Postgraduate Course Outline:

Postgraduate students should achieve the following requirements for program completion:

- 12 Credit hours of Core courses.
- 12 Credit hours of Elective courses.
- 12 Credit hours of Researching.

<table>
<thead>
<tr>
<th>Subject Field</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Cr. Hr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td>CC 711</td>
<td>Advanced Programming Languages</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CC 721</td>
<td>Advanced Computer Architecture</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CC 731</td>
<td>Advanced Computer Networks</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>CC 741</td>
<td>Systems Science and Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

Elective Courses

A total of 12 Cr. Hr.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Cr. Hr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC 712</td>
<td>Advanced Database Systems</td>
<td>3</td>
</tr>
<tr>
<td>CC 713</td>
<td>Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CC 714</td>
<td>Computer Systems Security</td>
<td>3</td>
</tr>
<tr>
<td>CC 715</td>
<td>Neural Networks Systems</td>
<td>3</td>
</tr>
<tr>
<td>CC 716</td>
<td>Pattern Recognition</td>
<td>3</td>
</tr>
<tr>
<td>CC 722</td>
<td>Advanced Digital Systems</td>
<td>3</td>
</tr>
<tr>
<td>CC 723</td>
<td>Embedded Systems Design</td>
<td>3</td>
</tr>
<tr>
<td>CC 725</td>
<td>VLSI System Design</td>
<td>3</td>
</tr>
<tr>
<td>CC 727</td>
<td>Application-Specific Architectures</td>
<td>3</td>
</tr>
<tr>
<td>CC 729</td>
<td>Computer Design and Performance Evaluation</td>
<td>3</td>
</tr>
<tr>
<td>CC 732</td>
<td>CAD for Computer Communications Networks</td>
<td>3</td>
</tr>
<tr>
<td>CC 733</td>
<td>Analysis and Design of Computer Networks</td>
<td>3</td>
</tr>
<tr>
<td>CC 734</td>
<td>Network Security</td>
<td>3</td>
</tr>
<tr>
<td>CC 735</td>
<td>Sensor Networks</td>
<td>3</td>
</tr>
<tr>
<td>CC 737</td>
<td>Mobile, Wireless and Ad-Hoc Networks</td>
<td>3</td>
</tr>
<tr>
<td>CC 742</td>
<td>Real-Time Systems</td>
<td>3</td>
</tr>
<tr>
<td>CC 743</td>
<td>Data Compression and Image Processing</td>
<td>3</td>
</tr>
<tr>
<td>CC 746</td>
<td>Multimedia Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CC 747</td>
<td>Advanced Computer Controlled Systems</td>
<td>3</td>
</tr>
<tr>
<td>CC 753</td>
<td>Advanced Topics in Artificial Intelligence</td>
<td>3</td>
</tr>
</tbody>
</table>
Course descriptions:

**CC 711 – Advanced Programming Languages**
Cr.3.

Different paradigms of programming languages. Introduction to programming languages, history of programming languages, language design principles, syntax, basic semantics, data types, control and abstract data types. Difference between object oriented, functional logic, parallel programming and visual programming.

**CC 712 – Advanced Database Systems**
Cr.3.

This course introduces material related to current advancements and research topics in the area of distributed heterogeneous database.

**CC 713 – Software Engineering**
Cr.3.

This course introduces software engineering as a concept, software development and the development life cycle. It also introduces different topics of software engineering like software quality, reusability, reliability, maintenance, security, testing, and software psychology. Also requirement analysis software tools and software design topics explained.

**CC 714 – Computer Systems Security**
Cr.3.

Conventional encryption (classical and modern algorithm techniques), public-key cryptography, number theory, message authentication and hash functions, hash and MAC algorithm, digital signatures and authentication protocols, mail security, IP security, web security, system security firewalls, projects for teaching cryptography and network security.
**CC 715 – Neural Networks Systems**  
Cr.3.

Introduction to intelligent systems. How does the brain of humans work? Parallel processing through multi nodes and nontraditional processing approach are clarified. Applications in various fields.

**CC 716 – Pattern Recognition**  
Cr.3.

This course provides in-depth review of various methodologies and techniques used in pattern recognition. This includes: feature extraction, reduction and representation to building complex algorithms for handling problems of data analysis. Concepts used in structural and statistical pattern recognition are also explored.

**CC 721 – Advanced Computer Architecture**  
Cr.3.

Overview of parallel architectures and programming techniques, parallel processes, models and semantics, parallel, concurrent and distributed programming. Task scheduling, shared memory parallel programming, complexity aspects, parallel processor design considerations, and pipelined processor design consideration, special-purpose parallel architecture design

**CC 722 – Advanced Digital Systems**  
Cr.3.

This course introduces a range of aspects of advanced digital design. It starts with an introduction to the VHDL, Verilog and ABEL hardware description languages. The course provides techniques for designing and implementing synchronous and asynchronous digital circuits. It explains briefly the various design parameters and tradeoffs such as area, timing and cost of die. Advanced processor design paradigms and architectures such as dataflow, reconfigurable, asynchronous and processor-in-memory are also discussed.

**CC 723 – Embedded Systems Design**  
Cr.3.

Processors, chipsets, busses, and I/O devices for high-end embedded systems. Embedded operating systems; device drivers and applications for embedded systems.

**CC 725 – VLSI System Design**  
Cr.3.

This course focuses on a range of current VLSI design methods, testing and design-for-test techniques. The course presents designs for datapath subsystems including adders, shifters, multipliers, counters and others. Moreover, the course describes memory subsystems and special-purpose subsystems including clocking, I/O, mixed-signal blocks and routing techniques.
**CC 727 – Application-Specific Architectures**
Cr.3.

This course tackles the micro-architectures that are non Von Neumann architectures. These architectures are dataflow, processor-in-memory, reconfigurable computing and asynchronous processor approaches. The course also discusses special-purpose architectures.

**CC 729 – Computer Design and Performance**
Cr.3.

This course compares between the two major design methodologies based on ISA (Instruction Specific Architecture) and Special-purpose Architecture. The course covers the topics of queuing theory and Markov processes as a tool for computer system performance evaluation. Moreover, the students are introduced to operational analysis techniques regarding performance of computer systems. The course introduces the student to the principles of design, build and test of special-purpose processors. Moreover, the students are introduced to the concepts of evaluating the performance of such processors. It is intended for first year graduates specializing in computer engineering. These include Markov continuous and discrete processes. Benchmarking processor and computer system architectures have become extremely difficult due to the complexity of the processors and the complexity of the applications that run on the computers. This course will focus on quantitative and analytical characterization of processors and applications from general purpose and scientific computing. Several papers from recent computer architecture, performance evaluation, and workload characterization related conferences will be used as supplemental material.

**CC 731 – Advanced Computer Networks**
Cr.3.

Fundamental concepts of computer network architectures and protocols with Internet as case study.

**CC 732 – CAD for Computer Communications Networks**
Cr.3.

The course illustrates how computer-aided-design (CAD) tools can be used to simulate computer communications networks and systems. A student hands on series of lab sessions will be used to demonstrate how the various properties of networks affect the quality of the service, and shows how modern computer-aided design (CAD) software can be used to evaluate and optimize the design of a communication networks in general.

**CC 733 – Analysis and Design of Computer Networks**
Cr.3.

To provide the advancements in research and technology of the field of computer networking to emphasize the hot research topics of the analysis, design, architecture and methodology of computer networking and their standards.
CC 734 – Networks Security  
Cr.3.

Fundamental concepts of computer network security and computer networks security issues.

CC 735 – Sensor Networks  
Cr.3.

Basics of sensor network communications. Applications, architectures, and communication protocols for sensor networks are treated in depth.

CC 737 – Mobile, Wireless and Ad-Hoc Networks  
Cr.3.

Mobile and wireless networking. Architectures and communication protocols for wireless local area networks, ad-hoc networks, cellular systems, WiMAX, and Wireless Mesh Networks.

CC 741 – Systems Science and Engineering  
Cr.3.

This course introduces a range of techniques for analyzing continuous and discrete linear time invariant systems. It starts with a review to techniques of solving differential and difference equations using Fourier and the Z-transforms. Subsequently, the course veers to applications involving digital filter design. Afterward, it provides an introduction to the Discrete Fourier Transform (DFT), and Fast Fourier Transform (FFT) with various applications. In addition, the course introduces students to the theory and applications of wavelets transforms.

The course also covers the following bodies of knowledge: Phenomena of real world systems, different imposed boundary conditions as well as symbolic systems manipulations and analysis.

CC 742 – Real-Time Systems  
Cr.3.

Real-time systems are characterized by the fact that it is not only the result of the calculation that is of importance but also the time when the result is available. A computer used for controlling a process is a good example of a real-time system. It must operate in a time-scale that is determined by the time scale of the process. At the same time it should be reactive to external events, often with time constraints on the reaction time.

CC 743 – Data Compression and Image Processing  
Cr.3.

Theory and algorithms of signal encoding and decoding for data compression. Applications in information systems, digital telephony, digital television, and multimedia Internet.
**CC 746 – Multimedia Engineering**  
Cr.3.

Introduce multimedia concepts, how to build and face technical complications of multimedia. Design and implementation of multimedia facilities.

**CC 747 – Advanced Computer Controlled Systems**  
Cr.3.

Introduction to the concepts of computer as a part of the system working as the brain which play the decision maker of the system.

**CC 753 – Advanced Topics in Artificial Intelligence**  
Cr.3.

This course allows the introduction of material relating to current artificial intelligence research topics, and current advances in artificial intelligence technology.

**CC 755 – Distributed and Parallel Systems**  
Cr.3.

This course studies the fundamental aspects of distributed systems and applications. Early foundations and recent developments in distributed systems will be investigated. Both client-server and peer-to-peer application designs will be discussed. Other topics include sockets, reliability, replication, group membership protocols, clock synchronization, and logical timestamps.

**CC 756 – DSP Hardware and Software System Design**  
Cr.3.

A study of theory and practice in the design and implementation of DSP algorithms on programmable processors, multiprocessors, and ASICs. Specification, evaluation, and implementation of real time DSP applications on embedded DSP-based environments.

**CC 757 – Modeling and Simulation**  
Cr.3.

To emphasize the topics of fundamental importance concerning the broad field of modeling and simulation to demonstrate the different stages included in conducting a simulation study, suing the discrete event simulation model.
**CC 758 – Advanced Applications of Digital Signal Processing**

Cr.3.

Discrete time transfer function, realization topology, IIR filter design, FIR filter design, DFT, FFT, Floating Point, sub-band transform and sub-band coding, sinusoidal signal generation, compression techniques, Multi-rate signal processing, Filter Banks, Wavelets and Applications to mp3 and JPEG 2000.

**CC 759 – Advanced Robotics**

Cr.3.

Robot algorithms are abstractions of for controlling motion and perception in the physical world. In this course the student will study advanced topics related to current research in robotics. Planning and control issues for realistic robot systems, taking into account: dynamic constraints, control and sensing uncertainty and non-holonomic motion constraints. Analysis of friction for assembly and grasping tasks. Sensing systems for hands including tactile and force sensing. Environmental perception from sparse sensors for dexterous hands. Grasp planning and manipulation.

**CC 760 – Computer Engineering Seminars**

Cr.3.

A series of seminars with topics related to different fields of computer engineering such as networking and computing fields: mobile ad hoc networks, voice and video over IP, state of the art in computer architecture design, etc...