EE6XXX Series (AY 2014-15) – Course Syllabus

COURSE CODE	COURSE TITLE	SEMESTER	
		1	2
EE6010	PROJECT MANAGEMENT & TECHNOPRENEURSHIP		X
EE6101	DIGITAL COMMUNICATION SYSTEMS	X	
EE6108	COMPUTER NETWORKS	X	
EE6122	OPTICAL FIBRE COMMUNICATIONS		X
EE6128	RF CIRCUITS FOR WIRELESS COMMUNICATIONS	X	
EE6129	WIRELESS AND MOBILE RADIO SYSTEMS		X
EE6130	ANTENNAS AND PROPAGATION FOR WIRELESS SYSTEMS		X
EE6203	COMPUTER CONTROL SYSTEMS	X	
EE6204	SYSTEMS ANALYSIS		X
EE6221	ROBOTICS AND INTELLIGENT SENSORS		X
EE6222	MACHINE VISION	X	
EE6223	COMPUTER CONTROL NETWORKS		X
EE6225	PROCESS CONTROL	X	
EE6303	ELECTROMAGNETIC COMPATIBILITY DESIGN	X	
EE6306	DIGITAL IC DESIGN	X	
EE6307	ANALOG IC DESIGN		X
EE6401	ADVANCED DIGITAL SIGNAL PROCESSING	X	
EE6402	REAL-TIME DSP DESIGN AND APPLICATIONS	X	
EE6403	DISTRIBUTED MULTIMEDIA SYSTEMS		X
EE6424	DIGITAL AUDIO SIGNAL PROCESSING		X
EE6427	VIDEO SIGNAL PROCESSING	X	
EE6501	POWER ELECTRONIC CONVERTERS	X	
EE6503	MODERN ELECTRICAL DRIVES		X

COURSE CODE	COURSE TITLE	SEMESTER	
		1	2
EE6508	POWER QUALITY		X
EE6509	RENEWABLE ENERGY SYSTEMS IN SMART GRIDS	X	
EE6510	POWER SYSTEM OPERATION AND PLANNING	X	
EE6511	POWER SYSTEM MODELLING AND CONTROL		X
EE6601	ADVANCED WAFER PROCESSING		X
EE6602	QUALITY AND RELIABILITY ENGINEERING		X
EE6604	ADVANCED TOPICS IN SEMICONDUCTOR DEVICES	X	
EE6610	INTEGRATED CIRCUIT (IC) PACKAGING		X
EE6808	LED LIGHTING AND DISPLAY TECHNOLOGIES	X	

EE7XXX Series (AY 2014-15) – Course Syllabus

COURSE CODE	COURSE TITLE	SEMESTER	
		1	2
EE7201	COMPUTATIONAL METHODS IN ENGINEERING		X
EE7204	LINEAR SYSTEMS	X	
EE7205	RESEARCH METHODS		X
EE7207	NEURAL AND FUZZY SYSTEMS	X	
EE7401	PROBABILITY AND RANDOM PROCESSES	X	
EE7402	STATISTICAL SIGNAL PROCESSING		X
EE7403	IMAGE ANALYSIS AND PATTERN RECOGNITION		X
EE7602	DESIGN, FABRICATION AND ANALYSIS OF ELECTRONIC DEVICES		X
EE7603	ADVANCED SEMCONDUCTOR PHYSICS		X
EE7604	LASER TECHNOLOGY	X	

COURSE CODE	COURSE TITLE	SEMESTER	
		1	2
EE7605	SIGNAL INTEGRITY IN HIGH-SPEED DIGITAL SYSTEMS	X	
EE7606	ADVANCES IN NANOELECTRONICS	X	
EE7607	MODERN OPTICS	X	

EE6010 PROJECT MANAGEMENT AND TECHNOPRENEURSHIP

Academic Unit: 3.0
Pre-requisite: Nil
Effective: Academic Year 2013-2014
Last update: February 2013

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

Project Initiation and Planning. Project Scheduling and Implementation. Project Monitoring, Control and Evaluation. Innovation and Entrepreneurship.

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

1. Claude H. Maley, Project Management Concepts, Methods, and Techniques, 1st Edition, Auerbach Publications, 2012. (NTU eBook Collection)

REFERENCES

1. J. R. Bessant, Innovation and Entrepreneurship, 2nd Edition, John Wiley and Sons, 2011. (HD53.B557 2011)
2. James P. Lewis, Fundamentals of Project Management, 3rd Edition, American Management Association, 2007. (HD69.P75L674f 2007)

EE6101 DIGITAL COMMUNICATION SYSTEMS

Acad Unit: 3
Prerequisite: Nil
Effective: Acad Year 2004/2005
Last update: July 2004

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

Communication signals and baseband transmission. Digital modulation/demodulation. Error correction coding. Spread-spectrum techniques.

ASSESSMENT SCHEME

Continuous Assessment: 20%
Final Examination: 80%

TEXTBOOK

1. Sklar, Bernard, Digital Communications, 2nd edition, Prentice-Hall, 2001

REFERENCES

1. Proakis, John G, Digital Communications, 4th edition, McGraw Hill, 2001
2. Glover, Ian and Grant, Peter, Digital Communications, Prentice-Hall, 1998
3. Rhee, M Y, Error-Correcting Coding Theory, McGraw-Hill, 1989

EE6108 COMPUTER NETWORKS

Acad Unit:	3
Prerequisite:	Nil
Effective:	Acad Year 2000-2001
Last update:	Oct 2002

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

Network protocols and services. Transport protocols and services. Local area networks. Wide area networks and internetworking. Broadband and Asynchronous Transfer Mode (ATM) networks.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOKS

1. Andrew S Tanenbaum, Computer Networks, 3rd Edition, Prentice Hall, 1996.
2. Rainer Handel, Manfred N Huber and Stefan Schroder, ATM Networks: Concepts, Protocols, Applications, 3rd Edition, Addison Wesley, 1998.

REFERENCES

1. James Martin, Local Area Networks: Architecture and Implementations, 2nd edition, Prentice Hall, 1994.
2. T.N. Saadawi, M.H. Ammar and A.El. Hakeem, Fundamentals of Telecommunication Networks, John Wiley & Sons, 1994.
3. W. Richard Stevens, TCP/IP Illustrated, Volume 1: The Protocols, Addison Wesley, 1994.

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

Optical fibre fundamentals. System components. Optical fibre transmission systems. WDM systems and subsystems. Optical networks. Measurement techniques.

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

1. Keiser Gerd, Optical Fibre Communications, 3rd Edition, McGraw Hill, 2000.
2. Powers John, An Introduction to Fiber Optics Systems, 2nd Edition, McGraw Hill, 1999.
3. Palais Joseph C, Fibre Optic Communications, 4th Edition, Prentice Hall, 1998.
4. Rajiv Ramaswami and Kumar N. Sivarajan, Optical Networks – A Practical Perspective, 2nd Edition, Morgan Kaufmann Publishers, 2002.

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

Microstrip Line and Network Parameters. Microwave Power Dividers and couplers. Microwave Filters. Amplifiers. Oscillators and Synthesizers. Detectors and Mixers. Frequency Multipliers and Control Circuits. RF Receiver Design

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

1. D.M. Pozar, Microwave Engineering, John Wiley & Sons, USA, 2005.
2. .U.L. Rohde and D.P. Newkirk, RF/Microwave Circuit Design for Wireless Application. John Wiley, USA, 2009

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REFERENCES

1. D.M. Pozar, Microwave and RF design of Wireless Systems, John Wiley, USA, 2001.
2. D. Razavi, RF Microelectronics, Prentice Hall, USA, 1998.

3. G. Gonzale, Microwave Transistor Amplifiers: Analysis and Design, Prentice Hall, USA, 1997.
4. K. Chang, Microwave Solid-State Circuits and Applications, John Wiley, USA, 1994

EE6129 WIRELESS AND MOBILE RADIO 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 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

Wireless channel models. Fading and ISI mitigation techniques. Cellular concept and Multiple access techniques. Satellite communications.

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

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005.
2. Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communications, John Wiley, 2nd edition, 2003.

REFERENCES

1. Simon Haykin, Michael Moher, Modern Wireless Communications, Pearson Prentice-Hall, 2005.
2. Theodore S. Rappaport, Wireless Communications - Principles and Practice, Pearson Prentice-Hall, 2nd edition, 2002.

EE6130 ANTENNAS AND PROPGATION 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

Review of EM Theory and Basic Antenna Parameters. Wire and Aperture Antennas. Planar Antenna and Antenna Arrays. Small Antennas and Antenna Measurements. Principles of Radio Wave Propagation. Ground Wave and Ionospehric Propagation. Mobile Communication Channel.

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

1. C. A. Balanis, Antenna Theory and Design, John Wiley & Sons Inc., 3rd Edition, 2005.
2. R. L. Freeman, Radio System Design for Telecommunications, John Wiley, 2nd Edition, 1997.

REFERENCES

1. J. D. Kraus and R. J. Marhefka, Antennas for All Applications, 3rd Edition, McGraw-Hill, 2003.
2. C. A. Levis, J. T. Hohnson, and F. L. Teixeira, "Radiowave Propagation: Physics and Applications, John Wiley & Sons, 2010.

EE6203 COMPUTER CONTROL SYSTEMS

Acad Unit:	3.0
Prerequisite:	NIL
Effective:	Acad Year 2000-2001
Last update:	20 March 2000

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

Discrete-time system modeling and analysis. Cascade compensation. State-space design methods. Optimal control. Design and implementation of digital controllers.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOK

1. Kuo B. C., Digital Control Systems, 2nd Edition, Saunders College Publishing, 1992.

REFERENCES

1. Franklin G. F., Powell J. D. and Workman M. L., Digital Control of Dynamic Systems, Addison-Wesley, 1990.
2. Middleton R. H. and Goodwin G. C., Digital Control and Estimation - A Unified Approach, Prentice-Hall, 1990.

EE6204 SYSTEMS ANALYSIS

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

CONTENT

Linear, Dynamic and Integer Programming. Optimization Techniques. Random Processes. Queuing Models. Markov Decision Process.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOKS

1. Taha H. A., Operations Research: an Introduction, 9th Edition, Prentice Hall, 2010.
2. Puterman, Martin L., Markov Decision Processes: Discrete Stochastic Dynamic Programming (Wiley Series in Probability and Statistics), John Wiley & Sons, 2005.

REFERENCES

1. Frederick S. Hillier and Gerald J. Lieberman, Introduction to Operations Research, 9th Edition, McGraw Hill, 2010.
2. Viswanadham N. and Narahari Y., Performance Modeling of Automated Manufacturing Systems, Prentice Hall, 1992.
3. Christos G. Cassandras, and Stéphane Lafortune, Introduction to Discrete Event Systems, Kluwer Academic, Boston, 1999.
4. D. J. White, Markov Decision Processes, John Wiley, New York, 1997.

EE6221 ROBOTICS & INTELLIGENT SENSORS

Acad Unit: 3.0
Prerequisite: Nil
Effective: Acad Year 2000-2001
Last update: 20 March 2000

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

1. Schilling R. J., Fundamentals of Robotics: Analysis and Control, Prentice Hall, 1990.
2. McKerrow P. J., Introduction to Robotics, Addison-Wesley, 1991.

REFERENCES

1. Siegwart R. and Nourbakhsh I. R., Introduction to Autonomous Mobile Robots, The MIT Press, 2004.
2. Stadler W., Analytical Robotics and Mechatronics, McGraw-Hill, 1995.

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 auomation systems in industrial and practical settings. Development of vision based automation system may invovle image capture and analysis, three dimensional data processing and machine intelligence. Hence, this course covers these topics appropriately.

CONTENT

Fundamentals of image processing & analysis. Feature Extraction Techniques. Pattern / Object Recognition and Interpretation. Three Dimensional Computer Vision. Three-Dimensional Recognition Techniques. Biometrics.

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

1. Haralick R. M. and Shapiro L. G., Computer and Robot Vision, Vol. II, Pearson Education, 2002.
2. Gonzalez R. C. and Woods R. E., Digital Image Processing, Addison Wesley, 2010.
3. Duda R. O., Hart P. E. and Stork D. G., Pattern Classification, John Wiley & Sons, 2001.

EE6223 COMPUTER CONTROL NETWORKS

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

CONTENT

Data Networks in Control and Automation. Local Area Network Concepts and Fieldbus. Application Layer of Fieldbus and MAP. Internetworking and Protocols. Real-time Operating Systems and Distributed Control. Network Performance and Planning. Multimedia in Advanced Control and Instrumentation.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOKS

1. Andrews S. Tanenbaum, Computer Networks, 4th Edition, Pearson Prentice Hall, 2003.
2. Fred Halsall, Multimedia Communications, Addison-Wesley, 2001.

REFERENCES

1. William Stallings, High-Speed Networks and Internets: Performance and Quality of Services, 2nd Edition, Pearson Prentice Hall, 2002.
2. Douglas E. Comer, Computer Networks and Internets: with Internet Applications, Pearson Prentice Hall, 2004.
3. William Stallings, Wireless communications and Networks, Pearson Prentice Hall, 2005.

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

Basic control algorithms. Model Predictive Control. Multivariable control. Plant parameter estimation. Case studies in process control.

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

1. J.M. Maciejowski, Predictive Control with Constraints, Prentice-Hall, 2001.
2. Dale E. Seborg, Process Dynamics and Control, John Wiley & Sons Inc., 2004

REFERENCES

1. Camacho and Bordons, Model Predictive Control (2nd Edition), Springer 2004.

2. Liuping Wang, Model Predictive Control System Design and Implementation Using MATLAB, MATLAB, Springer 2009.
3. Rossiter, Model-Based Predictive Control, a Practical Approach, CRC Press, 2003.
4. B. Wayne Bequette, Process Control Modeling Design and Simulation, Prentice Hall, 2003.

EE6303 ELECTROMAGNETIC COMPATIBILITY DESIGN

Acad Unit: 3
Prerequisite: Nil
Effective: AY2014-15
Last update: October 2013

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

EMC Regulatory Requirements. Non-Ideal Behaviors of Passive Components. Conducted EMI and Filter Design. Electromagnetic Shielding. Basic Grounding Concept. Crosstalk. Printed Circuit Board Layout and Radiated EMI. Electrostatic Discharge. Radio Frequency Interference. Emission and Susceptibility Measurement Methods.

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 printed circuit board layout techniques to resolve EMI problems arising from crosstalk and to comply with radiated EMI emission limit;
6. Apply the correct protection techniques to minimize damages to active components due to ESD;
7. Apply the correct grounding and shielding methods for EMC purposes;
8. Compute antenna-to-antenna coupling for RFI analysis;
9. 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

1. Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons, 2009.

REFERENCES

1. Clayton R. Paul, "Introduction to Electromagnetic Compatibility", 2nd Edition, Wiley Interscience, 2006.
2. Elya B. Joffe and Kai-Sang Lock, "Grounds for Grounding – A Circuit-to-System Handbook", John Wiley & Sons and IEEE Press, 2010.

EE6306 DIGITAL INTEGRATED CIRCUIT DESIGN

Acad Unit: 3
Prerequisite: Nil
Effective: AY2014-15
Last update: October 2013

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

Review of Integrated Circuit Fundamentals. Layout and Design Issues. CMOS Digital Circuits. BiCMOS Digital Circuits. Sub-System Design in Digital Circuits. Design Methodologies.

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

1. Neil HE Weste and David M Harris, CMOS VLSI Design, Addison Wesley, 4th edition, 2011
2. Ming-Bo Lin, Introduction to VLSI Systems: A Logic, Circuit and System Perspective, CRC Press, 2012

REFERENCES

1. Jan M. Rabaey, A Chandrakasan, and B Nikolic “Digital Integrated Circuits”, 2nd edition Prentice Hall, 2003.
2. S.S. Rofail and K.S. Yeo, "Low-Voltage Low-Power Digital BiCMOS Circuits: Circuit Design, Comparative Study, and Sensitivity Analysis", Prentice Hall, 1999

EE6307 ANALOG INTEGRATED CIRCUIT DESIGN

Acad Unit: 3 AU
Prerequisite: Nil
Effective: AY2014-15
Last update: October 2013

OBJECTIVE

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

Review of Fundamentals. Analog Building Blocks. Switched Capacitor Circuits. Current Mode Circuits. Continuous-Time Filters. Data Converters.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOKS

1. Tony Chan Carusone, David Johns and Ken Martin, "Analog Integrated Circuit Design", 2^{nd} Edition, John Wiley & Sons, Inc., 2013.
2. Circuits and Systems Tutorials: ISCAS '94, edited by Chris Toumazou, et al., IEEE Press, November 1995.
3. P. V. Ananda Mohan, V. Ramachandran, M. N Swamy, Switched Capacitor Filter Theory, Analysis and Design Prentice-Hall, June 1995.

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

Discrete signal analysis and digital filters. Power spectrum estimation. Linear prediction and optimal linear filters. Multi-rate digital signal processing. DSP Architectures and applications.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOKS

1. J.G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Third Edition, Prentice-Hall, 1996
2. S. Haykin, Adaptive Filter Theory, Prentice-Hall, 1997.

REFERENCES

1. E.C. Ifeachor and B.W. Jervis, Digital Signal Processing –A practical approach, Second Edition, Prentice-Hall, 2002
2. P.P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice-Hall, 1993.

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

Digital Filter Implementation Issues. Advanced Arithmetic Techniques for Hardware. Architecture for General Purpose Digital Signal Processor. Peripherals for DSP Applications. Design and Development Tools for DSP Processors. Introduction to VLSI. Algorithms and Architecture for VLSI.

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

1. Kuo S M, Gan W S, Digital Signal Processors: architectures, implementations, and applications, Prentice Hall, 2005.
2. K. K. Parhi, VLSI Digital Signal Processing Systems: Design and Implementation, John Wiley, 1999.

REFERENCES

1. Richard G. Lyons, Understanding Digital Signal Processing, Prentice Hall, 2010.

EE6403 DISTRIBUTED MULTIMEDIA SYSTEMS

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

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

Media and Media Systems. Media Compression and Standards. Media Processing and Storage. Media Transmission and Delivery. Quality of Service on Distributed Multimedia Systems. Multimedia Applications.

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

1. Ze-Nian Li and Mark S. Drew, Fundamentals of Multimedia, Prentice Hall, 2004.
2. William Stallings, Data and Computer Communications, 9th Edition, Pearson, 2011.

REFERENCES

1. Yao Wang, Jorn Ostermann, Ya-Qin Zhang, Video Processing and Communications, Prentice Hall, 2002.
2. Patrick Ciccarelli, Christina Faulkner, Jerry FitzGerald, Alan Dennis, David Groth, Toby Skandier, Frank Miller, Networking Basics, 2nd Edition, Wiley, 2013.
3. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, 5th Edition, Pearson, 2011.

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

Psychology of Hearing. Principles of Digital Audio. Audio Processing and Synthesis. Digital Audio Compression. Characteristics of Speech Signals. Speech Enhancement. Vector Quantization. Linear Predictive Coding (LPC). Speech Recognition.

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

1. J. Watkinson, The Art of Digital Audio, 3rd Edition, Focal Press, 2000.
2. Ben Gold, Nelson Morgan, Dan Ellis, Speech and Audio Signal Processing, 2nd Edition, John Wiley & Sons, 2011.
3. Ian McLoughlin, Applied Speech and Audio Processing: With Matlab Examples, Cambridge University Press, 2009.

REFERENCES

1. Andreas Spanias, Ted Painter, Venkatraman Atti, Audio Signal Processing and Coding, John Wiley & Sons, 2006.
2. B. C. J. Moore, An Introduction to the Psychology of Hearing, Academic Press, 1989.
3. John R. Deller, John H.L. Hansen, John G. Proakis, Discrete-Time Processing of Speech Signals, IEEE Press, 2000.

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

Image and Video Basics. Image and Video Transform Coding. Filtering and Error Resilience for Image and Video. Image and Video Coding Principles and Standards. Recent and Emerging Topics in Image and Video Processing.

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

1. Yun Q. Shi and Huifang Sun, Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms, and Standards, CRC Press, 2nd Edition, 2008.
2. Y. Wang, J. Ostermann, and Y.-Q. Zhang, Video Processing and Communications, Prentice Hall, 2002.

REFERENCES

1. Iain E.G. Richardson, H.264 and MPEG-4 Video Compression. Video Coding for Next-generation Multimedia, John Wiley & Sons, 2003.
2. John W. Woods, Multidimensional Signal, Image, and Video Processing and Coding, Academic Press, 2012.

EE6501 POWER ELECTRONIC CONVERTERS

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

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

1. Mohan N, Undeland T M, and Robbins W P, Power Electronics - Converters, Applications and Design, Third Edition, John Wiley & Sons, Inc., New York, 2003.

REFERENCES

1. Rashid M H, Power Electronics, Circuits, Devices and Applications, Prentice Hall Pearson Education, Inc., Third Edition 2004.
2. Bose B K, Modern Power Electronics and AC Drives, Prentice Hall, NJ, 2002.

EE6503 MODERN ELECTRICAL DRIVES

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

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

Introduction. DC Motor Drives. Induction Motor Drives. Synchronous Motor Drives. Servo-Motor Drives.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOK

1. Krishnan R, Electric Motor Drives: Modelling, Analysis and Control, Prentice Hall International, Inc., 2001.

REFERENCES

1. Vas P, Sensorless Vector and Direct Torque Control, Oxford University Press, Inc., 1998.
2. Bose B K, Modern Power Electronics and AC Drives, Prentice Hall International, Inc., 2002.
3. Leonhard W, Control of Electric Drives, Springer-Verlag Berlin Heidelberg, 1996.
4. Krause P C, Wasynczuk O, and Sudhoff S D, Analysis of Electric Machinery and Drive Systems, Second Edition, New York, Wiley-IEEE, 2002.

EE6508 POWER QUALITY

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

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

Concept of Power Quality. Voltage Fluctuations and Variations. Transient Overvoltages. Harmonic Distortions.

ASSESSMENT SCHEME

Continuous Assessment 20%
Final Examination 80%

TEXTBOOKS

1. Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Electrical Power Systems Quality, Second Edition, McGraw-Hill, 2002.
2. Kennedy B W, Power Quality Primer, First Edition, McGraw-Hill, 2000.

REFERENCES

1. Bollen M H J, Understanding Power Quality Problems: Voltage Sags and Interruptions, First Edition, IEEE Press; 2000.
2. Arrillaga J and Watson N R, Power System Harmonics, Second Edition, John Wiley & Sons, 2003.

EE6509 RENEWABLE ENERGY SYSTEMS IN SMART GRIDS

Academic Unit:	3.0
Pre-requisite:	Nil
Effective:	Academic Year 2014-2015
Last update:	July 2013

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

Introduction to Power Systems with Distributed Generation. Distributed Generation. Energy Storage. Smart Grids.

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

Continuous Assessment	20 %
Final Examination	80 %

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

1. J. Momoh, Smart Grids: Fundamentals of Design and Analysis, IEEE Press, John Wiley and Sons, Inc., 2012. (NTU eBook Collection)
2. M. H. J. Bollen, The Smart Grid: Adapting the Power System to New Challenges, Morgan and Claypool Publishers, 2011. (NTU eBook Collection)
3. N. Hadjsaid and J. Sabonnadiere, SmartGrids, John Wiley and Sons, 2012. (TK3105.S636sm)

EE6510 POWER SYSTEM OPERATION AND PLANNING

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

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.

DESIRED 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

Forecasting and Scheduling. Network Application Functions. Probability and Reliability. Generation and Transmission Planning.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOKS

1. Wood A J and Wollenberg B F, Power Generation, Operation and Control, Second Edition, John Wiley & Sons, Inc., 1996.
2. Billinton R and Allan R N, Reliability Evaluation of Power Systems, Second Edition, Plenum Press, 1996.

REFERENCE

1. Billinton R and Allan R N, Reliability Evaluation of Engineering Systems, Second Edition, Plenum Press, 1992.

EE6511 POWER SYSTEM MODELLING AND CONTROL

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

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

Steady-state Power System Networks. Network Components. Stability Analysis. Power System Control.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOKS

1. Kundur P, Power System Stability and Control, McGraw-Hill, New York, 1994.
2. Mathur R M, and Varma R K, Thyristor-Based FACTS Controllers for Electrical Transmission Systems, IEEE Press, Wiley-InterScience, 2002.

REFERENCE

1. Anderson P M, and Fouad A A, Power System Control and Stability, IEEE Press, New York, 1994.

EE6601 ADVANCED WAFER PROCESSING

Acad Unit: 3
Pre-requisite: NIL
Effective: AY2014-2015 Semester 2
Last update: 10 October 2013

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

Dielectrics for CMOS technology. Chemical and mechanical polishing. Lithography and resist technology. Etching process and technology. Backend interconnect technology. Cleaning technology. Process integration. Metrology and analytical techniques

ASSESSMENT SCHEME

Continuous Assessment: 20%
Final Examination: 80%

TEXTBOOKS

1. James D. Plummer, Michael D. Deal, and Peter B. Griffin "Silicon VLSI Technology: Fundamentals, Practice, and Modeling," ISBN-13: 9780130850379, Prentice Hall, 2001.
2. C. Y. Chang and S. M. Sze, "ULSI Technology," ISBN 9780071141055, 1996.

REFERENCES

1. Gang He and Zhaoqi Sun (eds.), "High-k Gate Dielectrics for CMOS Technology", ISBN 978-3-527-33032-4 - Wiley-VCH, Weinheim, 2012
2. Karen Reinhardt and Werner Kern (Editors), "Handbook of Silicon Wafer Cleaning Technology", 2nd Edition, ISBN-13**:** 978-0815515548, William Andrew, 2008
3. David G. Seiler, Alain C. Diebold, T. J. Shaffner, Robert McDonald, Stefan Zollner (editors), "Characterization and Metrology for ULSI Technology 2003: International Conference on Characterization and Metrology for ULSI Technology, Austin, Texas 24-28 March 2003", *Volume 683 of AIP CONFERENCE PROCEEDINGS*, ISBN 0735401527, 9780735401525, American Institute of Physics, 2003

EE6602 QUALITY AND RELIABILITY ENGINEERING

Acad Unit: 3
Prerequisite: Nil
Effective: Acad Year 2014/15
Last update: October 4, 2013

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

Reliability Planning & Statistical Framework. Accelerated Testing. Statistical Process Control. Design of Experiments.

ASSESSMENT SCHEME

Continuous Assessment:	20%
Final Examination:	80%

REFERENCES

1. D.C. Montgomery, "Design and Analysis of Experiments", John Wiley, 8th Edition, 2009
2. D.C. Montgomery, "Introduction to Statistical Quality Control", John Wiley, 6th Edition, 2011
3. Paul A. Tobias, David Trindade, "Applied Reliability", Van Nostrand Reinhold, 2nd Edition, 1995.

EE6604 ADVANCED TOPICS IN SEMICONDUCTOR DEVICES

Acad Unit: 3
Prerequisite: Semiconductor fundamentals
Effective: Acad Year 2014-2015
Last update: 2 Oct. 2013

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

Bipolar transistor operating principles. Bipolar device modeling. State-of-the-art bipolar structures. MOS device operation. MOSFET modeling. MOS device scaling effects. Semiconductor memories. Semiconductor heterojunctions and devices. New devices and future trends.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOK

1. S. M. Sze and K. K. Ng, “Physics of semiconductor devices”, Wiley, 2006.

REFERENCES

1. Y. Taur and T. H. Ning, “Fundamentals of Modern VLSI Devices”, Cambridge University Press, 2nd edition, 2011.
2. Ashok K. Sharma, “Advanced Semiconductor Memories”, Wiley-Interscience, 2003.
3. J. Singh, “Physics of Semiconductors and Their Heterostructures”, McGraw-Hill, 1993.

EE6610 INTEGRATED CIRCUIT (IC) PACKAGING

Acad. Units: 3
Pre-requisite: Nil
Effective: AY 2014-2015 Sem 2
Last update: 8 Oct 2013

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

Introduction to IC & microsystems packaging. Fundamentals of electrical packaging design. Fundamentals of thermal management. Single chip and multichip packaging. IC assembly, sealing and encapsulation. Microsystems packaging and advanced packaging. Failure analysis & Reliability.

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

1. Rao R. Tummala, Introduction to system-on-package (SOP): miniaturization of the entire system, McGraw-Hill, 2008.
2. Rao R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill, 2001.

REFERENCES

1. Yufeng Jin, Introduction to microsystem packaging technology, CRC Press, 2011.
2. John H. Lau, Advanced MEMS packaging, McGraw-Hill, 2010.
3. Richard K. Ulrich, Advanced electronic packaging, 2nd ed., Wiley, 2006.

EE6808 LED Lighting and Display Technologies

Acad Unit:	3
Pre-requisite:	Nil
Effective:	AY2014-15 S1
Last update:	Oct 2013

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

Review of optoelectronic processes and related optics. Review of lighting and display technologies. Light-emitting diodes. Plasma display panels. Field emission displays. Liquid crystal displays. Organic light-emitting device. Electroluminescent and electrochromic displays.

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

[1] E. F. Schubert, “Light-emitting Diodes”, Cambridge Univ. 2006.
[2] J.-H. Lee, D. N. Liu, S.-T. Wu, “Introduction to Flat Panel Displays,” The SID (the Society for Information Display) - Wiley Series in Display Technology, 2009.

EE7201 COMPUTATIONAL METHODS IN ENGINEERING

Acad Unit: 3.0
Prerequisite: Nil
Effective: Acad Year 2006-07
Last update: April 2006

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

Matrices. Method of Least Squares. Optimization. Case Study I - Matrix Factorization in Kalman Filtering. Statistical Methods. Monte-Carlo Methods. Numerical Solution to Differential Equations. Case Study II – Parameter Estimation and Monte-Carlo Simulation in Optics Sensing.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOK

1. M. T. Heath, Scientific Computing: an Introductory Survey, 2nd Edition, McGraw-Hill, 2002.

REFERENCES

1. D. P. Bertsekas, Nonlinear Programming, Athena Scientific, 1999.
2. S. Boyd, L. Vandenberghe, Convex Optimization, Cambridge University Press, 2005.
3. S. Boyd, L. El Ghaoui, E. Feron, and V. Balakrishnan, Linear Matrix Inequalities in System and

Control Theory, SIAM, 1994.
4. F. van der Heijden *et al*, Classification, Parameter Estimation, and State Estimation: an Engineering Approach Using MATLAB, Wiley, 2004.
5. S. M. Kay, Fundamentals of Statistical Signal Processing, Volume 2: Detection Theory, Prentice Hall, 1998.
6. J. E. Freund, John E. Freund's Mathematical Statistics with Applications, 7th Edition, Prentice Hall, 2004.

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.

DESIRED 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

Input/Output System Models. State Space Representation. Norms of Signals and Systems. Decomposition of Linear Time-Invariant Systems. Linear Feedback Design. Convex Optimization for Linear System Analysis and Design.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOK

1. F. Szidarovszky and A.T. Bahill, Linear Systems Theory, 2nd edition, CRC Press, 1998. (Q295.S998)

REFERENCES

1. C.T. Chen, Linear System Theory and Design, Oxford University Press, 1999. (QA402.C518s)
2. M.J. Corless and A.E. Frazho, Linear Systems and Control: An Operator Perspective, Marcel Dekker, 2003. (QA402.3.C799)
3. M. Green and D.J.N. Limebeer, Linear Robust Control, Prentice Hall, 1995. (TJ213.G797)

EE7205 RESEARCH METHODS

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

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

Research Preparation and Planning. Research Sources and Review. Quantitative Methods for Data Analysis. Experimental research methods. Academic Writing & Presentation.

ASSESSMENT SCHEME

Continuous Assessment 50%
Final Examination 50%

REFERENCES

1. Dane F.C., Research Methods, Brooks/Cole Publishing Company, 1990.
2. Gay L.R. and Diehl, P.L., Research Methods for Business and Management, MacMillan Publishing Company, 1992.
3. Howard K. and Sharp J.A., The Management of a Student Research Project, Publ. Co. Ltd., 1996.
4. McBurney D.H., Research Methods, Brooks/Cole Publishing Company, 1994.
5. BLAKE & Bly.R.W., The elements of technical writing, Longman, 1993.

EE7207 NEURAL AND FUZZY SYSTEMS

Acad Unit: 3
Pre-requisite: Nil
Effective: Academic Year 2014-2015
Last update: Feb 2014

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

Introduction to artificial neural networks. Recurrent and Hopfield Neural Network. Multi-layer perception neural network. Radial basis function neural network. Support vector machines. Self-organizing map neural network. Applications of neural network. Fundamentals of fuzzy logic and fuzzy systems. Takagi-Sugeno (T-S) fuzzy modeling and identification. Stability analysis of fuzzy systems. Applications of fuzzy systems.

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

1. Simon Haykin, Neural networks and learning machines, 3rd Edition, Prentice Hall, 2009.
2. Gang Feng, Analysis and Synthesis of Fuzzy Control Systems – a Model-Based Approach, CRC Press Inc, 2010.

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

Probability concepts. Random variables. Multiple random variables. Sum of random variables and multidimensional distributions. Random Sequences. Probability density function estimation. Random variable simulation. Random processes. Correlation functions. Spectral density. Random processes in linear systems. Optimum linear systems. Nonlinear systems.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOK

1. Papoulis, A. and Pillai, S.U., Probability, Random Variables and Stochastic Processes, McGraw-

Hill, 2001.

REFERENCES

1. Cooper, G.R. and McGillem, C.D., Probabilistic Methods of Signals and System Analysis, Oxford University Press, 1998.
2. Yates, R.D. and Goodman, D.J., Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers, Wiley, 1998.
3. Stark, H. and Woods, J.W., Probability and Random Processes with Applications to Signal Processing, Prentice-Hall, 2002.
4. Viniotis, Y., Probability and Random Processes for Electrical Engineers, McGraw-Hill, 1998.
5. Peebles, P. Z. Probability, Random Variables and Random Signal Principles, McGraw-Hill, 2001.
6. McDonough, R.N. and Whalen, A.D., Detection of Signals in Noise, Academic Press, 1995.

EE7402 STATISTICAL SIGNAL PROCESSING

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

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

Signal Estimation Theory. Properties of Estimators. Fundamentals of Detection Theory. Detection of Deterministic and Random Signals. Application of Signal Detection and Estimation. Introduction to Adaptive Filtering. Gradient based Adaptation. Adaptive Filter Applications.

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

1. Thomas A. Schonhoff, Arthur Anthony Giordano, Detection and Estimation Theory and Its Applications, Prentice-Hall, 2006.
2. Ali H. Sayed, Adaptive Filters, John Wiley & Sons, 2008.

REFERENCES

1. S. M. Kay, Fundamentals to Statistical Signal Processing: Volume I: Estimation Theory, Prentice-Hall, 1993.
2. S. M. Kay, Fundamentals to Statistical Signal Processing: Volume II: Detection Theory, Prentice-Hall, 1998.
3. S. Haykin, Adaptive Filter Theory, Prentice Hall, 2002.

4. Dimitris G. Manolakis, Vinay K. Ingle and Stephen M. Kogon, Statistical and Adaptive Signal Processing, McGraw-Hill International Editions, 2000.

EE7403 IMAGE ANALYSIS AND PATTERN RECOGNITION

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

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

Image Fundamentals. Image Enhancement and Restoration. Image Analysis. Decision Theory and Statistical Estimation. Classification and Clustering. Dimensionality Reduction.

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

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, 3rd Edition, Pearson Prentice Hall, 2008.
2. R. O. Duda, P. E. Hart, and D. G. Stork, Pattern Classification, 2nd Edition Wiley Inter-science, 2001.

REFERENCES

1. Gonzalez, R. C., Woods, R. E., and Eddins, S. L., Digital Image Processing Using, Matlab, Prentice Hall, 2004.
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2nd Edition 2011.

EE7602 DESIGN, FABRICATION AND ANALYSIS OF ELECTRONICS DEVICES

Academic Unit :	3
Prerequisite / Co-requisite :	Nil
Effective :	Academic Year 07/08 (Semester 2)
Last update :	28 February 2007

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

Electronic Devices Overview. Electronic Device Fabrication. Device Design. Simulation and Layout. Electronic Interfaces. Packaging and Characterization. Electronic Device and Applications.

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

1. S. M. Sze, Semiconductor Devices: Physics and Technology, 2nd Edition (2001).
2. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers (2000).
3. Gregory T. A.Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill (1998).
4. Minghang Bao, Analysis and Design Principles of MEMS Devices, Elsevier (2005).

EE7603 ADVANCED SEMICONDUCTOR PHYSICS

Acad Unit:	3
Pre-requisite:	Fundamentals of semiconductor materials/devices
Effective:	AY 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

Crystal Structure. Energy Bands of Semiconductors. Doping and Carrier Concentrations. Low Dimensional Systems. Electrical Transport Phenomena. Excess Carriers. Optical Properties.

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%

TEXTBOOKS

1. S. L. Chuang, “Physics of Photonic Devices”, Wiley 2009.
2. J. Singh, "Electronic and optoelectronic properties of semiconductor structures", Cambridge 2003
3. C.N. Wolfe, N. Holonyak, Jr., and G.E. Stillman, “Physical properties of semiconductors”, Prentice Hall, 1989

REFERENCES

1. John H. Davies, “The Physics of Low-Dimensional Semiconductors—an introduction”, Cambridge University Press, 1998

EE7604 LASER TECHNOLOGY

Acad Unit:	3
Pre-requisite:	Fundamentals of modern optics
Effective:	AY /14
Last update:	25/(1/2013

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

Laser Fundamentals. Laser Resonators. Laser Oscillation. Laser System Design. Laser Techniques. Semiconductor Lasers. Laser Applications.

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

Continuous Assessment	20%
Final Examination	80%

TEXTBOOK

1. Orazio Svelto, **Principles of Lasers**, Springer US, 2010 (ISBN: 978-1-4419-1301-2).

REFERENCES

1. C. B. Hitz, J. Ewing and J. Hecht, **Introduction to Laser Technology**, IEEE Press, 2012.
2. William T. Silfvast, **Laser Fundamentals**, Cambridge University Press, 2008.
3. Joseph T. Verdeyen, **Laser Electronics**, Prentice Hall, 1995.

EE7605 SIGNAL INTEGRITY IN HIGH SPEED DIGITAL SYSTEMS

Acad Unit:	3.0
Pre-requisite:	Nil
Effective:	AY2014-15
Last update:	October 2013

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

High Speed Properties of Logic Gates. Modeling and Analysis of Interconnections. Transmission Lines and Terminations. Power Distribution Networks and Ground Planes. Clock Distribution; Case Study.

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.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

TEXTBOOKS

1. Eric Bogatin, Signal Integrity: Simplified, Prentice Hall, 2004.

REFERENCES

1. Jan M. Rabey, Anantha Chandrakasan and Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, 2nd Edition, Prentice Hall, 2003.
2. Madhavan Swaminathan and A. Ege Engin, Power Integrity Modeling and Design for Semiconductors and Systems, Prentice Hall, 2007

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 nanostrucutres are studied.

CONTENT

Low Dimensional Systems. From Micrometer MOS to Nanometer MOS. Characterization and Patterning Techniques. Carbon Nanotubes and Graphene. Silicon and Metal Oxide Nanostructures.

ASSESSMENT SCHEME

Continuous Assessment	20%
Final Examination	80%

REFERENCES

[1] George W Hanson, "Fundamentals of Nanoelectronics", Pearson Prentice Hall 2008.
[2] Simon Deleonibus (ed), "Electronic Devices Architectures for the Nano-CMOS Era", edited by, Pan Stanford Publishing 2009.
[3] Mircea Dragoman and Daniela Dragoman, "Nanoelectronics, Principles and Devices", Artech House 2006.

EE7607 MODERN OPTICS

Acad Unit: 3
Pre-requisite: Fundamental knowledge of the geometrical optics and physical optics.
Effective: Acad. Year 2014-2015
Last update: 8 Oct 2013

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 nanophontonic instrumentation techniques, i.e. the scanning near field optical microscopy (SNOM) and photonic crystals are also included.

CONTENT

Scalar Diffraction. Wavefront Modulation. Holography. Optical Characterization of Solids. Optical Spectroscopy. Near Field Optics & SNOM. Photonic crystals.

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

1. Eugene Hecht, Optics, 4th edition, Addison-Wesley, 2002.
2. Saleh and Teich, Fundamentals of Photonics, 2nd edition, Wiley, 2007.

REFERENCES

1. J.W. Goodman, Introduction to Fourier Optics, 3rd edition, McGraw-Hill, Inc., New York, NY (2005).
2. D. Dragoman, M. Dragoman , Optical Characterization of Solids; Springer; 1st edition (2001).
3. Nikolai V. Tkachenko, Optical Spectroscopy: Methods and Instrumentations, Elsevier Science (2006).
4. J. P. Fillard, Near Field Optics & Nanoscopy, World Scientific, 1996.