### EE9XXX Series (AY 2014-15) – Course Syllabus

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>SEMESTER</th>
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<tbody>
<tr>
<td>EE9908</td>
<td>AN INTRODUCTION TO RADAR SYSTEMS</td>
<td>X</td>
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<tr>
<td>EE9910</td>
<td>SPECIAL TOPIC - SYSTEMS, COMPLEXITY &amp; INNOVATION</td>
<td>X</td>
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<tr>
<td>EE9911</td>
<td>SPECIAL TOPIC - FROM CONCEPTS IN OPTICS TO ADVANCED PHOTONICS</td>
<td>X</td>
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<tr>
<td>EE9912</td>
<td>SPECIAL TOPIC – INTRODUCTION TO NANOPHOTONICS</td>
<td>X</td>
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<tr>
<td>EE9913</td>
<td>SPECIAL TOPIC- SPACE ENVIRONMENT &amp; SPACECRAFT SYSTEMS ENGINEERING</td>
<td>X</td>
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<tr>
<td>EE9914</td>
<td>SPECIAL TOPIC - CRYPTOGRAPHY AND CYBERSECURITY</td>
<td>X</td>
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**Remarks:**

EE9908 – offered from 9 to 20 March 2015
EE9910 – offered from 13 Jan 2015 to 20 Apr 2015
EE9914 – offered from 13 Jan 2015 to 20 Apr 2015
LEARNING OBJECTIVE

A) Students learn basic radar concepts including the Radar Equation.
B) Students learn the operation and tradeoffs for common radar systems including high resolution, Doppler, bistatic and multistatic radar concepts.
C) Students learn basic radar signal processing and synthetic aperture radar processing.

CONTENT

Study of radar systems and their applications; emphasis on measurement of target parameters by means of radar with application to ranging, tracking, mapping, and navigation.

COURSE OUTLINE

Historical background and the nature of radar
The Radar Equation, detection and clutter
Radar technology
MTI and pulse Doppler radar
Waveform design and pulse compression
CW and FM Radar
Tracking Radar
Radar Antennas and Arrays
SAR
Classification
Bistatic radar
Emerging trends
System examples
Epilogue

LAB DESCRIPTION

Write a program in Matlab to compute the output of a pulse compression filter for the following two cases; (i) for a single point target and (ii) for two point targets showing (a) when they are unresolvable and (b) where they are resolved. Present your results in a short report with analysis and conclusions drawn from your results. Guidance; Use typical radar parameters and state these in your report. Explain how you are able to validate your results. Check and label scales of figures carefully. If you wish to work as part of a group you may but you must submit your own individual answer.
LEARNING
1. Students learn basic radar concepts including the Radar Equation.
2. Students learn the operation and tradeoffs for common radar systems including high resolution, Doppler, bistatic and multistatic radar concepts.
3. Students learn basic radar signal processing and synthetic aperture radar processing.

ASSESSMENT SCHEME

Continuous Assessment
100%
Final Examination 0%

TEXTBOOKS

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%
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**


Watts, Duncan J., “Six Degrees”, Norton, 2004


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


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

<table>
<thead>
<tr>
<th>Continuous Assessment</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Individual project presentation</td>
<td>60%</td>
</tr>
<tr>
<td>Participation during classes</td>
<td>10%</td>
</tr>
<tr>
<td>Quiz</td>
<td>30%</td>
</tr>
<tr>
<td>Grading: Pass/Fail</td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td>100%</td>
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TEXTBOOKS


REFERENCES

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


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
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


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

- Spacecraft Power Systems by Mukun R. Patel, CRC Press, 2005
LEARNING OBJECTIVE

The course aims to provide an opportunity for graduate students at School of EEE to obtain a fundamental but practical knowledge and background of cryptography and cybersecurity responding to the emerging threats to public information security and personal privacy. This course covers diverse topics on cryptography and cybersecurity including symmetric and asymmetric cryptography, privacy-enhanced techniques, security and privacy in vehicular communications, e-Healthcare systems, smart grid communications, cloud computing, big data, and other cybersecurity related issues.

CONTENT


LEARNING OUTCOME

On the successful completion of the course, students will be able to

- Understand the basic network attacks, security requirements, and cryptographic tools
- Understand the concepts of symmetric cryptography, block ciphers, stream ciphers, and hash functions
- Understand the fundamentals of finite fields, number theory and their applications to cryptography
- Understand the concepts of asymmetric cryptography, RSA cryptosystem and signatures
- Understand ElGamal cryptosystem and digital signature.
- Understand and apply key exchange technique in practice
- Understand privacy enhanced techniques
- Understand cyber security challenges in vehicular communications
- Understand cyber security challenges in e-Healthcare systems
- Understand cyber security challenges in smart grid communications
- Understand cyber security challenges in cloud computing
- Understand cyber security challenges in big data
- Explore new security topics with ease and confidence
STUDENT ASSESSMENT

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<tr>
<td>Continuous Assessment</td>
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<tr>
<td>Assignments</td>
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<tr>
<td>Quizzes</td>
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<tr>
<td>Final project report</td>
<td>50%</td>
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<td>Total</td>
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Grading: Pass/Fail

TEXTBOOKS


REFERENCES
