EE9XXX Series (AY 2014-15) – Course Syllabus

COURSE CODE	COURSE TITLE	SEMESTER	
		1	2
EE9910	SPECIAL TOPIC - SYSTEMS, COMPLEXITY & INNOVATION		X
EE9911	SPECIAL TOPIC - FROM CONCEPTS IN OPTICS TO ADVANCED PHOTONICS	X	
EE9912	SPECIAL TOPIC – INTRODUCTION TO NANOPHOTONICS	X	
EE9913	SPECIAL TOPIC- SPACE ENVIRONMENT & SPACECRAFT SYSTEMS ENGINEERING	X	

Remarks:

A) The following 2 courses only available for research students admitted before Aug 2014 admission:

EE9911 – offered from 30 June 2014 to 11 July 2014
EE9912 – offered from 12 Aug 2014 to 25 Aug 2014

B) EE9913 will offer from 4 to 23 September 2014. Students may register this course during the course registration period I & II.

EE9910 SPECIAL TOPIC - SYSTEMS, COMPLEXITY AND INNOVATION

Academic Unit:	3
Pre-requisite:	Graduate students intending or already embarked on degrees by research. Class size is limited to 20 in the first instance as a high degree of interactivity is expected.
Effective:	1 Jan 2014
Last update:	5 Sep 2013

LEARNING OBJECTIVE

This is a trans-disciplinary course covering systems thinking, complexity and agent based modeling, as well as innovation and entrepreneurship. Unlike most graduate courses which go deeper into specific areas of study, this course is designed to broaden the perspective of graduate students.

The course introduces the graduate student embarking on research to topics that broaden his/her perspective and help to develop the skill of tapping diverse disciplines to advance his/her research. It also introduces the student to processes of innovation and technology development so that their research can be better linked to real world problems and eventually applied for the benefit of society.

CONTENT

Systems thinking and modeling of human society
Complex systems and emergent properties
Agent-based modeling
The genetics of technology innovation
Innovation and global markets
Entrepreneurship and enterprise

LAB DESCRIPTION

NetLogo programme from Northwestern downloaded onto personal laptops used for Agent-based modeling examples and exercises.

LEARNING OUTCOME

At the completion of the course, the student should

- Appreciate systems thinking and be able to look at any problem and issue in a broad, multidisciplinary context.
- Understand Complexity and Agent-based modeling to help broaden their perspective on their research in a multidisciplinary manner.
- Appreciate practical applications of their research and potential for innovation, ready to apply their research through start-ups.

ASSESSMENT SCHEME

Continuous Assessment	12 Weekly Assignments	60%
	*Term Paper	40%

Total: 100%

Graded Pass/Fail as significant group work is expected.
Students will be assessed and graded individually.

**Students are to write a paper on applications of research results, commercialisation possibilities and a brief business plan. Each student would make a 8 min presentation on the final day of classes. Grading would be based on both write-up and presentation.*

TEXTBOOK

Railsback, Steven F. and Grimm, Volker, "Agent-Based and Individual-Based Modeling", Princeton, 2012

REFERENCES

Senge, Peter M., "The Fifth Discipline", Doubleday, 1990

Christensen, Clayton M., "The Innovator's Dilemma", HarperBusiness, 2000

Watts, Duncan J., "Six Degrees", Norton, 2004

Meadows, Donella H., "Thinking in Systems, A Primer", Sustainability Institute, 2008

Arthur, W. Brian, "The Nature of Technology", First Free Press, 2009

Fitzgerald, E., Wankerl, A., Schramm, C., "Inside Real Innovation", World Scientific, 2011

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EE9911 **SPECIAL TOPIC - FROM CONCEPTS IN OPTICS TO ADVANCED PHOTONICS**

Acad Unit: 3
Pre-requisite: Nil
Effective: May-June 2014
Last update: 27 January 2014

LEARNING OBJECTIVE

1. Introduction of photonics and optics
2. Current topics in photonics
3. Applications to modern optics

CONTENT

Introduction to photonics. Modern optics. Light-matter interaction. Guided optics. Silicon photonics. Optical cavities and resonators. Photonic crystals. Optical antennas and nanoemitters. Applications in quantum information and quantum communications.

LEARNING OUTCOME

The students will grasp the basic concepts to understand photonics and modern optics, which is a fast emerging field of research and technology with numerous potential applications in photovoltaics, telecommunication, storage, lighting, sensing, biophysics.

STUDENT ASSESSMENT

Continuous Assessment	Individual project presentation	60%
	Participation during classes	10%
	Quiz	30%
	Grading: Pass/Fail	
	Total:	100 %

TEXTBOOKS

1. Fundamentals of photonics, M. Teich and B. Saleh. Wiley Press.
2. Photonics, A. Yariv and P. Yeh, Oxford University Press (2010).

REFERENCES

1. Recent progress in lasers on silicon, D. Liang, and J. E. Bowers, Nature Photonics 4, 511 (2010).
2. Photonic crystals, D. J. Norris, Nature Materials 6, 177 (2007).
3. Quantum communications, N. Gisin, and R. Thew, Nature Photonics 1, 165 (2007).

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EE9912 SPECIAL TOPIC - INTRODUCTION TO NANOPHOTONICS

Acad Unit: 3
Pre-requisite: Nil
Effective: Acad Year 2014/15
Last update: 26 February 2014

LEARNING OBJECTIVE

1. To understand the key principles of nanophotonics.
2. To develop the ability to design nanophotonic building blocks including filters, sensors and light-emitters among others.
3. To understand possible approach to interfacing optical-electronic biomolecular nanostructures via nanophotonic phenomena.

CONTENT

Introduction to nanophotonics. Analogies of electrons and electromagnetic waves. Quantum confinement in semiconductors. Nanoplasmonics. Controlling light-matter interaction at the nanoscale. Examples from applications.

LEARNING OUTCOME

Nanophotonics is a contemporary field of new science and nanotechnology, which uses light propagation and light—matter interactions in nanostructures to improve existing systems and/or to develop new components and devices in optoelectronics, information technologies, display and lighting systems, photovoltaics, sensors and microchips for biomedicine.

The course will provide a consistent description of basic physical phenomena, principles, experimental advances and potential impact of light propagation, emission, and scattering in complex nanostructures: from analogies between electromagnetic waves and electrons to photonic circuitry and photonic metamaterials.

The proposed course aims to train research students and support the photonic design research at NTU, and the need for advanced photonics design experts in the Singapore micro-opto-electronics industry.

STUDENT ASSESSMENT

Continuous Assessment	Based on 3 assignments in the form of studies, and problem solving. Students will be assessed individually. Grading: Pass / Fail	100%
	Total:	100%

TEXTBOOK

1. Introduction to Nanophotonics by Sergey V Gaponenko

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EE9913 SPECIAL TOPIC - SPACE ENVIRONMENT AND SPACECRAFT SYSTEMS ENGINEERING

Acad Unit: 3
Pre-requisite: None
Effective: AY2014/15
Last update: April 2014

LEARNING OBJECTIVE

Students will learn
- systems engineering approach toward spacecraft development.
- basics of the technological aspects of each spacecraft subsystem.
- basics of space environment and environmental testing.

CONTENT

Space Systems Engineering. Orbital Mechanics. Mission Analysis. Spacecraft Verification and Testing. Spacecraft Structures. Spacecraft Mechanical Verification and Testing. Space Environment Overview. Space Radiation Effects and Testing. Spacecraft Propulsion System. Spacecraft Dynamics and Attitude Control. Electrical Power Systems. Thermal Control and Testing. Telecommunications. Small Satellites.

LEARNING OUTCOME

Students will gain
- knowledge of systems engineering approach toward spacecraft development
- basic knowledge of technological aspects of each spacecraft subsystem
- basic knowledge of space environment and environmental testing.

STUDENT ASSESSMENT

Continuous Assessment	Assignments	30%
	Participation during classes	20%
	Quiz	50%
	Total :	100%
	Grading: Pass/Fail	
Final Examination		0%

TEXTBOOK

- Spacecraft Systems Engineering, edited by Peter Fortescue et al., Wiley

REFERENCES

- Harris' Shock And Vibration Handbook, sixth edition, Allan G. Piersol, Thomas L Paez, Macgrawhill, 2010.
- Spacecraft Thermal Control Handbook, David G. Gilmore, Aerospace Press, 2002.
- SMC-S-016 “Test Requirements For Launch, Upper-Stage And Space Vehicles”, 2008.
- ISO-15864 “ Space systems — General test methods for space craft, subsystems and units”, 2004.
- ECSS-ST-10-03 “Space Engineering – Testing”, 2011.
- Space Mission Analysis and Design, edited by J.R.Wertz and W.J. Larson. Space Technology Library, 1999.
- Spacecraft Power Systems by Mukun R. Patel, CRC Press, 2005
- Spacecraft Environment Interaction, by D.E. Hastings and H. Garrett, Cambridge University Press, 1996.

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