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EE7XXX Series (AY2015-16) - Course Syllabus

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<td>SIGNAL INTEGRITY IN HIGH-SPEED DIGITAL SYSTEMS</td>
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LEARNING OBJECTIVE

The objective of the first module is to introduce students to the basic project initiation and planning processes including scope definition, project estimation and work breakdown structure. The second module centers on providing students with the tools and techniques to develop well-designed project implementation schedule that clarifies and describes what the project should deliver and within what timeframe. The third module emphasizes on understanding of project performance monitoring, control and evaluation. The fourth module focuses the role of innovation in creating new ventures and fundamentals of entrepreneurship. Ultimately, the course aims to equip students with the necessary knowledge and skills to professionally manage projects in order to ensure successful delivery in an acceptable timeframe and at an acceptable cost.

CONTENT


COURSE OUTLINE

This course is designed to provide an understanding of the key elements in project management as well as the processes and motivations of innovation and entrepreneurship. The first module enables students to identify and plan the scopes and objectives of the project. The second module introduces knowledge on effective project scheduling and implementation strategies. The third module covers the important steps in the monitoring, control and evaluation of the project. The fourth module is to equip students with the essentials of innovation and how to translate innovative ideas into commercial ventures. This course is a core course for all Master of Science (MSc) students.

LEARNING OUTCOME

This course is to provide students with the understanding of the major concepts, methods, and techniques of project management, in particular issues related to the organization, planning, realization, and control of projects. The students will learn the processes and techniques associated with project management including cost, time, quality, risk, communication, human resources and procurement management while gaining the knowledge and skills to work as a project manager. The students will also gain the knowledge in innovation and entrepreneurship including key processes in introducing products and services to the market. The students will develop new skills and acquire knowledge on innovation that will enhance their ability to contribute to the long-term competitiveness of businesses.
ASSESSMENT SCHEME

Continuous Assessment 50 %  [Individual Assignment (15% each) x 2 = 30%]
[Group Assignment (10% each) x 1 = 10%]
[Quiz (10% each) x 1 = 10%]

Final Examination 50 %

TEXTBOOK


REFERENCES

OBJECTIVE

To provide students with a good understanding of the fundamental principles underlying the theory of digital communication systems, with emphasis on baseband signal processing and various modulation techniques.

DESIRED OUTCOME

Students completed the course are equipped with good knowledge of the elements of digital communication systems which will prepare them for advanced communications study and research.

OTHER RELEVANT INFORMATION

For this course, the students are expected to have basic background on Fourier analysis, probability and stochastic processes, and undergraduate communication courses (e.g.: E312 and E452 or the equivalence).

CONTENT


ASSESSMENT SCHEME

Continuous Assessment: 20%
Final Examination: 80%

TEXTBOOK


REFERENCES

OBJECTIVE

The course is designed to

1. provide graduate students with an in-depth understanding of the underlying concepts of computer networks,
2. extend the students knowledge of computer networks in the areas of multiple access techniques, network protocols and the upper layers of the OSI model, and
3. treat certain key related areas, such as performance, internetworking and current and emerging trends in networking technologies, in some detail.

DESIRED OUTCOME

Upon completion of this course, the student should have (i) a comprehensive understanding of network concepts and inter-operability and (ii) in-depth knowledge of the state-of-the art of a variety of networking topics.

OTHER RELEVANT INFORMATION

A first course in Data Communications & Networking would be desirable.

CONTENT


ASSESSMENT SCHEME

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS


REFERENCES

EE6122 OPTICAL FIBRE COMMUNICATIONS

Acad Unit: 3
Prerequisite: Nil
Effective: Acad Year 2007/2008
Last update: February 2007

LEARNING OBJECTIVE

To provide students with a good understanding of the fundamental principles that are involved in the design and implementation of optical fibre communication systems with emphasis on fibre technology and various transmission techniques.

CONTENT


COURSE OUTLINE

Students are expected to have basic background in telecommunication systems. The knowledge gained in this course is important for optical fibre communication systems.

LEARNING OUTCOME

Students will be equipped with in-depth knowledge of optical communication technologies. This will prepare them for advanced fibre communications and networks study and research.

STUDENT ASSESSMENT

Continuous Assessment: 20%
Final Examination: 80%

TEXTBOOKS / REFERENCES

EE6128 RF CIRCUITS FOR WIRELESS COMMUNICATIONS

Acad Unit: 3
Pre-requisite: Nil
Effective: Academic Year 2013-2014
Last update: June 2012

LEARNING OBJECTIVE

To provide students good understanding of fundamental techniques for the analysis and design of a variety of passive and active RF and microwave circuits for wireless communications.

CONTENT


LAB DESCRIPTION (if applicable)

Nil

LEARNING OUTCOME

Students will be equipped with the knowledge provided in this course, and be able to participate in analysis, design, simulation and implementation of various RF passive and active circuits. They will also be able to analyse and assess the performance of RF receiver subsystems for wireless communications.

STUDENT ASSESSMENT

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS


REFERENCES

LEARNING OBJECTIVE

This course is intended to provide students with a good understanding of the fundamental principles underlying the theory of wireless communication systems, multipath fading effects and their mitigation techniques, with emphasis on cellular mobile and satellite communication systems and signal processing.

CONTENT


LAB DESCRIPTION (if applicable)

Nil

LEARNING OUTCOME

Students who have completed this course will be equipped with the fundamental knowledge of wireless communications, multiple access and multipath fading concepts, basic understanding of several important wireless communication systems link budget, multiple access schemes and fading mitigation techniques, and the ability to perform basic design and performance analysis of wireless communication systems using the techniques described above.

STUDENT ASSESSMENT

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS

REFERENCES

EE6130  ANTENNAS AND PROPagation FOR WIRELESS SYSTEMS

Acad Unit: 3
Pre-requisite: Nil
Effective: Academic Year 2013-2014
Last update: June 2012

LEARNING OBJECTIVE

This course is intended to provide students with a good understanding of the general characteristics of different antennas, the principles and theory behind their operation, and modeling and measurement techniques for different antenna systems. In addition, the principles and characteristics of radio waves propagating in various environments and wireless channels are also dealt.

CONTENT


LAB DESCRIPTION (if applicable)

Nil

LEARNING OUTCOME

1. Gain understanding of different parameters used to characterize antennas. Know how to analyze wire and aperture radiating elements.
2. Be able to design various antennas and arrays for many wireless communication systems.
3. Have the knowledge of radio wave propagation mechanisms

STUDENT ASSESSMENT

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS

REFERENCES

OBJECTIVE
Practically all control systems that are implemented today are based on computer control. It is therefore important to understand computer-controlled systems well. The purpose of the course is to provide a thorough background for understanding, analyzing and designing of computer-controlled systems. The objectives include equipping students with the control theory that is relevant to the analysis and design of computer-controlled systems. Topics such as time-domain analysis, frequency domain analysis, state-space analysis will be covered. The design and implementation issues of computer-controlled systems will also be extensively discussed.

DESIRED OUTCOME
On completion of the course, the students should be able to understand specific theories of computer-controlled systems, carry out the design of controllers to meet desired performance specifications through various design techniques such as the frequency and state-space approaches, understand practical implementation techniques and considerations from a software and hardware point of view.

OTHER RELEVANT INFORMATION
A background with a fundamental course on continuous-time control systems is desirable.

CONTENT

ASSESSMENT SCHEME
Continuous Assessment 20%
Final Examination 80%

TEXTBOOK

REFERENCES
EE6204 SYSTEMS ANALYSIS

Acad Unit: 3.0
Prerequisite: Nil
Effective: Acad Year 2013-2014
Last update: 2 September 2013

CONTENT


ASSESSMENT SCHEME

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS


REFERENCES

OBJECTIVE

This course introduces fundamental concepts in robotics and intelligent sensing techniques. The objectives of the course are to provide an introductory understanding of robotics and intelligent sensors. Students will be exposed to a broad range of topics in robotics and intelligent sensors, with emphasis on basic of manipulators, coordinate transformation and kinematics, trajectory planning, control techniques, mobile robot kinematics, intelligent sensors, especially on the machine learning capability of robot kinematics and dynamics in a closed loop system.

DESIRED OUTCOME

On completion of this course, the student will be able to model robot manipulators and mobile robots; solve an inverse kinematics problem and plan a robot trajectory; design and analyze robot controllers by using appropriate methods; design basic robot intelligent sensor systems including static system learning (kinematics) and dynamic learning; and intelligent course recognition.

OTHER RELEVANT INFORMATION

CONTENT

Overview of robotics. Motion planning and control. Mobile robots. Controller hardware/software systems. Sensor systems and integration.

ASSESSMENT SCHEME

Continuous Assessment  20%
Final Examination 80%

TEXTBOOKS


REFERENCES

EE6222 MACHINE VISION

Acad Unit: 3
Pre-requisite: Nil
Effective: Academic Year 2013-2014
Last update: August 2013

LEARNING OBJECTIVE

This course aims to introduce to students the basic concepts of vision based automation systems in industrial and practical settings. Development of vision based automation system may involve image capture and analysis, three dimensional data processing and machine intelligence. Hence, this course covers these topics appropriately.

CONTENT


LEARNING OUTCOME

1. Understand the basic concepts of image pre-processing & analysis, feature extraction and pattern classification.
2. Understand the basic concepts of three dimensional image analysis and recognition.
3. Apply the machine vision concepts to develop simple automation systems.

STUDENT ASSESSMENT

Continuous Assessment 20%
Final Examination 80%

REFERENCES

EE6223 COMPUTER CONTROL NETWORKS

Acad Unit: 3.0
Prerequisite: Nil
Last update: August 1997

CONTENT


ASSESSMENT SCHEME

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS


REFERENCES

EE6225 PROCESS CONTROL

Acad Unit: 3
Pre-requisite: Nil
Effective: Academic Year 2013-2014
Last update: September 2013

LEARNING OBJECTIVE

This course is intended to provide a review of modern process control engineering. The purpose of the course is to serve as an introduction to process dynamics, modeling and control. The objectives include: (a) equipping students with basic understanding of issues related to basic control algorithms, advanced control strategies, multivariable control, plant parameter estimation, and process modelling and simulation; (b) enhancing students’ skills and techniques for tackling practical process control system design problems through case studies.

CONTENT


LEARNING OUTCOME

On completion of this course, students should be confident to handle tasks on modelling, analysis, design and implementation of control systems for the process industry.

STUDENT ASSESSMENT

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS


REFERENCES

LEARNING OBJECTIVE

With higher operating speeds and more compact packaging in electronics systems, electromagnetic compatibility (EMC) design of electronic systems is crucial due to mandatory international EMC regulations. Most electrical and electronic engineers are well trained in system design for a specific application but lack the necessary knowledge in designing that system to meet the EMC requirements. The objective of this course is to fill this missing gap. The course starts with the cause of electromagnetic interference (EMI) occurrence and the historical development of worldwide EMC regulatory standards. At the circuit design level, it covers non-ideal behaviors of passive components at high frequencies and their impacts on EMI, EMI filter design for switching mode power supplies, printed circuit board layouts to minimize crosstalk and radiation and electrostatic discharge (ESD) protections. At the system integration level, it covers radio frequency interference (RFI) analysis, grounding and shielding design. Finally, it discusses test methods and procedures for both emission and immunity tests to verify EMC performance of a system.

CONTENT


LEARNING OUTCOME

Through this course, students are expected to:
1. Understand the EMC regulatory requirements in North America, European Community and Asia Pacific region;
2. Select proper passive components for circuits operating at high frequencies without unwanted EMI behaviors;
3. Design an EMI filter for a switching-mode power supply to comply with conducted EMI emission limit;
4. Apply the correct printed circuit board layout techniques to resolve EMI problems arising from crosstalk and to comply with radiated EMI emission limit;
5. Apply the correct protection techniques to minimize damages to active components due to ESD;
6. Apply the correct grounding and shielding methods for EMC purposes;
7. Compute antenna-to-antenna coupling for RFI analysis;
8. Familiar with the basic measurement methodologies for electromagnetic emission and susceptibility requirements.
OTHER RELEVANT INFORMATION

This course is intended for graduate students. The prerequisite for understanding the course is a bachelor degree in Electrical and/or Electronic engineering.

ASSESSMENT SCHEME

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS


REFERENCES

LEARNING OBJECTIVE

The objective of this course is to provide students with a basic understanding of the integrated-circuit (IC) devices, namely the bipolar transistor and MOSFET. Some second order transistors’ effects will be discussed. The basic silicon devices processes, the working principle of CMOS logic circuits (both static and dynamic) as well as the consideration for power will all be covered. Following the basic devices, the BiCMOS devices that is used in niche areas of digital IC design, will be discussed. The issues of low voltage and low power, as well as the sensitivity analyses of BiCMOS digital circuits will all be presented. The layout design rules is also covered in the course before introducing the Sub-System Design in Digital Circuits.

In the Design Methodologies topic, the concepts on design flow, design analysis, verification, different implementation approaches, design synthesis and test methods are discussed. The objective is to provide the students with clear concepts on these topics.

All of these topics serves as important background to our present day devices and help to form a strong foundation for the learning of future newly developed semiconductor devices and their applications. Finally, this course together with the Analog IC Design course provide a comprehensive study of integrated circuit design for graduate students.

CONTENT


LEARNING OUTCOME

Students are expected to achieve a basic understanding of transistor device physics, as well as the secondary effects of these devices. They should be able to draw the layout for a block of CMOS circuit at the end of the course. The working mechanism of CMOS circuits (both static and dynamic) as well as the consideration for low power design should be better appreciated. Finally, they should be able to analyze and design digital CMOS circuits with high speed and more importantly, low power considerations. Finally, digital sub-system
design is covered to enable students to scale up from devices and circuits to digital functional modules and more complex digital integrated systems with low power consumption.

OTHER RELEVANT INFORMATION

This course is intended for graduate students. The prerequisites for understanding the course are: a bachelor degree in Physics or in Electrical and/or Electronic engineering.

ASSESSMENT SCHEME

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS


REFERENCES

OBJECTIVE

The course offers a broad range of topics for analog integrated circuits or mixed-signal integrated circuit systems, with the objective to emphasize on the topics:

1. Overview of analog IC fundamentals on components, noise and layouts
2. Theory on frequency compensation, band-gap reference and switched network fundamentals
3. Analysis of analog circuits including transfer functions and feedback mechanisms
4. Circuit design for current mirror circuits, amplifiers, continuous-time filters, switched-capacitor filters, current mode circuits and ADCs
5. Implementation of circuits and systems, with design considerations relating advantages, disadvantages and performance tradeoffs.

LEARNING OUTCOME

The learning outcomes of this subject are:

1. Understand the limitations of analog and mixed-signal integrated circuits.
2. Able to analyze analog building blocks.
3. Understand various circuit techniques for tackling different design requirements.
4. Able to design analog signal-processing blocks.
5. Understand circuit perspectives that are needed to synthesize integrated systems.

OTHER RELEVANT INFORMATION

The course serves an advanced conversion course for those who wish to gain in-depth knowledge in the integrated circuit design area or prepare for advanced research studies in a particular specialized topic.

CONTENT

ASSESSMENT SCHEME

Continuous Assessment  20%
Final Examination  80%

TEXTBOOKS

EE6401 ADVANCED DIGITAL SIGNAL PROCESSING

Acad Unit: 3
Prerequisite: Nil
Effective: Acad Year 2006/07
Last update: January 2006

OBJECTIVE
The purpose of this course is to provide in-depth treatment on methods and techniques in discrete-time signal transforms, digital filter design, optimal filtering, power spectrum estimation, multi-rate digital signal processing, DSP architectures, which are of importance in the areas of signal processing, control and communications. Applications of these methods and techniques are also presented. The intended audiences are research students and industry professionals working in the above-mentioned areas and related technical fields.

DESIRED OUTCOME
The topics covered in this course provide solid and comprehensive foundation for other more specialized areas in signal processing, control, and communications. At the end of the course, students would be able to apply fundamental principles, methodologies and techniques of the course to analyze and design various problems encountered in both academic research and industry R&D practice.

OTHER RELEVANT INFORMATION
The course requires knowledge of mathematical concepts in linear algebra and integral transform, and fundamental linear system theory.

CONTENT

ASSESSMENT SCHEME
Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS

REFERENCES
EE6402 REAL-TIME DSP DESIGN AND APPLICATIONS

Acad Unit: 3
Pre-requisite: Nil
Effective: Academic Year 2013-2014
Last update: January 2013

LEARNING OBJECTIVE

This course presents the basics of real-time signal processing using general purpose DSP and VLSI architecture. The concept of real-time processing would be emphasised in the course. Various software and hardware architectures and approaches for processing signals in real time would be discussed. Optimum general purpose DSP and VLSI system design and the trade-offs would be elaborated.

CONTENT


LAB DESCRIPTION (if applicable)

Nil

LEARNING OUTCOME

The student would understand the need of different architecture for implementing hardware systems for real-time processing. Techniques for designing systems to achieve required throughput using general purpose DSP and VLSI architecture would be acquired. In particular, basic skills required for developing and debugging of software algorithms and hardware architecture for system design would be achieved. These skills are useful in real-time system design in industrial applications.

STUDENT ASSESSMENT

Continuous Assessment 30%
Final Examination 70%

TEXTBOOKS


REFERENCES

LEARNING OBJECTIVE

This course aims at providing students with a good understanding of the basic concepts, technologies, and applications of distributed multimedia systems. Students will learn different important aspects of distributed multimedia systems including media systems, compression and standards, processing and storage, transmission and delivery, quality of service, and applications.

CONTENT


LAB DESCRIPTION (if applicable)

Nil

LEARNING OUTCOME

After the course, students are expected to have a good understanding of distributed multimedia systems and technologies, and be able to apply the concepts and techniques learned to practical applications.

STUDENT ASSESSMENT

Continuous Assessment  20%
Final Examination     80%

TEXTBOOKS


REFERENCES

EE6424 DIGITAL AUDIO SIGNAL PROCESSING

Acad Unit: 3
Pre-requisite: Nil
Effective: Academic Year 2013-2014
Last update: January 2013

LEARNING OBJECTIVE

Speech and audio are the most natural means of human communication. With the rapid advancement of technology, digital processing of speech and audio signals is becoming more popular. The first objective of this course will be to enable the students to understand how sound is perceived and the other objectives will be learning how various signal processing techniques can be applied to compress, enhance and recognize digital audio and speech signals.

CONTENT


LAB DESCRIPTION (if applicable)

Nil

LEARNING OUTCOME

Upon completion of the course, the students should have a basic knowledge of the various signal processing techniques taught so that they can contribute positively to research organizations or companies in the fields of telecommunication, signal processing and information technology.

STUDENT ASSESSMENT

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS

REFERENCES

EE6427 VIDEO SIGNAL PROCESSING

Acad Unit: 3
Pre-requisite: NIL
Effective: Academic Year 2013-2014
Last update: January 2013

LEARNING OBJECTIVE

The objective of this course is to provide students with knowledge in image and video signal processing. This course focuses on advanced topics in image and video processing, especially on the image filter, image and video compression, and some international standards for image and video processing. All of these topics are important to the understanding of image and video technologies and applications.

CONTENT


LAB DESCRIPTION (if applicable)

Nil

LEARNING OUTCOME

Through this course, students are expected to gain in-depth knowledge of image and video compression, and some international standards for image and video processing. Besides, it is hoped that through learning the theories, it may help students to develop some state-of-the-art image and video processing applications. This course will also arouse students’ interest in the course and further motivate them towards developing their career in the area of multimedia processing.

STUDENT ASSESSMENT

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS

REFERENCES

OBJECTIVE

The objective of this course is to familiarize the participating individuals with advanced aspects of power electronic converters. In order to provide a comprehensive understanding, coverage would be provided from basic device levels to advanced power electronic converters. Control aspects would be highlighted, and practical case studies would be discussed.

DESIRED OUTCOME

Having graduated from this course, an individual is expected to gain a good understanding of the theory and industrial applications of semiconductor devices, their protection aspects, and their applications in power conversion schemes. This would prepare the individual for R&D careers in utilities or in industries dealing with advanced power electronic equipment.

OTHER RELEVANT INFORMATION

This course is aimed at graduate students or engineers already working in related fields. Prior knowledge of power, electronics and control theory at the undergraduate level is required.

CONTENT

Introduction. AC-to-DC Converters. DC-to-DC Converters. DC-to-AC Converters.

ASSESSMENT SCHEME

Continuous Assessment  20%
Final Examination      80%

TEXTBOOK


REFERENCES

OBJECTIVE
The objective of this course is to familiarize the participating students with modern industrial electric drives. In order to provide a detailed understanding of industrial drive systems, the theory of operation, modeling and control of various types of commonly used industrial drives will be introduced. It also aims to broaden a student’s knowledge with the application of power electronic converters and inverters in controlling modern drive systems.

DESIRED OUTCOME
Graduates of this course are expected to gain a good understanding of the principle of operation, dynamic and steady-state modeling and controlling methods of modern electric drives. Furthermore, they will be at ease in dealing with almost all commonly used power electronic converters in drive systems. The course will prepare them to embark on a career in the area of electric drives or in power electronics. It will also prepare the students for high level R&D in these areas.

OTHER RELEVANT INFORMATION
This course is aimed at graduate students or engineers already working in related fields. Prior knowledge of power, motors, power electronics and control theory at the undergraduate level is expected.

CONTENT

ASSESSMENT SCHEME
Continuous Assessment 20%
Final Examination 80%

TEXTBOOK

REFERENCES
OBJECTIVE

The objective of this course is to instil participating individuals with an in-depth knowledge in power quality. With reliability and availability largely guaranteed, power quality is becoming the primary concern in electric power distribution systems. This module introduces the new concept of power quality and quantifies the power quality disturbances that fall within the wider umbrella of electromagnetic phenomena. It aims to provide a strong foundation for a better understanding of the fundamentals behind each power quality problem in addition to reaching for innovative and economical solutions.

DESIRED OUTCOME

Graduates of this module shall possess the necessary skills to handle power quality related problems. This involves identifying the cause or source of the problem and assessing the severity of each problem with respect to the vulnerability of the affected devices. Computer modelling and simulations for examining the system responses or to evaluate the effectiveness of various solutions are essential skills imparted to the participants. As technology advances and equipment become more sensitive, new innovative ideas and approaches are needed to arrive at the most economical solutions. Graduates expected to be conversant with power quality terminologies, and ready to tackle power quality related challenges.

OTHER RELEVANT INFORMATION

This course is aimed for graduate students and/or practicing engineers working in electric power distribution related fields. Some knowledge of fundamentals of power systems and engineering mathematics is expected.

CONTENT


ASSESSMENT SCHEME

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS


REFERENCES

LEARNING OBJECTIVE

The objectives of this course are to learn about the issues in renewable energy systems and distributed generation. It covers the understanding and design of distributed generation systems based on solar photovoltaics, wind turbines, fuel cells, micro-turbines and micro-hydro generation. These systems can be connected to the utility grid or to a microgrid. The course will cover various types of energy storage devices. The course will also introduce various smart grid technologies, including advanced metering infrastructure, demand side management, demand response management and electric vehicles. These technologies are focused on providing efficient and environmentally friendly electric energy solutions that can help in improving energy efficiency and reducing energy consumption.

CONTENT


COURSE OUTLINE

This course is aimed for graduate students or engineers already working in related fields and is designed to provide key concepts of power systems, distributed generation, energy storage and smart grids. The first topic introduces the basic knowledge of power systems with distributed generation and the concepts of microgrids and smart grids. The second topic enables students to grasp basic principles and applications of different distributed generation systems. The third topic introduces the knowledge on energy storage devices which are used in power systems. The fourth topic provides students with an understanding of various smart grid technologies. Prior knowledge of power systems, power electronics, electrical machines and control theories at the undergraduate level will be helpful.

LEARNING OUTCOME

The students can easily appreciate that engineering for sustainability is an emerging theme and that the need for more environmentally friendly electrical energy systems is an important part of the global trend. The students will learn that distributed generation systems in microgrids can offer increased reliability and reduced network losses. The students will also understand that renewable energy systems based on energy sources such as solar and wind do
not diminish over time and are independent of fluctuations in fuel price. The students will also gain insight into different energy storage devices and their applications. The course will equip students with the concepts and technologies of the smart grid. The students will also be able to acquire the knowledge of current research, and the critical issues in the development and deployment of the smart grid.

**ASSESSMENT SCHEME**

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<td>Final Examination</td>
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**TEXTBOOK**

1. S. Chowdhury, S. P. Chowdhury, and P. Crossley, Microgrids and Active Distribution Networks, Institution of Engineering and Technology, 2009. (NTU eBook Collection)

**REFERENCES**

OBJECTIVE

The objective of this course is to impart to the students the knowledge relevant to power system planning and operations. The course will provide in-depth coverage of all essential aspects of power system operation and planning including load forecasting, generation scheduling, network operation, probability and reliability, generation planning and transmission planning.

DESIRABLE OUTCOME

The knowledge gained in this course should enable the participants to understand the important functions and issues involved in different activities associated with power system operation and planning. It will provide the fundamental concepts and techniques required to deal with all the issues in power system planning and operation functions. The knowledge gained will also serve as an excellent starting point for graduate students interested in conducting research in various aspects of power systems.

OTHER RELEVANT INFORMATION

This course is designed for graduate level study. Therefore, a good understanding of power system fundamentals and engineering mathematics is the recommended prerequisite for the course.

CONTENT


ASSESSMENT SCHEME

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS


REFERENCE

OBJECTIVE
The objective of this course is to provide the attendees with comprehensive knowledge on power system modelling and control. This would include modelling of power networks, generating units and loads, the fundamental concept of power system stability and methods of analysis along with control techniques for stability enhancement. Knowledge on advanced methods based on FACTS would also be discussed. It also aims to equip the attendees with an in-depth understanding of the practical issues related to the control of power systems and an awareness of the advanced modeling, analysis and control techniques applicable to power systems.

DESIRED OUTCOME
The attendees of this course are expected to gain a sound understanding of the characteristics and modeling process of synchronous machines and system loads in power system stability studies, their uses in the design of controllers and development of techniques for assessment and improvement of system performance under steady state, dynamic and transient conditions. The concepts of operation, modeling and control of power electronics-based FACTS devices will also give the attendees an understanding of how FACTS devices enhance power network performance. Case studies will provide the attendees with an insight into the actual application of modeling and control techniques in solving practical issues in power systems. The knowledge gained will also serve as an excellent starting place for graduate students interested in carrying out research in various aspects of power engineering.

OTHER RELEVANT INFORMATION
This course is designed for graduate students and engineers in the electric power industry. It is also intended for engineers who anticipate future involvement in this area. Prior knowledge of power system analysis and control at the undergraduate senior level is expected.

CONTENT

ASSESSMENT SCHEME
Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS

REFERENCE
OBJECTIVE

1. To study deep sub-micron front end process technology
2. To study deep sub-micron back end process technology
3. To study characterization techniques relevant to deep sub-micron process technology

LEARNING OUTCOME

The students will be exposed to state-of-the-art advanced CMOS process technologies. They will also be exposed to future technology. They will also become more familiar with the relevant diagnostic techniques for process related issues.

OTHER RELEVANT INFORMATION

Prior knowledge required: some basic knowledge of MOSFETs and CMOS technology
Level of difficulty: medium
Mathematics: simple

CONTENT


ASSESSMENT SCHEME

Continuous Assessment: 20%
Final Examination: 80%

TEXTBOOKS

REFERENCES

OBJECTIVE

This course aims to provide a basic coverage of theory and practices on methods of achieving high quality and reliability in products and processes that are necessary for technology and engineering management with examples from the electronic industry.

DESIRED OUTCOME

Students are expected to acquire working knowledge and essential techniques on the statistics for quality and reliability, statistical process control, and design of experiments.

OTHER RELEVANT INFORMATION

A basic course at undergraduate level in engineering statistics or equivalent is required.

CONTENT


ASSESSMENT SCHEME

Continuous Assessment: 20%
Final Examination: 80%

REFERENCES

OBJECTIVE

This course is intended for beginning graduate students and practicing R&D engineers and will cover the basic principles of operation of the bipolar junction transistor (BJT) and the metal oxide semiconductor field effect transistor (MOSFET). The applications of the MOSFET in semiconductor memory will be described. More recent developments in heterojunction devices will also be presented. In addition, some new semiconductor devices and future trends will also be introduced.

DESIRED OUTCOME

- To understand in detail the fundamental principles of operation and electrical characteristics of BJTs and MOSFETs.
- To understand the principles of operation and challenges of the newer semiconductor devices and to be able to apply them to the design of different devices for different specifications.

OTHER RELEVANT INFORMATION

The students intending to study this course should have taken undergraduate courses related to semiconductor fundamentals and engineering mathematics.

CONTENT


ASSESSMENT SCHEME

Continuous Assessment 20%
Final Examination 80%

TEXTBOOK

REFERENCES

LEARNING OBJECTIVE

This course aims to provide a deep understanding of the fundamental principles underlying the core technology of integrated circuit (IC) packaging for graduate students, and build-up their ability in IC packaging design, materials, thermal management, fabrication and characterization. The course will also provide essential basic principles in novel areas, such as MEMS, microfluidics and biosensors.

CONTENT


COURSE OUTLINE

This course covers the essential principles, techniques and examples of practical usage of both essential and advanced packaging methods. These will cover a large range, from standard applications (such as IC packaging which is very relevant and widely used in industry) to novel specialized applications (such as MEMS and biosensors) and to modern trends such 3D systems, stacking, multichip and systems-on-chip packaging.

LEARNING OUTCOME

Students will acquire the knowledge of packaging principles of many various types of ICs and microsystems. The target is for the students to understand not only how traditional IC packaging is done and what techniques are used for this purpose, but also to learn about and assimilate other advanced applications, such as multichip packaging; system-on-chip packaging; 3D & stacking solution; MEMS, microfluidics & biosensors packaging. This will form a solid know-how base with notions relevant for practical applications in both industry and research.
ASSESSMENT SCHEME

Continuous Assessment: 20 %
Final Examination: 80%

TEXTBOOKS

REFERENCES
LEARNING OBJECTIVES

- To study state-of-the-art optoelectronic devices for lighting and displays with an emphasis on innovation.
- To inspire innovation by walking students through generations of devices.
- To develop a good understanding and deep appreciation of the device architecture and operating principles of LEDs and major display technologies.

CONTENT


COURSE OUTLINE

The course provides the students with both fundamental concepts and technological advances in lighting and displays. The course bridges between the fundamentals and applications related to lighting and displays. The course covers the review of physics for optoelectronic processes and structures and background optics related to lighting and displays as well as the review of lighting and display technologies. It spans light-emitting diodes operating principles and lighting metrics. Among various lighting and display technologies covered in the course are plasma display panels, field emission displays, liquid crystal displays, inorganic light-emitting diodes, organic light-emitting devices, and electroluminescent displays, and electrochromic displays.

In each technology covered in the course, the basic device structure and the operation principles are studied. The advantages and disadvantages offered by each technology are related to the basic device operation. Discussing generations of devices in each technology innovation is emphasized.

LEARNING OUTCOME

Through this course, the students are expected to acquire a thorough understanding of light-emitting diodes (LEDs), plasma display panels (PDPs), field emission displays (FEDs), liquid crystal displays (LCDs), organic light-emitting devices (OLEDs), electroluminescent displays
ELDs), and electrochromic displays (ECDs). Other desired learning outcomes of the course include a high level of technical competence in the state-of-the-art device architecture and operating principles of lighting and major display technologies and ability to evaluate and compare lighting and display technologies.

**ASSESSMENT SCHEME**

Continuous Assessment 20%
Final Examination 80%

**TEXTBOOKS**

EE7101 INTRODUCTION TO INFORMATION AND CODING THEORY

Acad Unit: 3
Pre-requisite: EE6101
Effective: August 2012
Last update: 5 March 2012

LEARNING OBJECTIVE

• To provide students with a good understanding of the fundamental principles of information theory, with emphasis on the concepts of entropy, mutual information, the asymptotic equipartition property (AEP), and channel capacity, as well as applications in data compression and channel coding.
• To provide students the fundamentals of classical and modern coding theory, with emphasis on linear block codes, convolutional codes, turbo codes, and low-density parity-check (LDPC) codes

CONTENT


LEARNING OUTCOME

Students taking this course will be equipped with a good knowledge and understanding of information theory, coding theory and their applications, including data compression, characterization of channel capacities, and various classical and modern error correction coding techniques. This course aims to prepare them well for further studies and research in digital communications and data storage systems.

STUDENT ASSESSMENT

Continuous Assessment 50%
Final Examination 50%

TEXTBOOKS

REFERENCES

OBJECTIVE

The course is designed to present a broad overview of computational methods for postgraduate studies in engineering. It gives the students a general but deeper understanding of numerical techniques available for solving mathematical problems in various categories, such as linear algebra, least squares, optimization, statistical decisions, stochastic simulations and differential equations, which are very commonly encountered in current engineering applications.

DESIRED OUTCOME

By mastering the underlying principles of the computational methods introduced in this course, the students should be aware of the relevant issues in selecting appropriate methods and using them wisely in a wide range of engineering applications, and be able to formulate the problems and interpret the results properly.

OTHER RELEVANT INFORMATION

This course is meant for postgraduate students in all branches of engineering. Basic knowledge of Linear Algebra, Multivariable Calculus, Probability/Statistics and Differential Equations is desirable.

CONTENT


ASSESSMENT SCHEME

Continuous Assessment 20%
Final Examination 80%

TEXTBOOK


REFERENCES

3. S. Boyd, L. El Ghaoui, E. Feron, and V. Balakrishnan, Linear Matrix Inequalities in System and


EE7204  LINEAR SYSTEMS

Academic Unit :  3.0.
Prerequisite :  Nil
Effective :  Acad Year 2006/07
Last update :  April 2006

OBJECTIVE

Linear system theory is the core of modern control and signal processing. It has applications in control, signal processing and communications. The aim of this course is to equip students with a solid understanding of the fundamentals of linear systems analysis and design using the state space approach.

DESIRABLE OUTCOME

On completion of the subject, students will have a fundamental understanding of linear systems theory and will be able to apply linear system analysis and design tools to various engineering problems.

OTHER RELEVANT INFORMATION

Minimum requirement for the course is some background in signals and systems and linear algebra.

CONTENT


ASSESSMENT SCHEME

Continuous Assessment  20%
Final Examination  80%

TEXTBOOK


REFERENCES

Objective

In this course, the students will learn the basic skills that are essential to becoming a successful researcher. The objective of the course is to teach research skills in a systematic fashion, early in a student’s graduate program. Lecture topics will include research methodology, experimental design, professional ethics and academic integrity, and oral and written presentation techniques. Students will be required to perform a literature survey (on a topic in their own research area), construct a research proposal that includes an experimental design, and write a paper summary in the style of a formal scientific paper.

Desired Outcome

On successful completion of the course, students should be able to
- Explain the reasons for undertaking research
- Produce a simple project proposal
- Understand the purposes of studying the literature and be able to undertake a literature search
- Plan experiments, taking into consideration the health and safety aspects as well as the scientific requirements
- Present data appropriately and deal with errors (in a simple manner)
- Understand the differing requirements for reporting research in a variety of formats

Appreciate the requirements and opportunities for protecting and exploiting research.

Other Relevant Information

Intensive three hours per week teaching period of lectures and tutorials, followed by assessment package of a nominal xx hours work, to be submitted before the end of the course week.

Content


Assessment Scheme

Continuous Assessment  50%
Final Examination  50%
REFERENCES

LEARNING OBJECTIVE

This course is intended to provide PhD students with an in depth understanding of the fundamental theories and learning methods, as well as advanced issues of neural networks and fuzzy logic systems. After the course, the students will be able to apply the learned knowledge to solve problems in their respective research fields.

CONTENT


LEARNING OUTCOME

1. Gain an in depth understanding of fundament theories, learning methods and advanced issues of neural network and fuzzy logic.
2. Be able to apply the learned knowledge of neural and fuzzy systems to solve their research problems.

STUDENT ASSESSMENT

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS

EE7401  PROBABILITY AND RANDOM PROCESSES

Acad Unit: 3.0  
Prerequisite: Nil  
Effective: Acad Year 2006/07  
Last update: March 2006

OBJECTIVE

The aim of this course is to introduce the concepts and computational tools of probability and random processes to the solution of problems that occur in the analysis of signals and systems. The intended audience consists of research students primarily working in signal processing, detection, estimation, and pattern classification. It is assumed that students of this course have minimum background in probability theory but wish to study subjects such as communication engineering, information theory, noise theory, reliability theory, or random vibrations in which probabilistic methods are applied. The emphasis will be on material that has direct application to important engineering systems such as radar, sonar and communications.

DESIRED OUTCOME

After completing this course, the student will have

- gained some familiarity with the application of probability and random processes in engineering problems,
- a working knowledge of some probabilistic and stochastic computational tools, and
- the ability to do performance calculations, such as the receiver operating characteristic of communication and detection systems.

OTHER RELEVANT INFORMATION

The student will need to have a mathematical background that includes calculus and some linear algebra, as well as some exposure to signal analysis and linear systems.

CONTENT


ASSESSMENT SCHEME

Continuous Assessment 20%  
Final Examination 80%

TEXTBOOK

REFERENCES

LEARNING OBJECTIVE

This course serves as an introduction to the field of statistical signal processing. It aims at covering certain basic techniques of signal detection and estimation, and adaptive filtering. These are the essential techniques that have been used in many application fields such as signal processing, controls and communications.

CONTENT


LAB DESCRIPTION (if applicable)

Nil

LEARNING OUTCOME

The basic concepts and techniques to be taught at a sufficient depth to enable the students to have enough background for practical applications or for better understanding their application fields such as signal processing, controls and communications. The learning outcome would be that the student is fully equipped with the theoretical background to select suitable algorithms for their applications and to be well equipped to pursue R & D work.

STUDENT ASSESSMENT

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS


REFERENCES

LEARNING OBJECTIVE

Understanding the fundamental yet critical methods of automatic image analysis and pattern recognition by computers/machines. Acquiring foundations for further topics such as computer vision, machine learning, data mining and artificial intelligence.

CONTENT


LAB DESCRIPTION (if applicable)

Nil

LEARNING OUTCOME

Students of this course will be trained to have the ability of utilizing mathematics to solving real-world problems in the area of image analysis and pattern recognition. Students will learn solid fundamentals in image processing and analysis, statistical estimation, machine learning, pattern recognition and classification.

STUDENT ASSESSMENT

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS

REFERENCES

LEARNING OBJECTIVE
This course aims to provide a deep understanding of the fundamental principles underlying the core technology of electronic devices for graduate students, and build-up strong fundamental knowledge in device design, fabrication and analysis.

CONTENT

COURSE OUTLINE
This course covers all important aspects of electronic devices from design, fabrication, characterization and applications.
In order to follow this course, students should have a good background in electronic and microelectronics, materials and semiconductor processes, basic concepts in applied physics and electronic design and fabrication.

LEARNING OUTCOME
After pursuing the course, graduate students are expected to gain a good knowledge in the fundamental theories, design, simulation, and fabrication processes related to electronic devices.

STUDENT ASSESSMENT
Continuous Assessment: 20 %
Final Examination: 80 %

REFERENCES
EE7603 ADVANCED SEMICONDUCTOR PHYSICS

Acad Unit: 3
Pre-requisite: Fundamentals of semiconductor materials/devices
Effective: AY13/14
Last update:

LEARNING OBJECTIVE

The course provides the students with profound knowledge of semiconductor physics, including the following topics of crystal structures, the energy bands of semiconductors, doping and carrier concentrations, low dimensional systems, electrical transport phenomena, excess carriers and optical properties of semiconductors, etc.

CONTENT


COURSE OUTLINE

This course is divided into 7 topics. The topics of crystal structure and low dimensional systems serve as the fundamentals for semiconductors. The topics of energy bands of semiconductors and doping and carrier concentrations discuss the electronic properties which make semiconductors different from metals and insulators. In the topic of electrical transport phenomena, carrier transport in electric field and magnetic field and carrier diffusion are analyzed. The topic of excess carriers addresses carrier recombination, continuity equations, etc. Electron-photon interaction and light absorption in semiconductors will be studied in the last topic of optical properties.

LAB DESCRIPTION

Nil

LEARNING OUTCOME

Through this course, the students are expected to acquire a thorough understanding of semiconductor physics principles and to solve the problems encountered in the study of semiconductor materials and devices independently.

ASSESSMENT SCHEME

Continuous Assessment 20%
Final Examination 80%

Updated as at 25 June 09
TEXTBOOKS


REFERENCES

LEARNING OBJECTIVE

The course aims to introduce students the operation principles and useful techniques of lasers. It will provide advanced knowledge in the topics of laser fundamentals, laser technology, and laser system design. In addition, some applications of lasers in scientific research, industrial material processing and medical treatment will also be addressed.

CONTENT


COURSE OUTLINE

This course is divided into 7 topics. The topics of laser fundamentals, laser resonators, laser oscillation and laser system design cover the basic properties and operation principles of lasers. The topic of laser techniques discusses the various useful laser engineering and methods for achieving special laser functions, including the tunable lasers, femtosecond lasers. In the topic of semiconductor lasers, the properties of the semiconductor gain media, the various types of semiconductor lasers are summarized. In the last topic, major applications of lasers in different fields are outlined.

LAB DESCRIPTION

Nil

LEARNING OUTCOME

On completing the course the students will gain a clear understanding on the laser physics and engineering, modern laser technology, and the various practical laser applications. It is expected that the students will acquire the knowledge which allows them to independently solve most of the laser related problems encountered in their workplace.

ASSESSMENT SCHEME

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TEXTBOOK


REFERENCES

LEARNING OBJECTIVE

The course covers analog behavior of digital system under high-speed operation. The focus is restricted to the interconnects, drivers and receivers. This course aims to provide knowledge on the following important topics:

(1) Introduction to modeling and characterization of output buffers and receivers for analysis and design of digital system under high-speed operation.

(2) Introduction to modeling of interconnects including model reduction techniques, in PCB as well as in integrated circuits.

(3) Analysis of transmission lines and termination.

(4) Introduction to signal integrity issues due to non-ideal interconnects and buffers, timing, clock distributions and power distribution network fluctuation.

CONTENT


COURSE OUTLINE

This course is divided into 4 topics. The topics of “High Speed Properties of Logic Gates” (6 hours) and “Modeling and Analysis of Interconnections” (6 hours) serve as the fundamentals. The topics of "Transmission Lines and Terminations" (9 hours), "Power Distribution Networks and Ground Planes" (6 hours) and "Clock Distribution" (6 hours) discuss how the interconnects affect the electrical performance of the system in terms of reflections, cross talk, timing failures and rail collapse in the power distribution.

LEARNING OUTCOME

“Signal Integrity” is a high-speed design practice that ensures the transmitted signals are received correctly at the receiver. In physical design, it is about meeting voltage and timing
specifications to prevent circuit failure and intermittent errors. Signal Integrity is a field of study involving not only high-speed digital design but also analog design with operating frequency overlapping into the radio frequency (RF) design arena. It is about signal waveform quality, signal coupling, power distribution network and even electromagnetic interference (EMI) compliance to ensure proper functioning of the high-speed design. The desired outcomes of the course are:

(1) A good understanding of the topics listed in the objectives listed above.

(2) A high level of technical competence in analysis signal integrity problems and using contemporary SI tools.

(3) Ability to design system interconnects.

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TEXTBOOKS


REFERENCES

EE7606 ADVANCES IN NANOELECTRONICS

Acad Unit: 3
Pre-requisite: Fundamentals of semiconductor materials/devices
Effective: AY2014-15 S2
Last update: October 2013

OBJECTIVE

- To study the fundamentals and electronic applications of semiconductor nanostructures.
- To have a deep understanding of major challenges in nanoscale MOS technologies.
- To learn the technologies of synthesis, characterization and manipulation of nanostructured semiconducting materials.

DESIRED OUTCOME

Through this course, the students are expected to acquire a thorough understanding of major challenges in nanoscale MOS technologies and to study the fundamentals and electronic applications of semiconductor nanostructures. They should be aware of state-of-the-art technologies of synthesis, characterization and manipulation of nanostructured semiconducting materials.

OTHER RELEVANT INFORMATION

This course contains 5 topics. The topic of low dimensional systems (6 hrs) serves as the fundamentals for nanoelectronics. In the second topic (6 hrs), the technical challenges in the transition from micrometer MOS to nanometer MOS are discussed. Several widely used characterization and patterning techniques are studied in the third topic (6 hrs). In Topics 4 and 5 (21 hrs), the physical properties and potential electronic applications of carbon nanotubes, graphene, silicon nanowires and metal oxides nanostructures are studied.

CONTENT


ASSESSMENT SCHEME

Continuous Assessment 20%
Final Examination 80%
REFERENCES

LEARNING OBJECTIVE

The course is intended for the research students. It provides both fundamental and advanced knowledge of the diffraction theory of light and the working principles of a number of important optical techniques such as wavefront modulation, holography, and optical spectroscopy. In addition, an introduction to two key nanophotonic instrumentation techniques, i.e. the scanning near field optical microscopy (SNOM) and photonic crystals are also included.

CONTENT


LEARNING OUTCOME

Students will acquire the basic knowledge on wave optics and understand the working principles of many optical methods and techniques used for nanotechnology research. Thus they will be able to select the most suitable approach in their research, and solve the optical problems encountered either in their academic research or in the workplaces.

STUDENT ASSESSMENT

Continuous Assessment 40%
Final Examination 60%

TEXTBOOKS

REFERENCES