical reasons.

5.3.3 Students have been approved for deferment of study, or approved for going beyond the maximum period of registration (applicable to students admitted in or before 2019/20).

5.4 If a student is waived from a particular stage of study on the basis of advanced qualifications held at the time of admission, the student concerned will be required to

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[1] Credit transfer from undergraduate studies to postgraduate studies will be allowed on the condition that these credits were on top of the baccalaureate requirements.

complete fewer credits for award. For these students, the exempted 'deducted' credits at admission stage will be counted towards the maximum limit for credit transfer when students apply for further credit transfer after their admission.

5.5 Normally, not more than 50% of the credit requirement for award may be transferable from approved institutions outside the University. For transfer of credits from programmes offered by PolyU, normally not more than 67% of the credit requirement for award can be transferred. In cases where both types of credits are being transferred (i.e. from programmes offered by PolyU and from approved institutions outside the University), not more than 50% of the credit requirement for award may be transferred.

5.6 For credit transfer of retaken subjects, the grade attained in the last attempt should be taken in the case of credit transfer with grade being carried over. Students applying for credit transfer for a subject taken in other institutions are required to declare that the subject grade used for claiming credit transfer was attained in the last attempt of the subject in their previous studies. If a student fails in the last attempt of a retaken subject, no credit transfer should be granted, despite the fact that the student may have attained a pass grade for the subject in the earlier attempts.

5.7 Students should not be granted credit transfer for a subject which they have attempted and failed in their current study unless the subject was taken by the student as an exchange-out student in his current programme.

6. Registration Period/Study Load/Academic Probation/Deregistration

Normal duration for completion of a programme (applicable to students admitted in or after 2020/21)

6.1 Students should complete the programme within the normal duration of the programme. Those who exceed the normal duration of the programme will be de-registered from the programme unless prior approval has been obtained from relevant authorities. The study period of a student shall exclude deferment granted for justifiable reasons, and the semester(s) when the student has been approved to undertake internship. Any semester in which the students are allowed to take zero subject will be counted towards their total period of registration.

6.2 Students who have been registered for the normal duration of the programme may request extension of their studies for up to one year with the approval of the relevant Heads of Department. Applications for extension of study period beyond one year and up to two years will require the approval from Faculty Board Chairman.

6.3 For part-time Taught Postgraduate Programmes, the Heads of Department may approve the extension of studies up to two years, and Faculty Board Chairman may approve the extension of studies beyond two years and up to four years.

6.4 Students who have exceeded the normal duration of the programme for more than two years (four years for part-time Taught Postgraduate Programmes) and have been de-registered can submit an appeal to the Academic Appeals Committee to request further extension. If the appeal fails, the student shall be de-registered.

Maximum period of registration for completion of a programme (applicable to students admitted in or before 2019/20)

6.5 The maximum period of registration is five years from the date of first registration. This period shall exclude deferment granted for justifiable reasons such as illness or posting to work outside Hong Kong, but any semester in which the students are allowed to take zero subject will be counted towards the maximum period of registration. No extension of registration period will be granted on grounds of timetable conflict or non-availability of subjects.

6.6 A student's registration shall lapse if it is no longer possible for him/her to obtain an award within the maximum period of registration.

Study Load

6.7 Unless exceptional approval is given, the maximum study load to be taken by a student in a semester is 21 credits. For such cases, students should be reminded that the study load approved should not be taken as grounds for academic appeal.

Academic Probation

6.8 Students who have a Grade Point Average (GPA) (See Section 15) lower than 1.70 will be put on academic probation in the following semester. Once when these students are able to pull their GPA up to 1.70 or above at the end of the semester, the status of "academic probation" will be lifted. The status of "academic probation" will be reflected in the examination result notification, but not in transcript of studies.

6.9 To help improve the academic performance of students on academic probation, these students will be required to take a reduced study load in the following semester (Summer Term excluded). The maximum number of credits to be taken by the students is decided by the programme host and subject to the approval of the relevant authorities.

Deregistration

6.10 Students will cease to be registered for the Master's award if:

6.10.1 they exceed the maximum period of registration (applicable to students admitted in or before 2019/20); or

6.10.2 they have reached the final year of the normal period of registration, unless approval has been given for extension (applicable to students admitted in or after 2020/21); or

6.10.3 they have reached the maximum number of retakes allowed for a failed compulsory subject; or

6.10.4 they fail to register on any subject in a semester without obtaining approval[2]; or

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[2] This does not apply if the student is enrolled on the dissertation.

6.10.5 their GPA is lower than 1.70 for two consecutive semesters and their Semester GPA in the second semester is also below 1.70; or

6.10.6 their GPA is lower than 1.70 for 3 consecutive semesters; or

6.10.7 they are granted the Master's award / PgD exit award.

When a student falls within any of the categories as stipulated above, except for 6.10.2 with approval for extension and 6.10.7, the Scheme Board of Examiners shall de-register the student from the programme without exception.

6.11 Those students who fall into any of the categories stated in Sections 6.10.1, 6.10.2, 6.10.3, 6.10.5 and 6.10.6 above will be awarded a PgD exit award before being deregistered if they have satisfied the requirements for a PgD exit award.

6.12 Those students who do not fall into any of the categories stated in Section 6.10 above will have "progressing" status.

6.13 The progression of students to the following academic year will not be affected by the GPA obtained in Summer Term, if any.

6.14 A student may be deregistered from the programme enrolled before the time frame specified in Sections 6.10.5 and 6.10.6 if his academic performance is poor to the extent that the Scheme Board of Examiners deems that his chance of attaining a GPA of 1.70 at the end of the programme is slim or impossible.

7. Deferment of Study and Zero Subject Enrolment

7.1 A student may be allowed to interrupt his studies for a certain amount of time. This can be done by seeking either "deferment of study" or "zero subject enrolment". Both applications will have to be approved by the Chairman of Award Committee.

7.2 To apply for deferment of study, the student will have to provide strong justification for deferring his studies for one semester or longer. Deferment will normally be granted for no more than 2 semesters at a time. The total period of deferment cannot exceed 4 semesters. The deferment period will not be counted towards the total period of registration (or maximum period of registration for students admitted in or before 2019/20). Where the period of deferment of study begins during a stage for which fees have been paid, no refund of such fees will be made. Students who have been approved for deferment are not entitled to enjoy any campus facilities during the deferment period.

7.3 Students must apply to the Chairman of Award Committee for not taking any subjects in a semester. Otherwise they will be classified as having unofficially withdrawn from their study. Zero subject enrolment will only be considered for one semester at a time. Prior approval must be obtained. Applications should be submitted before the commencement of the semester concerned or in exceptional circumstances before the end of the add/drop period. All semesters in which the students are allowed to take zero subjects will be counted towards the total period of registration (or maximum period of registration for students admitted in or before 2019/20). A fee for retention of study place will be charged.

8. Subject Registration/Adding and Dropping of Subjects/Withdrawal of Subjects

8.1 In addition to programme registration, students need to register for the subjects at specified periods prior to the commencement of the semester. An add/drop period will also be scheduled for each semester/term. Students may apply for withdrawal of their registration on a subject after the add/drop period if they have a genuine need to do so. The application should be made to the relevant award hosting department and will require the approval of both the subject teacher and the Award Chairman concerned. Applications submitted after the commencement of the examination period will not be considered. For approved applications of subject withdrawal, the tuition fee paid for the subject will be forfeited and the withdrawal status of the subject will be shown in the assessment result notification and transcript of studies, but will not be counted in the calculation of the GPA.

8.2 The pre-requisite requirements of a subject must have been fulfilled before a student registers for that subject. However, the subject offering Department has the discretion to waive the pre-requisite requirements of a subject, if deemed appropriate. If the pre-requisite subject concerned forms part of the requirements for award, the subject has to be passed in order to satisfy the graduation requirements for the programme concerned, despite the waiving of the pre-requisite.

8.3 Subject to the maximum study load of 21 credits per semester and the availability of study places, students are allowed to take additional subjects on top of the prescribed credit requirement for award before they become eligible for graduation.

9. Changing Programme of Study Within the Scheme

9.1 If students wish to change the award for which they are registered they should seek the approval of the Chairman of Award Committee of the new award into which they would like to enter. Applications should be submitted to the host department of the new award for consideration and at the same time the Department of the old award be informed of such applications.

9.2 The Chairman of the Award Committee of the new award will ensure that there is availability of places and other resources to allow the proposed changes to be made.

10. Dissertation and Dissertation Assessment

10.1 Academic supervisors, and professional supervisors (optional) are appointed by the Award Committee. Students are expected to submit a dissertation proposal to the Award Committee no later than the last teaching day of the semester in which he first registers for dissertation.

10.2 Students can register on dissertations only if they are co-taking and/or have taken a total of 3 taught subjects (including credit transferred subjects) in that semester. Students are required to pay for all of the 9 credits the dissertation carries in the first semester when he enrols on the dissertation. Fees paid will not be refunded even if the student withdraws from his dissertation or from the Scheme during the course of his registration. Students will be required to complete their dissertations within the normal period of 3 semesters. The minimum period for the dissertation work to be completed is 1 semester (for students admitted in 2018/19 or before) / 2 semesters (for students admitted in 2019/20 or after). Those who are not able to complete their dissertation may apply on the advice of the supervisor to the Award Committee for approval to extend the dissertation registration beyond the normal period but within the maximum period of 4 semesters. Applications for extension beyond the normal period will be considered by the Scheme Committee and approved only under exceptional circumstances.

10.3 When permission is granted to extend the dissertation registration beyond the normal period, the student will be required to pay a 3-credit tuition fee for each additional semester.

10.4 Break of study is normally not permitted once a student registers for dissertation and students are expected to pursue their dissertation in consecutive semesters.

10.5 The assessment panel will consist of two categories of member, namely:

10.5.1 the supervisors (academic supervisor, and professional supervisor if relevant); and

10.5.2 a second assessor who is a subject expert from the department, from another department in the University, or from industry, to be nominated by the Award Committee.

10.6 A copy of the dissertation should be sent to each of the assessors and one copy should be kept by the student.

10.7 After submission of the formal report the academic supervisor should make arrangements with the assistance of the department on a mutually convenient time and place for an oral examination at which the other assessors will be present. The date set for the oral examination should allow sufficient time for the examiners to read the submission and should normally be no later than one month after submission of the dissertation.

10.8 After conducting the oral examination the assessment panel will jointly allocate a grade guided by the following weightings which may vary depending on the nature of the project. Individual awards may modify key items and the recommended weightings according to the needs of each award.

Progress 20%	Dissertation 50%	Oral 30%	Total 100%

10.9 After the assessment of the dissertation is complete the academic supervisor will write a report on the outcome using standard outline report forms. These reports must be signed by all who participated in the assessment of the dissertation and be forwarded to the Award Committee.

10.10 The report will contain a date by which the student should submit his final dissertation and the number of hard and electronic copy required to the host Department which would arrange to send an electronic copy to the Library. The deadline for submission of the examination report to the Award Committee is TWO WEEKS before the meeting of the Subject Assessment Review Panel.

10.11 Departments could at their discretion allow students to complete their dissertations during the summer break. In such cases these results could be processed by the Subject Assessment Review Panel held for the summer semester to allow students to graduate.

10.12 A set of operational guidelines on dissertation is attached at *Annex* for the reference of staff and students.

11. Assessment of Taught Subjects

11.1 The assessment regulations adopted by the Scheme conform to the University's General Assessment Regulations for taught programmes. The ultimate authority in the University for the confirmation of academic decisions is the Senate, but for practical reasons, Senate has delegated to the Faculty Boards the authority to confirm the decisions of Boards of Examiners provided these are made within the framework of the General Assessment Regulations. Recommendations from the Scheme Board of Examiners which fall outside these Regulations shall be ratified by the Academic Planning and Regulations Committee and reported to Senate as necessary.

11.2 A variety of assessment methods, such as open book examinations, will be used. All other forms of assessment are included in the term coursework. This may include tests, assignments, projects, laboratory work, field exercises, presentations and other forms of classroom participation. Continuous Assessment assignments which involve group work should nevertheless include some individual components therein. The contribution made by each student in continuous assessment involving a group effort shall be determined and assessed separately, and this can result in different grades being awarded to students in the same group.

11.3 Assessment methods and parameters of subjects shall be determined by the subject offering Department. The assessment for a subject is based on one or two components, namely coursework and/or examination. The weighting of coursework and examination is shown in the individual subject description forms. The subject offering department can decide whether students are required to pass both the continuous assessment and examination components, or either component only, in order to obtain a pass. Such requirements would be specified in the subject description forms. Learning outcome should be assessed by continuous assessment and/or examination appropriately, in line with the outcome based approach.

11.4 Assessment grades shall be awarded on a criterion-referenced basis. A student's overall performance in a subject shall be graded as follows from 2020/21 onwards[3]:

Subject grade	***Short description***	***Elaboration on subject grading description***

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[3] For the short description of subject grades and elaboration on subject grading descriptions for 2019/20 and before, please refer to the previous editions of this document.

Subject grade	***Short description***	***Elaboration on subject grading description***
A+ A A-	Excellent	Demonstrates excellent achievement of intended subject learning outcomes by being able to skillfully use concepts and solve complex problems. Shows evidence of innovative and critical thinking in unfamiliar situations, and is able to express the synthesis or application of ideas in a logical and comprehensive manner.
B+ B B-	Good	Demonstrates good achievement of intended subject learning outcomes by being able to use appropriate concepts and solve problems. Shows the ability to analyse issues critically and make well-grounded judgements in familiar or standard situations, and is able to express the synthesis or application of ideas in a logical and comprehensive manner.
C+ C C-	Satisfactory	Demonstrates satisfactory achievement of intended subject learning outcomes by being able to solve relatively simple problems. Shows some capacity for analysis and making judgements in a variety of familiar and standard situations, and is able to express the synthesis or application of ideas in a manner that is generally logical but fragmented.
D+ D	Pass	Demonstrates marginal achievement of intended subject learning outcomes by being able to solve relatively simple problems. Can make basic comparisons, connections and judgments and express the ideas learnt in the subject, though there are frequent breakdowns in logic and clarity.
F	Fail	Demonstrates inadequate achievement of intended subject learning outcomes through a lack of knowledge and/or understanding of the subject matter. Evidence of analysis is often irrelevant or incomplete.

11.5 "F" is a subject failure grade, whilst all others ("D" to "A+") are subject passing grades. No credit will be earned if a subject is ‘failed’.

Indicative descriptors for modifier grades

Main Grade (solid)	The student generally performed at this level, indicating mastery of the subject intended learning outcomes at this level.
+ (exemplary)	The student consistently performed at this level and exceeded the expectations of this level in some regards, but not enough to claim mastery at the next level.
- (marginal)	The student basically performed at this level, but the performance was inconsistent or fell slightly short in some regards.

Note: The above indicative descriptors for modifier grades are not applicable to the pass grades D and D+

11.6 A numeral grade point is assigned to each subject grade.

The grade points assigned to subject grades attained by students from 2020/21 are as follows:

Grade	*Grade Point for grades attained from 2020/21*
A+	4.3
A	4.0
A-	3.7
B+	3.3
B	3.0
B-	2.7
C+	2.3
C	2.0
C-	1.7
D+	1.3
D	1.0
F	0.0

The grade points assigned to subject grades attained by students before 2020/21 are as follows:

Grade	*Grade Point for grades attained before 2020/21*
A+	4.5
A	4.0
B+	3.5
B	3.0
C+	2.5
C	2.0
D+	1.5
D	1.0
F	0.0

12. Retaking of subjects

12.1 Students may only retake a subject which they have failed (i.e. Grade F or S or U). Retaking of subjects is with the condition that the maximum study load of 21 credits per semester is not exceeded.

12.2 The number of retakes of a subject should be restricted to two, i.e. a maximum of three attempts for each subject is allowed.[4]

12.3 In cases where a student takes another subject to replace a failed elective subject, the fail grade will be taken into account in the calculation of the GPA, despite the passing of the replacement subject.

12.4 Students need to submit a request to the Faculty Board for the second retake of a failed subject.

12.5 Students who have failed a compulsory subject after two retakes and have been de-registered can submit an appeal to the Academic Appeals Committee (AAC) for a third chance of retaking the subject.

12.6 In relation to 12.5 above, in case AAC does not approve further retakes of a failed compulsory subject or the taking of an equivalent subject with special approval from the Faculty, the student concerned would be de-registered and the decision of the AAC shall be final within the University.

13. Exceptional circumstances

13.1 Absence from an assessment component

13.1.1 If a student is unable to complete all the assessment components of a subject, due to illness or other circumstances which are beyond his control and considered by the subject offering Department as legitimate, the Department will determine whether the student will have to complete a late assessment and, if so, by what means. This late assessment shall take place at the earliest opportunity, and normally before the commencement of the following academic year (except that for Summer Term, which may take place within 3 weeks after the finalisation of Summer Term results). If the late assessment cannot be completed before the commencement of the following academic year, the Faculty Board Chairman shall decide on an appropriate time for completion of the late assessment.

13.1.2 The student concerned is required to submit his application for late assessment in writing to the Head of Department offering the subject, within five working days from the date of the examination, together with any supporting documents. Approval of applications for late assessment and the means for such late assessments shall be given by the Head of Department offering the subject or the subject teacher concerned, in consultation with the Award Chairman.

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[4] The retake count for students admitted in or before 2019/20 will be reset to "0" in 2020/21 when the revised regulations come into effect.

13.2 Assessment to be completed

For cases where students fail marginally in one of the components within a subject, the BoE can defer making a decision until the students concerned have completed the necessary remedial work to the satisfaction of the subject examiner(s). The remedial work must not take the form of re-examination.

13.3 Other particular circumstances

A student's particular circumstances may influence the procedures for assessment, but not the standard of performance expected in the assessment.

14. Eligibility for Award

14.1 A student would be eligible for award if he satisfies all the conditions listed below:

14.1.1 Accumulation of the requisite number of credits – 30 for MSc; 18 for PgD exit award; and

14.1.2 Satisfying the residential requirement for at least 1/3 of the credits to be completed for the award he is currently enrolled, unless the professional bodies stipulate otherwise; and

14.1.3 Satisfying all requirements as defined and/or stipulated for the respective awards and as specified by the University; and

14.1.4 Having a Grade Point Average (GPA) of 1.70 or above at the end of the programme[5];

14.1.5 Having successfully completed the Online Tutorial on Academic Integrity accessed via LEARN@PolyU (理學網); and

14.1.6 Satisfying the National Education (NE) requirement[6] (applicable to students admitted in or after 2022/23) as specified at: https://www.polyu.edu.hk/ous/nationaleducation/understanding-china-and-hongkong/.

14.2 The PgD exit award and Master's degree award are classified as: Distinction, Credit, and Pass.

14.3 A student is required to graduate as soon as he satisfies all the conditions for award (see Section 14.1 above). Subject to the maximum study load of 21 credits per

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[5] For programmes leading to nested awards where satisfaction of the conditions leading to the lesser award is a subset of the conditions leading to the more advanced award, and where students opt to graduate with the lesser award when failing to complete the requirements for the more advanced award, subjects taken solely for fulfilling the requirements for the more advanced award may be excluded in the GPA calculation for the purpose of satisfying this condition (i.e. the student can graduate with the lesser award if the Award GPA of the lesser award can meet the minimum GPA requirement for graduation).

[6] All students enrolling on offshore programmes (regardless of their nationality) will be waived from the NE requirement. NE requirement can also be waived for students who are non-HK residents enrolling on online programmes on a case-by-case basis, i.e. if they submit a request to ask for a waiver. Waiver should not be granted to students enrolling on online programme who are residing in HK or have the right of abode in HK.

semester, a student may take more credits than he needs to graduate on top of the prescribed credit requirements for his award in or before the semester within which he becomes eligible for award.

14.4 A student, however, will not be granted the same PgD exit award (in the same area) for the second time despite his satisfying the conditions for award as stipulated in Section 14.1 above, if he has been granted the award before.

14.5 If a student's registration status has been set to "Study ended" due to non-compliance with PolyU regulations, for example, failure to pay fees, he will not be eligible for the award unless his registration status has been reinstated.

15. Grade Point Average (GPA)

15.1 At the end of each semester/term, a Grade Point Average (GPA) will be computed as follows, and based on the grade point of all the subjects:

$$\text{GPA} = \frac{\sum_{n=1}^{N} \text{Subject Grade Point}_n \times \text{Subject Credit Value}_n}{\sum_{n=1}^{N} \text{Subject Credit Value}_n}$$

where N = number of all subjects (inclusive of failed subjects) taken by the student up to and including the latest semester/term. For subjects which have been retaken, only the grade point obtained in the final attempt will be included in the GPA calculation

In addition, the following subjects will be excluded from the GPA calculation:

(i) Exempted subjects
(ii) Ungraded subjects
(iii) Incomplete subjects
(iv) Subjects for which credit transfer has been approved without any grade assigned
(v) Subjects from which a student has been allowed to withdraw (i.e. those with the grade 'W')

Subject which has been given an “S” code, i.e. absent from all assessment components, will be included in the GPA calculation and will be counted as “zero” grade point. GPA is thus the unweighted cumulative average calculated for a student, for all relevant subjects taken from the start of the programme to a particular point of time. GPA is an indicator of overall performance, and ranges from 0.00 to 4.30 from 2020/21.

15.2 For the purpose of determining the award classification, any subjects passed after the graduation requirement has been met or subjects taken on top of the prescribed credit requirements for award shall not be taken into account in the grade point calculation for award classification (i.e award GPA). However, if a student attempts more elective subjects (or optional subjects) than those required for graduation in or before the semester in which he becomes eligible for award, the elective subjects (or optional subjects) with a higher grade/contribution shall be included in the grade point calculation (i.e. the excessive subjects attempted with a lower grade/contribution, including failed subjects, will be excluded).

15.3 Subjects offered within the Scheme contribute equally to the calculation of the GPA and award GPA. The table below shows different types of GPA and their calculation methods:

Types of GPA	Purpose	Rules for GPA calculation
GPA	Determine progression/ graduation	(1) All academic subjects taken by the student throughout his/her study, both inside and outside the programme curriculum, are included in the GPA calculation. (2) For retake subjects, only the last attempt will be taken in the GPA calculation. (3) Level weighting, if any, will be ignored.
Semester GPA	Determine progression	Similar to the rules for GPA as described above, except that only subjects taken in that Semester, including retaken subjects, will be included in the calculation.
Award GPA	For determination of award classification	(1) If the student has not taken more subjects than required, the Award GPA will be as follows: For programmes without level weighting: Award GPA = GPA (2) If the student has taken more subjects than required, refer to Section 15.2 above.

16. Guidelines for Award Classification

16.1 In using these guidelines, the Scheme Board of Examiners shall exercise its judgement in coming to its conclusions as to the award for each student, and where appropriate, may use other relevant information.

The following GUIDELINES will be used by the Scheme Board of Examiners to recommend the classification of the award:

	Guidelines
Distinction	The student’s performance/attainment is outstanding, and identifies him as exceptionally able in the field covered by the programme in question.
Credit	The student has reached a standard of performance/ attainment which is more than satisfactory but less than outstanding.
Pass	The student has reached a standard of performance/attainment ranging from just adequate to satisfactory.

16.2 The following are the award GPA ranges for determining award classifications:

Award	***Award GPA***
Distinction	3.60 – 4.30
Credit	3.00 – 3.59
Pass	1.70 – 2.99

16.3 In awarding a distinction, the Scheme Board of Examiners would also take into consideration the amount of credit transfers earned by the student. To be considered for a distinction, the student should normally have no more than 40% of the credits earned by credit transfer [i.e. 4 taught subjects (12 credits) for MSc; 2 (6 credits) for PgD exit award)].

16.4 Students who have committed academic dishonesty or non-compliance with examination regulations will be subject to the penalty of the lowering of award classification by one level. The minimum of downgraded overall result will be kept at a Pass. In rare circumstances where both the Student Discipline Committee and Scheme Board of Examiners consider that there are strong justifications showing the offence be less serious, the requirement for lowering the award classification can be waived.

16.5 Decisions by the Scheme Boards of Examiners on award classifications to be granted to each student on completion of the programme shall be ratified by the Faculty Board. For cases the decisions of which do not conform to the above indicative GPA range, they should be referred, by the Faculty Board, to the Academic Planning and Regulations Committee for ratification.

17. Appeal Against Assessment Results/De-registration Decisions by the Scheme Board of Examiners

A student may appeal against the decision of the Scheme Board of Examiners within a stipulated period after the public announcement of the examination results (this refers to the date when results are announced to students via the web). Students should refer to the Student Handbook for details on the appeal procedures.

18. Recording of Disciplinary Actions in Students' Records

18.1 With effect from Semester One of 2015/16, disciplinary actions against students' misconducts will be entered in students' records.

18.2 Students who are found guilty of academic dishonesty or non-compliance with examination regulations will be subject to the penalty of having the subject result concerned disqualified and be given a failure grade with a remark denoting 'Disqualification of result due to academic dishonesty / noncompliance with examination regulations'. The remark will be shown in the students' record as well as the assessment result notification and transcript of studies, until their leaving the University.

18.3 Students who have committed disciplinary offences (covering both academic and non-academic related matters) will be put on ‘disciplinary probation’. The status of ‘disciplinary probation’ will be shown in the students’ record as well as the assessment result notification, transcript of studies and testimonial during the probation period, until their leaving the University. The disciplinary probation is normally one year unless otherwise decided by the Student Discipline Committee.

18.4 The University reserves the right to withhold the issuance of any certification of study to a student/graduand who has unsettled matters with the University, or is subject to disciplinary action.

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Operational Guidelines on Dissertation

With the exception of the stipulations in Section 10 of the Scheme Regulations which must be compiled with, this Annex serves as a guideline to students and staff. Departments may have different or additional conditions set out to assist students in preparing their dissertations.

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1. INTRODUCTION

The dissertation is a very significant component of a Master's programme. It carries a weight equivalent to three taught subjects and represents around 315 – 345 hours of student effort. Since students usually continue with their jobs while they work on their dissertations, the subject of the dissertation is preferably related to the student's employment.

The dissertation should be an exposition of a student's own work and ideas. Where others have had an input (e.g. in a team situation) this should be clearly identified. Plagiarism is unacceptable. Expulsion may be imposed in cases of proven plagiarism (See *Annex-Pages 18 to 20*).

Though the subject areas of dissertations are so diverse it is impossible to define a standard approach to carry out the dissertation, its content should include an introduction and definition of objectives, a literature survey, a review of the problem followed by a description of the student's approach to solving the problem, the results or findings, an intellectual analysis of the results or findings, and finally a logical review of the conclusions drawn.

Students are encouraged to initiate dissertation topics relating to their employment. However, students may take up campus based dissertations in cases of difficulty.

2. THE DISSERTATION PROCESS: PREPARATION, PROGRESS AND ASSESSMENT

The procedures for preparing a dissertation can be divided into three different stages.

2.1 Proposal

2.1.1 Each department hosting an award may arrange an Award Dissertation Seminar in the first week of each semester. At this time the Chairman of Award Committee will circulate a list of staff research interests and possible topics to students. Academic supervisors, and professional supervisors (optional) are assigned by the Award Committee. Only students who have registered on the dissertation subject will be assigned supervisors and permitted to submit proposals.

2.1.2 The purpose of these Dissertation Seminars is to enable participants to identify and define a problem for valid research, to develop their abilities to identify and evaluate appropriate research methods, and to provide a framework from which participants can begin their own research work. The content of some of the seminars will include research methods, research design, analysis of data, presentation of findings, and ethical and legal considerations. Staff members active in research will participate and interact with students in answering questions and leading discussion on major issues.

2.1.3 Subsequent to the Dissertation Seminar, the student will prepare a dissertation proposal in a standard format using a synopsis form (Form ENG-PSE125 attached) in consultation with his academic supervisor. This standard form can be downloaded from the web.

2.1.4 Students are expected to submit their dissertation proposal to the Award Committee for approval no later than the last teaching day of the semester in which the student first registers for dissertation.

2.1.5 Regulations concerning dissertation registration

2.1.5.1 Once a dissertation proposal is approved the student shall proceed at once to carry out the work.

2.1.5.2 Students should be aware that approval to commence a dissertation is by no means automatic. There will be cases where a student is not permitted to proceed with a dissertation and therefore such students will be required to leave the Scheme on completion of the requirements for a Postgraduate Diploma award.

2.1.5.3 Students can register on dissertations only if they are co-taking and/or have taken a total of 3 taught subjects (including credit transferred subjects) in that semester. The normal period for completion of a dissertation is 3 semesters. Students are required to pay for all of the 9 credits the dissertation carries in the first semester when he enrols on the dissertation. Fees paid will not be refunded even if the student withdraws from his dissertation or from the Scheme during the course of his registration. The registration period for the dissertation is set at a maximum of 4 semesters from the date of registration, subject to the regulations on the maximum period of registration for completion of a programme *(applicable to students admitted in or before 2019/20)* / normal duration for completion of a programme *(applicable to students admitted in or after 2020/21)* and subject to satisfactory reports on progress from the academic supervisor. The minimum period for the dissertation work to be completed is 1 semester (for students admitted in 2018/19 or before) / 2 semesters (for students admitted in 2019/20 or after). Break of study is normally not permitted once a student registers for dissertation and students are expected to pursue their dissertation in consecutive semesters.

2.1.5.4 Subject to satisfactory reports on progress from the academic supervisor, students whose dissertation proposal has been approved will continue to register on their dissertation until either the completion of their dissertation or the normal dissertation registration period expires.

2.1.5.5 The student should plan to submit the completed dissertation well before the final deadline and at least several months before the end of the normal period.

2.2 Progress Reports

2.2.1 Students are expected to submit a progress report (Form ENG-PSE126 attached) to the Award Committee via their academic supervisor at least once every semester to ensure smooth progress of the dissertation.

2.2.2 Students should inform their academic supervisors immediately when difficulties arise.

2.3 Early Warning

Upon request from the Award Committee, a student who fails to progress to his academic supervisor's satisfaction will receive a warning letter from the department hosting the award.

2.4 Submission of Dissertation before Assessment

2.4.1 Under normal circumstances, with the agreement of the supervisor(s), students may prepare for assessment after satisfactory progress.

2.4.2 Students should submit the dissertation together with a Dissertation Submission Form (Form ENG-PSE127 attached) to the academic supervisor one month prior to the end of the semester.

2.5 Assessment

2.5.1 Oral examination

After submission of the dissertation for assessment, the academic supervisor shall make arrangements with the assistance of the department on a mutually convenient time and place for an oral exam at which the other assessors will be present.

2.5.2 Assessment panel

The assessment panel will consist of two categories of member, namely:

2.5.2.1 the supervisors (academic supervisor, and professional supervisor if relevant); and

2.5.2.2 a second assessor who is a subject expert from the department, from another department in the University, or from industry, to be appointed by the Award Committee.

2.5.3 Regulations concerning dissertation assessment

2.5.3.1 The date set for the oral examination shall allow sufficient time for the examiners to read the submission and should normally be no later than one month after submission of the dissertation.

2.5.3.2 After conducting the oral examination, the assessment panel will jointly allocate a grade guided by the following weightings which may vary depending on the nature of the project. Individual awards may modify key items and the recommended weightings according to the needs of each award.

Progress 20%	Report 50%	Oral 30%	Total 100%

2.5.3.3 After the assessment of the dissertation is complete the academic supervisor shall write a report on the outcome using a standard outline report form. This report must be signed by all who participated in the assessment of the dissertation and be forwarded to the Award Committee.

2.5.3.4 The report shall contain a date by which the student should submit his final dissertation and the number of hard and electronic copy required to the host Department which would arrange to send an electronic copy to the Library. The deadline for submission of the report of the assessment panel to the Award Committee is TWO WEEKS before the meeting of the Subject Assessment Review Panel.

2.5.3.5 Departments could at their discretion allow students to complete their dissertations during the summer break. In such cases these results could be processed by the Subject Assessment Review Panel held for the summer semester to allow students to graduate.

2.5.3.6 Applications to defer submission should NOT normally be considered or approved except under exceptional circumstances such as illness. In such cases, students' applications for deferment of study can be considered.

2.5.3.7 If a student wishes to delay the submission of the completed dissertation beyond the normal period but within the maximum period of 4 semesters, he may apply on the advice of the supervisor. The application must be approved by the Award Committee.

2.5.3.8 When permission is granted to extend the dissertation registration beyond the normal period, the student shall be required to pay a fee which is set out in the Student Handbook, which shall entitle him to register for one additional semester.

3. DISSERTATION SUPERVISION

The amount of effort required by students in the dissertation should clearly be reflected in the quantity and quality of the final submission. In assessing the standard of dissertations supervisors will be seeking to ensure that the student has met with the aims of this part of the programme.

3.1 Academic Supervisor

3.1.1 The student and academic supervisor should contact each other from time to time to discuss progress against his agreed programme. The responsibility for arranging meetings between student and academic supervisor is shared by both parties.

3.1.2 The academic supervisor will provide guidance to complement that available within the student's employing organisation and advises the student about the style of presentation of the dissertation. If a professional supervisor has been appointed, the academic and professional supervisors will liaise as circumstances require. The academic supervisor will be available for consultation on a regular basis both at the University and at the student's workplace according to circumstances.

3.2 Professional Supervisor (optional)

3.2.1 The role of the professional supervisor is to be able to assess the student's effort in the workplace and assist in the conduct of the oral examination and provide assurance that the candidate's work has been independently done. Students should approach a prospective professional supervisor and explain their requirements and should obtain his agreement to act as professional supervisor.

3.2.2 If the work for the dissertation forms part of a group endeavour within the student's organisation, it is essential that the student's personal contribution can be identified and that the professional supervisor can speak for the part which the student has played.

4. FORMAT AND PRESENTATION OF DISSERTATION

4.1 Each copy of a dissertation must be typewritten in double or one-and-a-half lines spacing on International-size-A4 paper, except for drawings, maps, or tables, for which there are no restrictions. The electronic copy should follow the same page set up and spacing specification.

4.2 A dissertation should contain the following parts, each starting on a new page, in the following order:

4.2.1 A cover page

DISSERTATION TITLE *(all capitalised)*

STUDENT NAME (*all capitalised)*

MSc in XXX

The Hong Kong Polytechnic University

Year of Award

4.2.2 A title page

The Hong Kong Polytechnic University

Name of Department

Dissertation Title

Student Name

A dissertation submitted in partial fulfillment of the requirements
for the MSc in xxx

the month and year of the initial
submission

4.2.3 A Certificate of Originality

CERTIFICATE OF ORIGINALITY

I hereby declare that this dissertation is my own work and that, to the best of my knowledge and belief, it reproduces no material previously published or written, nor material that has been accepted for the award of any other degree or diploma, except where due acknowledgement has been made in the text.

_____ (Signed)

_____(Name of student)

4.2.4 Dedication (optional)

4.2.5 Abstract
- Consisting of a summary of the work done with 200-500 words.

4.2.6 Publications arising from the dissertation (optional)
- Follow the format described in Paragraph 4.5 below.

4.2.7 Acknowledgements

4.2.8 Table of contents

4.2.9 List of figures, tables and abbreviations (all optional)

4.2.10 Chapter 1 : Introduction (the subtitles for all chapters are to be decided by the students)

4.2.11 The dissertation body

4.2.12 Conclusions and Suggestions for Future Research (the latter being optional).

4.2.13 References
- The references for all chapters can be placed at the end, or those for each chapter can be placed at the end of the chapter.
- References should be presented in alphabetical order of the first author, using the reference citation format for academic journal papers, book chapters, conference papers, research reports/working papers and books/research monographs, or in an internationally accepted format used by the discipline in which the study lies.

4.3.1 Intellectual property created by students in the course of their study at the University shall be owned by the University only if the student receives financial support from the University in the form of wages, salary or stipends for undertaking their study or research in the University; makes material use of the University's resources for his/her research work; receives material guidance and intellectual input from the University's staff for his/her research work; or if his/her research work is funded by a grant to the University or to him/her by virtue of his/her employment by the University.

4.3.2 Generally speaking, intellectual property rights, among other things, refers to novel information and ideas that the law protects. It means the material or communicable result of scientific, humanistic, literary, and artistic effort. It includes, but is not limited to, works in the forms of copyrights, designs, inventions, discoveries, trademarks, formulae, processes, computer software, drawings and sculptures, journal articles, and conference presentations. Students should not, therefore, make the claim that they own the intellectual property of the research work in their dissertation or in other publications that resulted from their research work.

4.4 Each copy of the dissertation submitted for examination purpose should include the words 'Initial Submission for Examination Purpose' lettered on the front cover.

4.5 The approved dissertation should be submitted in electronic format and must be prepared in accordance with the following requirements:

File format	PDF format Compatible with PDF version 1.4 (Acrobat 5) or higher Must be text-searchable Image PDF is not acceptable
Paper size	A4 (210 x 297 mm), except for drawings, maps or tables
Security	No password assigned and all security settings should be turned off
Font	All fonts must be embedded
Spacing	Must be double or one-and-a-half lines

The electronic version must be clear enough that it presents all images, data and symbols.

5. BINDING OF DISSERTATIONS

[This is optional. Students should consult your department on the requirement.]

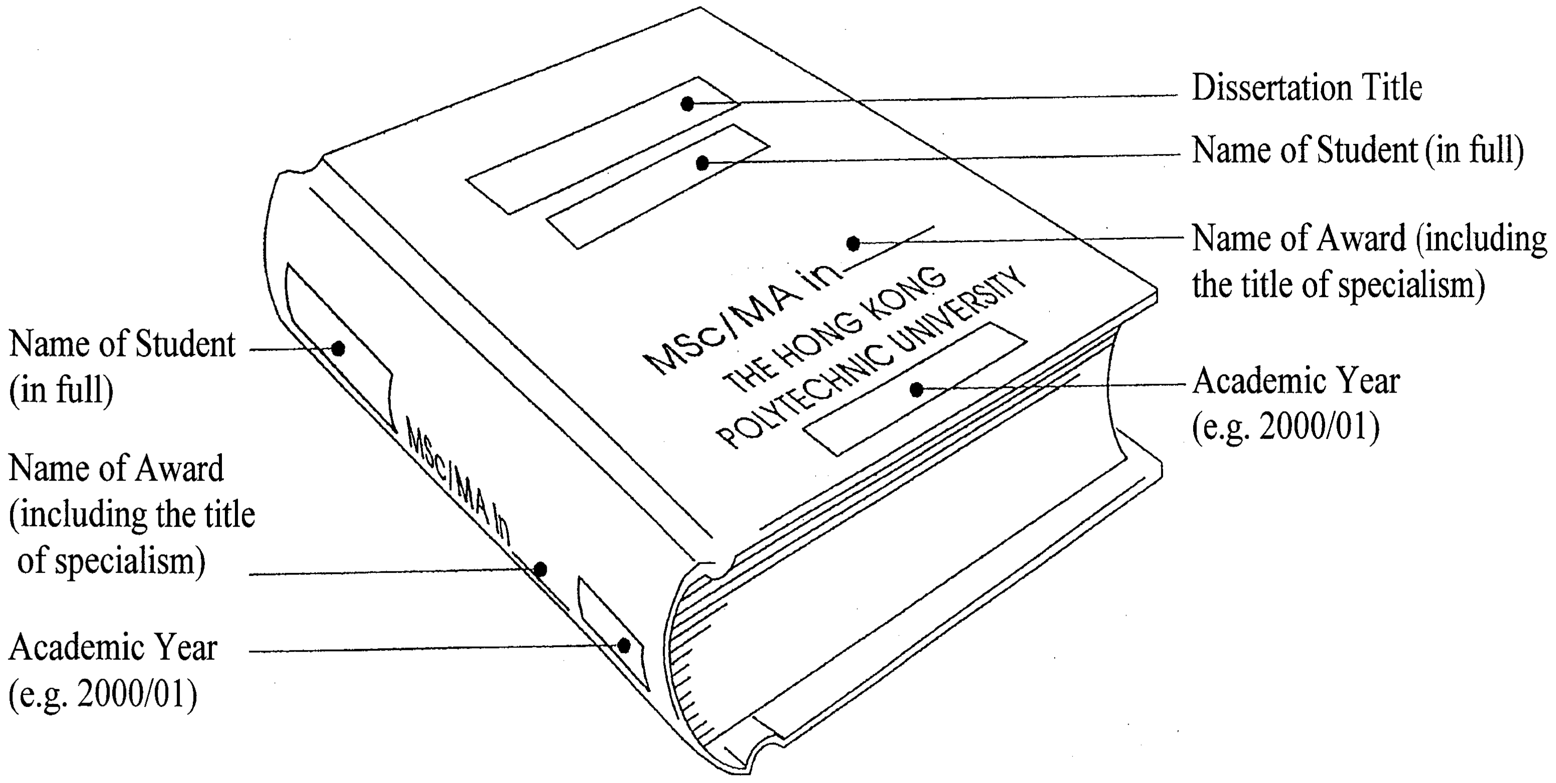
5.1 After assessment students will have their dissertations bound by outside binderies at their own expense. A rough sketch of a bound dissertation is set out on next page.

5.2 All dissertations should be bound with hard covers, with silver blocking on the front cover and on the spine. The colour should be navy blue.

5.2.1 Of the final copies submitted, one of these may be in a temporary heat-sealed "Perfect" binding with the title, name of author, degree and date. One of the final copies will be bound and will be lodged with the host department.

5.2.2 These final copies of the dissertation shall be checked and approved by the academic supervisor or Dissertation Coordinator. This shall be done within one month of the dissertation oral examination.

Rough Sketch of a Bound Dissertation



THE HONG KONG
POLYTECHNIC UNIVERSITY
香港理工大學

Form ENG-PSE125

Postgraduate Scheme in Engineering
Synopsis

Dissertation Proposal for MSc in ___________________________________

This form should be typewritten. All sections should be completed in full. Sections 1-3 are to be completed by the student. In signing this form the Award Committee confirms that the student is registered on dissertation, the proposal is of an acceptable academic standard and that the university resources necessary for the dissertation will be made available. The completed form should be sent to the Award Committee for approval no later than the last day of a semester.

Section 1 : Student Details

Student's Name :

Student No. :

Tel No. :

Email address. :

Subjects taken so far (include title, grade, and academic year for all subjects for which a grade has been obtained)

Section 2 : Supervisor Details

Academic Supervisor's Name, Qualifications and Department :

Professional Supervisor's Name, Qualifications, Position, and Affiliation (appointment of which is optional) :

Professional Supervisor's Address :

Tel. No. :

Email address. :

Section 3 : Details of Dissertation Topic

Dissertation title :

Signature of student : Date :

Section 4 : Comments of Academic Supervisor

The proposed dissertation topic is considered pertinent to the specialism of (please tick as appropriate):

A list of specialisms offered will be listed for selection.

☐ Not applicable

Signature : Date :

Section 5 : Comments of Professional Supervisor, if any

Signature : Date :

Section 6 : Decision of Award Committee

Approved/Referred back for improvement/Rejected

Signature : Date :
Chairman, Award Committee

Objectives of the Project

Content

(Innovative features, challenge, academic value and applicability of the project)

(Cont'd)

Methodology

References

Scheduled programme of work

Description of facilities required and justification

(Also detail any other supporting facilities obtained elsewhere)

Expected completion date :

Student's Signature

THE HONG KONG
POLYTECHNIC UNIVERSITY
香港理工大學

PolyU-FENG
05002

Form ENG-PSE126

Postgraduate Scheme in Engineering
Dissertation Progress Report

This report is to be completed by the student then endorsed by the academic supervisor who will forward it to the Award Committee every *semester*.

Section 1 : To be Completed by Student

Student's Name :__________________________________ Student no. ________________________

MSc in

____

Academic Supervisor's Name :

____

Dissertation Title :

____

Start Date : ______________________________ Expected Completion Date : __________________________

Student's report

Briefly describe progress since last report (or since commencement):

Please explain any problems you have identified and suggest appropriate action :

Signed : ____________________________________ Date : _________________________________

Section 2 : To be Completed by Academic Supervisor

Academic Supervisor's comments

Progress is generally satisfactory / unsatisfactory*

The proposed dissertation topic is considered pertinent to the specialism of (please tick as appropriate):

A list of specialisms offered will be listed for selection.

☐ Not applicable

Comments :

Signed : ___________________________________ Date : ________________________________

THE HONG KONG
POLYTECHNIC UNIVERSITY
香港理工大學

PolyU-FENG
05002
Form ENG-PSE 127

Postgraduate Scheme in Engineering
Dissertation Submission Form

Section 1 : To be completed by student

Students' Name : Student No.:

MSc in :

Proposed Dissertation Title :

Name and department/company of academic, and professional supervisor (if any):

Signature : Date :

Section 2 : To be completed by Academic Supervisor

Please tick as appropriate:

- ☐ I agree that the dissertation is ready for submission.
- ☐ I do not agree that the dissertation is ready for submission. My specific views on the shortcomings have been made known to the student.
- ☐ I am satisfied with the title proposed by the student.
- ☐ I have amended the title proposed by the student as shown above.
- ☐ The proposed/amended dissertation topic is considered pertinent to the specialism of *(please choose from below):*

A list of specialisms offered will be listed for selection.

☐ Not applicable

Signature : Date :

Section 3 : To be completed by Chairman of Award Committee

The Award Committee has nominated ____

as the assessor for this dissertation (optional if a professional supervisor is present).

Signature : Date :

About Plagiarism

(Students should refer to the Student Handbook for details https://www.polyu.edu.hk/ar/students-in-taught-programmes/student-handbook/)

Plagiarism refers to the act of using the creative works of others (e.g. ideas, words, images or sound, etc) in one's own work without proper acknowledgement of the source. According to the Webster's Ninth New Collegiate Dictionary (1987), to 'plagiarise' means

> [T]o steal and pass off (the ideas or words of another) as one's own : [to] use (a created production) without crediting the source : [to] commit literary theft : [to] present as new and original an idea or product derived from an existing source.

The University views plagiarism, whether committed intentionally or because of ignorance or negligence, as a serious disciplinary offence. Excuses such as "not knowing that this is required" or "not knowing how to do it" will not be accepted. It is the student's responsibility to understand what plagiarism is, and take action steps to avoid plagiarism in their academic work. The golden rule is: "if in doubt, acknowledge".

Avoiding Plagiarism

Students are required to submit their original work and avoid any possible suggestion of plagiarism in the work they submit for grading or credit. Below are some suggestions on how you can avoid plagiarism in your own work:

Use sources with care and respect

- Take careful notes so that you know where you got your information
- Keep track of all the sources you have used for each assignment
- Cite all your sources in your finished work, distinguishing carefully between your own ideas/work and those taken from others
- Include all your sources in your Reference or Bibliography section, normally included at the end of the paper

Find out the expectations of your Department and your teacher

- Different disciplines or professions may have slightly different conventions for citation and referencing. Ask your Department or teacher for the specific citing and reference system or conventions used in your chosen profession/discipline
- Ask your teacher what types of collaborations and help is permitted for the specific assignment

Develop your academic skills

- Plan your academic work carefully and start early so that you have time to do your own work
- Make a work schedule for your work and try to keep to it
- Study resource materials and attend courses or workshops provided by the University to continually improve your skills in referencing and academic writing

Be honest, and always do your own work

Resources and Support Provided to Students

To know more about plagiarism and how to cite sources properly in your work, please refer to the booklet "About Plagiarism and How to Avoid It" developed by the University at https://www.polyu.edu.hk/ogur/docdrive/Academic_Integrity/Plagiarism_Booklet.pdf.

You can also obtain more information about using sources and referencing styles from the following web page of the Centre for Independent Language Learning, English Language Centre of this University at https://elc.polyu.edu.hk/CILL/reference.aspx.

The University Library subscribes to EndNote. It is a reference management tool that could be used to help you create your own bibliographic database. More details can be found at: https://libguides.lb.polyu.edu.hk/ref-mgt-tools/endnote

The following is extracted from 'Policy on promoting academic integrity in PolyU' (formulated by the University's Learning and Teaching Committee in June 2012)

1. Academic integrity is the foundation of any academic endeavour of a university, and is valued highly at PolyU. It is therefore the responsibilities of all members of the University, including both staff and students, to ensure that they pursue their scholarly work in an academically honest manner.

2. The purpose of this policy on promoting academic integrity is to nurture among students responsible and ethical attitudes towards their academic work. More specifically, it attempts to:

   - Educate students about the importance of honest behaviours in academic pursuits and scholarly work;

   - Provide guidelines and tools for academic staff to detect cases of suspected plagiarism, and take necessary actions;

- Provide opportunities for students to develop their ability to produce work that is plagiarism-free.

4. All academic staff are expected to actively monitor students' work for incidents of suspected plagiarism, using methods – including electronic detection – that are most suited for the context. They can, wherever they deem appropriate, require students to send any text-based assignments for electronic plagiarism check when/before submitting them for assessment.

5. Students of postgraduate taught and postgraduate research programmes must send their theses or dissertations for electronic plagiarism check, and revise the work if necessary, before submitting the work formally for examination. The respective Chief Supervisors are responsible for making sure that their students have complied with this requirement before sending their theses/dissertations to the Internal and/or External Examiners, and advising their students on how to revise their work to conform to the academic conventions of their discipline/profession.

6. All publications (e.g. conference paper or journal articles) produced by students and research personnel bearing the name of PolyU must also be sent for electronic plagiarism check, and subsequently revised if necessary, before submission to the relevant bodies (e.g. conference organisers or journal editors) for review for publication. Where appropriate, the overseeing academic staff are responsible for ensuring compliance of students/research personnel with this requirement.