1. PHILOSOPHY
The doctoral and masters programmes prepare students for creative teaching, research, development and professional works in academic, industrial and military applications of electronic engineering in any one of the areas of specializations. The programmes aim at preparing graduate students to be able to understand and analyze electronic materials, components and complete electronic systems, and simulate their behaviours on computers in order to specify new sub-systems and effect adaptation and development. The students are also trained to be able to specify, design, develop and commission hardware and instruments of varying degrees of complexity in their special areas.

The Doctoral programme is expected to probe much deeper into issues than the master programme. The programme should be able to develop/design techniques in electronic engineering in the pursuit of new principles and new or better engineering materials and techniques.

2. OBJECTIVES
The Department of Electronic Engineering postgraduate programmes are intended to achieve the following objectives:

i. Prepare graduate students to be able to understand and analyze electronic materials, components and complete systems through modeling and simulation;

ii. Train postgraduate students to be able to design, develop, install and maintain hardware and instruments of varying degrees of complexity in their special area;

iii. Obtain high levels of graduate student achievement in Electronic Engineering through reliance on laboratory hands-on activities thereby producing graduates with the requisite expertise for satisfying career with Educational Institution, Industry, Business and Government;

iv. Promote technology transfer, continuing engineering education training and re-training in the specialized areas in Electronic Engineering;

v. Produce graduates capable of initiating and leading Research and Development (R & D) works in the areas of specialization;

vi. Prepare candidates to be able to design, develop and test efficient electronic systems in real time.

vii. Produce the highest educated and trained manpower that will ameliorate and eventually reverse the acute shortage of academics in the specialized areas;
viii. Produce the highest level of consultants capable of providing technical solutions to Governments, Industry and Business, and
ix. Promote collaboration between specialists/experts in the specializations.

3. SCOPE
Electronic Engineering postgraduate programme was created to develop and execute a world-class electronic engineering postgraduate programme intended to provide sound theoretical and practical training for graduate students. This intention was born out of the national drive to be part of the digital revolution and the information society, as well as an institutional strive to be at the cutting edge of global developmental trends in the research and development in Information and Communication Technology (ICT).

The postgraduate programmes of the Department of Electronics Engineering are being offered at two levels, namely: Masters and Doctoral levels. The Master degree is in two forms: Master of Engineering (M.Eng.) and Master of Science (M.Sc.) both in Electronic Engineering specific specialization. The Masters and Doctoral (Ph.D) programmes lay emphasis on both theoretical and practical (project) aspects of postgraduate work especially as it relates to the technological needs of the nation. Both programmes offer specialization in the following areas:
- Communication,
- Digital Electronics and Computer and
- Control Engineering.

4. ADMISSION REQUIREMENTS
4.1 Masters Programmes
Candidates for M.Sc. and M.Eng. must possess B.Sc or B.Eng. degree certificate with minimum GPA of 2.50. The applicants must have Electronic Engineering background or other related discipline. The applicants are, in addition, expected to satisfy the current postgraduate programme admission requirements in the department/faculty.

4.2 Doctor of Philosophy Programme
The candidates for Ph.D degree must possess the minimum of M.Sc. or M.Eng. degree certificate with GPA OF 3.0/4.0 or 3.5/5.0 minimum requirement. The applicant must have Electronic Engineering background and any other minimum requirement as in the current postgraduate programme in the department/faculty.

5. AREAS OF SPECIALIZATION
The areas of specialization for M.Sc, M.Eng. and Ph.D include:
i. Communication,
ii. Control Engineering,
iii. Digital Electronic and Computer and
6. **DURATION OF PROGRAMMES**

6.1 **Masters Programmes**

The M. Sc. and M. Eng. Degree programmes have defined duration based on the mode of the programme i.e. whether part-time or full-time mode.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Minimum Duration</th>
<th>Maximum Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-time</td>
<td>3 semesters</td>
<td>6 semesters</td>
</tr>
<tr>
<td>Part-time</td>
<td>6 semesters</td>
<td>8 semesters</td>
</tr>
</tbody>
</table>

6.2 **Doctor of Philosophy Programmes**

The Ph.D. degree programme has a defined duration based on the mode of the programme i.e. whether part-time or full-time mode.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Minimum Duration</th>
<th>Maximum Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-time</td>
<td>6 semesters</td>
<td>8 semesters</td>
</tr>
<tr>
<td>Part-time</td>
<td>8 semesters</td>
<td>14 semesters</td>
</tr>
</tbody>
</table>

7. **MODE OF STUDY**

Doctor of Philosophy and Masters programmes are pursued on both full-time and part-time modes where the minimum credit loads are 30 units.

7.1 **Masters Programmes**

The M. Sc. and M. Eng. degrees are obtained through course work predominated programmes and dissertation. All candidates for Masters in Electronic Engineering pass through individualized remedial programme approved by the Departmental Postgraduate Studies Committee. The core courses are compulsory for the candidates and they are intended to harmonize the students’ diverse academic backgrounds and equip them with the necessary tools for meaningful work in their various areas of specialization. The pass score for the courses is 50%.

7.2 **Doctor of Philosophy Programmes**

The Ph.D degree is obtained through course work and comprehensive research to be embodied in a thesis which is defended orally before a constituted panel. The Ph.D research must show incontrovertibly satisfactory level of originality and creativity and shall generally result in the development of a new technique processes or correlation and in the advancement of knowledge beyond the current frontier. Candidates qualify to proceed into research aspect of the programme only after obtaining 60% score average from course work. Unsuccessful candidates are allowed only second opportunity to re-access the course work.
8. **CERTIFICATION**

8.1 **Masters Programmes**

At the end of the masters programme the graduates are awarded the M. Eng. or M.Sc. degree certificates.

M. Eng. - If graduate has first degree in Engineering.

M. Sc. - If graduate has non-Engineering first degree.

8.2 **Doctor of Philosophy Programmes**

At the end of the Ph.D programme the graduates are awarded the Ph.D degree certificates.

9. **JOB OPPORTUNITIES**

It is imperative to note that the technological advancement of any country lies in the hands of its Engineers. The need for Electronic Engineers in the society today cannot be over-emphasized. This is because Electronic Engineering permeates almost every aspect of life and industry. Our graduates are properly equipped to take on challenging jobs such as design, development and production of hardware and software for industries such as Telecommunications, ICT Companies, Computer Networking Firms, Software Companies, Oil Companies etc. There are also numerous job opportunities in Banks, Research Institutes and Academic Institutes.

**LIST OF APPROVED SUPERVISORS**

**PROFESSORS**

1. C. I. Ani
   M.Sc. (Moscow), M.Phil (Sussex), PhD (Wales), MNSE
   Data Communication and Networks Resource Management

2. O. U. Oparaku
   B. Eng (Nig), PhD (Newcastle UT), MNSE
   Solid State/Semiconductor Electronics and Solar Energy

**SENIOR LECTURERS**

1. O. N. Iloanusi (Doctoral Supervisor)
   B. Eng (Nig.), M.Eng. (Nig.), PhD (Nig.), MNSE
   Biometrics, Digital System Design, Digital Signal Processing, and Logic Design

2. M. A. Ahaneku (Masters Supervisor)
   B.Eng. (FUTO), M.Sc. (FUTO), Ph.D (Nig.), MNSE
   Microwave and Satellite Communications, Radio and Telecommunication,
3. V. C. Chijindu  
B. Eng. (ASUTECH), M. Eng. (ESUT), Ph.D (UNIZIK), MNCS  
Software Engineering, Image Engineering and Digital System Design

4. N. J. Eneh  
B. Eng. (ESUT), M. Eng. (ESUT), Ph.D (UNIZIK), MNSE  
Control Systems and Digital System Design

5. U. A. Nnolum  
B. Eng. (UK), M. Eng. (UK), Ph.D (UK)  
Software Engineering, Digital System Design and Digital Signal Processing

6. C. C. Udeze  
B. Eng. (UNIZIK), M. Eng. (UNIZIK), Ph.D (UNIZIK), MNSE, COREN  
Control Systems, Datacenter Networks and Digital System Design

STRESS AREAS                CODES
Foundational Courses         0  
Communication                1  
Digital Electronics & Computers 2  
Control                      3

M. Sc. and M. Eng. COURSE OUTLINE

A. COMMUNICATION SPECIALIZATION

Compulsory Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 610</td>
<td>Communication Theory</td>
<td>3</td>
</tr>
<tr>
<td>ECE 611</td>
<td>Communication Networks &amp; Protocols</td>
<td>3</td>
</tr>
<tr>
<td>ECE 612</td>
<td>Communication Modeling &amp; Simulation</td>
<td>3</td>
</tr>
<tr>
<td>ECE 613</td>
<td>Network Traffic Control</td>
<td>3</td>
</tr>
<tr>
<td>ECE [ ]</td>
<td>(Two Elective Courses)</td>
<td>6</td>
</tr>
</tbody>
</table>

 18 Units

Research

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 601</td>
<td>Seminars</td>
<td>3</td>
</tr>
<tr>
<td>PGC 601</td>
<td>Research Methodology and ICT in Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ECE 600</td>
<td>Project</td>
<td>6</td>
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</tbody>
</table>
### Optional/Elective Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 614</td>
<td>Microwave &amp; Satellite Communication</td>
<td>3</td>
</tr>
<tr>
<td>ECE 615</td>
<td>Mobile Communication</td>
<td>3</td>
</tr>
<tr>
<td>ECE 616</td>
<td>Networks Design &amp; Implementation</td>
<td>3</td>
</tr>
<tr>
<td>ECE 617</td>
<td>Optical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECE 618</td>
<td>Microwave Communication System Design</td>
<td>3</td>
</tr>
<tr>
<td>ECE 619</td>
<td>Radar And Navigation Systems</td>
<td>3</td>
</tr>
</tbody>
</table>

(Two courses only are required to be chosen.)

### B. DIGITAL ELECTRONICS AND COMPUTERS SPECIALIZATION

#### Compulsory Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 620</td>
<td>Digital System Design</td>
<td>3</td>
</tr>
<tr>
<td>ECE 621</td>
<td>Computer Systems Architecture I</td>
<td>3</td>
</tr>
<tr>
<td>ECE 622</td>
<td>Software Engineering Development</td>
<td>3</td>
</tr>
<tr>
<td>ECE 625</td>
<td>Digital Integrated Electronics</td>
<td>3</td>
</tr>
<tr>
<td>ECE 623</td>
<td>Computer Systems Architecture II</td>
<td>3</td>
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<tr>
<td>ECE 626</td>
<td>Digital Signal Processing</td>
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**24 Units**

#### Research

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<th>Course Code</th>
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<th>Units</th>
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<tbody>
<tr>
<td>ECE 601</td>
<td>Seminars</td>
<td>3</td>
</tr>
<tr>
<td>PGC 601</td>
<td>Research Methodology and ICT in Engineering</td>
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<tr>
<td>ECE 600</td>
<td>Project</td>
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**12 Units**

### Optional/Elective Courses

<table>
<thead>
<tr>
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<th>Units</th>
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<tbody>
<tr>
<td>ECE 624</td>
<td>Software Engineering Project Management</td>
<td>3</td>
</tr>
<tr>
<td>ECE 627</td>
<td>Web Engineering and Cyber Security</td>
<td>3</td>
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<tr>
<td>ECE 628</td>
<td>Biometrics and Image Processing</td>
<td>3</td>
</tr>
<tr>
<td>ECE 629</td>
<td>Nanoelectronics and Optoelectronics</td>
<td>3</td>
</tr>
</tbody>
</table>

(Two courses only are required to be chosen.)
C. CONTROL SPECIALIZATION

## Compulsory Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 630</td>
<td>Stochastic Control</td>
<td>3</td>
</tr>
<tr>
<td>ECE 631</td>
<td>Optimal Control</td>
<td>3</td>
</tr>
<tr>
<td>ECE 632</td>
<td>Multivariable Control</td>
<td>3</td>
</tr>
<tr>
<td>ECE 635</td>
<td>System Modeling and Simulation</td>
<td>3</td>
</tr>
<tr>
<td>ECE [ ]</td>
<td>(Two Elective Courses)</td>
<td>6</td>
</tr>
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</table>

### Research

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ECE 601</td>
<td>Seminars</td>
<td>3</td>
</tr>
<tr>
<td>PGC 601</td>
<td>Research Methodology and ICT in Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ECE 600</td>
<td>Project</td>
<td>6</td>
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</tbody>
</table>

### Optional/Elective Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ECE 633</td>
<td>Linear Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECE 634</td>
<td>Large Scale Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECE 636</td>
<td>Control Strategies</td>
<td>3</td>
</tr>
<tr>
<td>ECE 637</td>
<td>Linear System Theory</td>
<td>3</td>
</tr>
<tr>
<td>ECE 638</td>
<td>System Control</td>
<td>3</td>
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</tbody>
</table>

(Two courses only are required to be chosen.)

## Ph.D COURSE OUTLINE

### Compulsory Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 712</td>
<td>Modeling &amp; Simulation Practice</td>
<td>3</td>
</tr>
<tr>
<td>ECE 713</td>
<td>Advanced Security Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ECE [ ]</td>
<td>(One Elective Course)</td>
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</tbody>
</table>

### Research

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 701</td>
<td>Seminars I</td>
<td>3</td>
</tr>
<tr>
<td>PGC 701</td>
<td>Synopsis and Research Grant Writing</td>
<td>3</td>
</tr>
</tbody>
</table>
ECE 702  Seminars II  3
ECE 700  Thesis  12
\[ \text{21 Units} \]

**Optional/Elective Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ECE 710</td>
<td>Network Management &amp; Reliability</td>
<td>3</td>
</tr>
<tr>
<td>ECE 714</td>
<td>Long-Distance Networks</td>
<td>3</td>
</tr>
<tr>
<td>ECE 716</td>
<td>Advanced Signal Processing</td>
<td>3</td>
</tr>
</tbody>
</table>

*(One course only is required to be chosen.)*
COURSE DESCRIPTIONS

ECE 600 Project Report (6 Units)
Each candidate for a Masters degree shall be assigned a suitable research project approved by the Departmental Postgraduate Studies Committee. The results of the research shall be embodied in a project report.

PGC 601: Research Methodology and ICT in Engineering (3 Units)
Use of advanced analytical tools like MATLAB/SIMULINK, SCILAB/XCOS, etc for solution of engineering problems and their applications (Application of these softwares depends on the various problems formulated in different departments and in the specific specializations).

Information literacy, information sources (media, publishers, aggregators); validity of information, plagiarism and legal aspects.

Information search – search engines, journal repositories, academic (social) networks, search strategies, personal contacts, tools for managing references.

Integrating information literacy in research, cloud computing, audiovisual tools, e.g powerpoint presentations.

Literature review: Reading and summarizing relevant articles, critical analysis and evaluation of research, identification of themes and comparators, writing review documents and identification of research (or knowledge) gaps.

Scientific method and nature of evidence: Experimental methods and design methods (as may be applicable to individual departments and research areas), data collection and management of quantitative data. Human participants – expert reviews, focus groups, questionnaires and interviews.

Project management and report writing: project planning, report structure and style, general report writing techniques.

ECE 601 Seminars (3 Units)
Each master’s candidate shall present at least one seminar on his/her research project before graduation.

ECE 610 Communication Theory (3 Units)
Signals (Deterministic and random) and Systems; Signal processing (signal domain transformations, convolution, sampling, quantization, compression and coding); Modulation and Demodulation (Analogue and digital); Information theory; Noise; Error control coding.

ECE 611 Communication Networks and Protocols (3 Units)
LAN - Physical Structure; Medium Access Control; LAN Standards – IEEE 802.x; LAN Interconnections – Bridges, Routers & Gateways. MAN - DQDB, FDDI; WAN - PSTN; PSDN; ISDN; B-ISDN; INTERNET; ATM; FRAME RELAY; SONET; Advanced Network Architectures.
OSI-layer protocols; Protocol Design – Protocol Specification and Implementation. ASN.1 Representation and Pseudo-Coding. HDLC; X.25; TCP/IP and IPx

ECE 612 Communication Modeling & Simulation (3 Units)
Teletraffic; Queuing Theory; Traffic Modeling (Data, Voice and Video Modeling); Network Systems Modeling - Loss System and Delay System;

Computer Simulation Modeling - Computer Simulation using Object Oriented Network Simulation Packages – SPSS, MATLAB Simevent, OPNET: Riverbird modeler, Network II.5, BONES.

ECE 613 Network Traffic Control (3 Units)
Network Algorithm and shortest path routing; Broadcast Routing information;
Flow models optimal routing and topological design; Characterization of optimal routine; Window flow control; Rate control scheme; Rate Adjustment Algorithm; Flow control protocols in practice.

ECE 614 Microwave & Satellite Communication (3 Units)

ECE 615 Mobile Communications (3 Units)

ECE 616 Networks Design and Implementation (3 Units)
Feasibility and design plan. System specification; Systems structure and component selection and dimensioning; Signaling –SS7 (physical and protocol architecture); Performance analysis and maintenance.

ECE 617 Optical Systems (3 Units)

ECE 618 Microwave Communication System Design (3 Units)
Route and site selection; influence of terrain, weather, rain and obstructions. Calculation of path profiles. Use of aerial maps. System Noise Objectives. ITU-T/R international circuits. Choice of equipment; radio equipment, RF combiners; guides, antenna systems, randomes, repeaters and
links and the estimates. System reliability estimates. Calculation of the probability of outages due to propagation.

**ECE 619  Radar And Navigation Systems  (3 Units)**


**ECE 620  Digital Systems Design  (3 Units)**


**ECE 621  Computer Systems Architecture I  (3 Units)**

Computer Fundamentals and Classification, Computer Design by layers: from Applications to Transistors; Design goals (speed, cost, size, power consumption, etc.). Quantitative Principles of Computer Design: Make the Common Case Fast; Amdahl’s Law and application; CPU Performance Equation.

**BASIC ARCHITECTURE OF A STORED PROGRAM COMPUTER**


Seven Key Elements of Instruction Set Architecture (ISA). Assembly Language Programming.

**MEMORY**

Characteristics of Memory; Memory Hierarchy Performance Parameters; Types of Semiconductor Memories and applications; Memory design; Memory Interleaving. Virtual Memory – Hard disk.

**ECE 622  Software Engineering Development  (3 Units)**

Overview of Software Engineering

Software; Nature of Software; Importance of Software; Differences between Software and hardware; characteristics of software that distinguishes it from other products people build.
Types of software: Component – off – the – shelf (COTS), Bespoke, Differences between COTS and Bespoke. Application software. Middleware, Operating Systems, Utilities.

Software Engineering as a Profession

Profession as a body of knowledge, Code of Ethics and Professional Body regulating the profession; Software Engineering Code of Ethics and Professional Practice developed by ACM/IEEE – CS; Whistle-Blowing and Ethical Dilemma.

The Engineering of Software


Software Engineering Life Cycles

Steps in Software Engineering Life Cycle – Requirements Elicitation; Systems Analysis and Specification; Systems Design, Implementation (Coding and Integration); Commissioning and Maintenance. Methods for Requirement Elicitation and Requirement Challenges. Waterfall model; Iterative and Incremental Development; Spiral Development; Rational Unified Process Development; Agile Development techniques; Extreme Programing Development techniques; Scrum; Test-driven development; Manual versus Automated Testing, Refactoring; Advantages and disadvantages of different software development method for an application.

Software Engineering development using Object Orientation


Unified Modeling Language (UML); Different types of diagrams used in UML and their uses; Use Case diagram as interaction between actors and the system itself; Class Diagrams and their representation; Class Associations: Generalization, Aggregation, Composition and Inheritance; State Diagrams and examples of Activity Diagrams; Component Diagrams; Deployment Diagrams.

Object Oriented Programming.

**ECE 623 Computer Systems Architecture II** (3 Units)


PIPELINING (Instruction Level Parallelism)
Pipelining Techniques; Pipeline Unites (Stages), Pipeline with staging Latches; Space Time Graphs.

Instruction –time diagram. Operation of the Pipeline. Instruction Overlap and Pipelining. Pipeline for RISC Processor; Pipeline equations, Pipeline efficiency. Instruction Pipeline Hazards; Detecting Hazards, Data Dependencies, Output dependencies, Forwarding.

Superscalar Processors; Superscalar design with Specialized execution units; Out-of-Order instruction Issue; Centralized, Distributed Instruction Windows. Differences between non-pipelined and pipelined processors, Register Renaming; Reorder buffer. Arithmetic Pipelines: Illustrative examples – How Pentium and i7 processors implement pipelining.

Multiprocessors and multithreading

ECE 624  Software Engineering Project Management  (3 Units)


Managing the Software Development Process

Estimating Software Projects; Contracts; Project planning and monitoring; Project Scheduling; Costing and Budgeting; Models of Software projects.

Quality Management

Software Quality; Why software fails; Concepts in Quality Assurance; Software Standards; Reviews and Inspections; Capability Maturity Modeling; ISO 9000 Standards; Metrics.

Risk Management

Software Risks: Characteristics of High Risk Projects; Risk Analysis and Management; Relationship between Software Risks and Software Failures: Likelihood of Failure, Impact of Failure; Checklist for Software Risks.

ECE 625  Digital Integrated Electronics  (3 Units)

PURIFICATION OF SEMICONDUCTORS MATERIALS:


Creation of Vacuum. Vacuum Pumps:

Types of vacuum pumps – Positive displacement pumps, Diffusion pumps, Cryogenic pumps, Turbomolecular pumps. Pressure ranges of vacuum pumps.
ECE 626  Digital Signal Processing  (3 credits)

ECE 627  Web Engineering and Cyber Security  (3 Units)
WEB ENGINEERING
Computing Technologies: The Internet and the Web; Impact. Attributes of Web-based Applications (WebApps); Framework for Web Engineering (WebE)

Web Development
Requirements for High Quality WebApps: Design Goals; Design Pyramid for WebApps: Interface Design; Aesthetic Design; Content Design; Architectural Design; WebApp Architecture: Model-View-Controller (MVC) Architecture; Navigational Design, WebE Team.

Website Design; Web Portal Design; Web Project Management.

CYBER SECURITY

ECE 628  Biometrics and Image Processing  (3 Units)
ECE 629  Nanoelectronics and Optoelectronics (3 Units)

Nanoelectronics

Overview of Nanotechnology – Fundamental Concepts and Applications.

Introduction of Nanoelectronics – description of electronics at the nanoscale – principles of quantum mechanics, the wave-particle duality, wave functions and Schrodinger equation. Electronic properties of molecules, carbon nanotubes and crystals, energy band formation and origin of metals, insulators and semiconductors. Nanomaterials for electronic applications. Nanoelectronic devices – nanowire MOSFETSs, nanotubes FETS, quantum dot lasers, field emission displays, solar cells, nano sensors.

Optoelectronics


ECE 630  Stochastic Control (3 Units)


ECE 631  Optimal Control (3 Units)


ECE 632  Multivariable Control (3 Units)


ECE 633  Linear Systems (3 Units)

Basic systems concepts: systems, models, representations, dynamical systems representation; Input/output representation state space description singular points and flow pattern in state space, pancake theory and Benison theorem. Linear System; controllability, operability, minimal representation, stability criteria, Lyapunov stability theory. Equivalent discrete systems Z and W

**ECE 634 Large-Scale System** (3 Units)


**ECE 635 System Modeling and Simulation** (3 Units)

Modeling different levels (of systems complexity) for different applications; Design verification, fault analysis, time analysis and testing. Concept of dynamic feedback systems, including; stability, adaptive control and Characteristics of linear vs non-linear systems. Artificial intelligence and Microprocessor application. An introduction to systems, analysis by simulation; continuous, non-linear and Distribution system. Analog simulation with logic elements and hybrid Systems. Solution of difference equations using state space and Z-transform Methods, numerical integration; stability. Digital simulation of one discrete (CPPSS) AND ONE CONTINUOUS (CSMP) simulation language; Pseudorandom members.

**ECE 636 Advanced Control Engineering** (3 Units)


**ECE 637 Linear System Theory** (3 Units)


**ECE 638 System Control** (3 Units)

The minimum effort control; The regulator control; The tracker control; Digital control implementation; Process identification; Advanced Control strategies: NIMC, Adaptive, Fuzzy Logic; MPC and GLC
ECE 700 Thesis/Dissertation (12 Units)

Each candidate for a Doctoral degree shall be assigned a suitable research project approved by the Departmental Postgraduate Studies Committee. The results of the research shall be embodied in a thesis/dissertation.

PGC 701 Synopsis and Research Grant Writing (3 Units)

Choice of broad research area with considerations of interdisciplinary topics, Identification of research/ knowledge gaps and research objectives.


Developing long-term research plan, Identification of potential funding agencies and their requirements. Research objectives in relation to interests of the funding agencies. Estimating research timelines, Budget preparation, manpower requirements and availability, research facilities, legal issues, etc.

ECE 701 and ECE 702 Seminars (3 Units each)

Each doctoral candidate shall present at least three seminars on his/her research project before graduation. At least, one seminar shall be presented at faculty level before graduation.

ECE 710 Network Management and Reliability (3 Units)

Fault; Configuration; Performance; Accounts; and Security Management. Management Protocols – SNMP, CORBA and CMIP; Management Information Base (MIB).

Reliability; Network Monitoring Techniques – Local and Remote

ECE 712 Modeling & Simulation Practice (3 Units)


ECE 713 Optical Networking (3 Units)

Optical Technologies Required; Derived Technology Applications; Overlay Networks; Two-Layer Networks are Emerging; Optical Switching; Distributed Switching; MEMS Switching; Practical Optical Add–Drop Multiplexer; OXCs and OADMIs Enhance Availability and Survivability; Improvements in the Management of the New Network Architecture; All-Optical Cross-Connects; Options for Optical Layer Signaling; Four Classes of Optical Networks; Generic Networks; Optical Bidirectional Line-Switched Rings; Generalized Multiprotocol Label Switching (GMPLS); Selected GMPLS Terminology; The GMPLS Protocol Suite; GMPLS Switching Based on Diverse Formats; Bundling Links; Standardization of Optical Control Plane Protocols; GMPLS and ASON Differ; Hierarchical Routing in Optical Networks
ECE 714  Long-Distance Networks  (3 Units)
Design Problems; Transmission Factors in Long-Distance Telephony; Design of Long-Distance
Links; Design of Line-of-Sight Microwave Systems; Design of Satellite Communications; Fiber-
Optic Communication Links.

ECE 715  Advanced Security Engineering  (3 Units)
The multidisciplinary nature of security. Background: types of attacks and attackers; range of
systems. Overview of security standards and best practices. Access control; authentication
techniques, passwords and password vulnerabilities. Data protection. Basic Cryptography;
Certificates; Crypto-primitives and cyphers. Privacy and anonymity. Trust. Trust mechanisms
and level of trust. Computer security; software and platform security. Network security; attack
detection and mitigation. ATM security; E-commerce security. Card security; GSM and SIM
cards; Payment systems. Security of database applications; injection attacks; Cross-site scripting.
Penetration listing and Web-based systems / Cyber security. Fraud and loss prevention: Banking

ECE 716  Advanced Signal Processing  (3 Credits)
DT Processing of CT Signals and CT Processing of DT Signals: Fractional Delay
Data Acquisition: Sampling in time, aliasing, interpolation, and quantization, sampling Rate
Conversion, spectral analysis. Quantization and Oversampled Noise Shaping. IIR, FIR Filter
Multirate Systems and Polyphase Structures. Linear Prediction and All-pole Modeling. The
Discrete Fourier Transform (DFT). Linear Filtering with the DFT. Spectral Analysis with the
Image processing I: Extension of filtering and Fourier methods to 2-D signals and systems.
Image processing II: Interpolation, noise reduction methods, edge detection, homomorphic
filtering.