DENNIS GABOR UNIVERSITY

BSc in Computer Science Engineering

PRESENTATION OF THE PROGRAMME 2023/2024



Name: Computer Science Engineering
Qualification: Computer Science Engineer
Type of the course: full-time undergraduate BSc degree course
Duration of the course: 7 semesters

COURSE DESCRIPTION

Computer science lies in the centre of our technologically driven society, supporting everything from large corporate systems to the individual mobile devices. The rapid world-wide expansion and development of the IT sector provides the background for the application based, practice oriented courses in computing. Industry requires a large number of IT professionals who are able to undertake design, supervise production, install and operate systems and equipments.

The course is aimed at those with a desire to study mathematics, algorithms, electronics, which provide the theoretical basis and design methods for communications, computers, programming, software engineering, control, etc. Practical and organizational skills are encouraged through laboratory works, project presentations and management studies.

COURSE STRUCTURE

- **Year 1 (two semesters)**
  In the first year of BSc students will study subjects that give a thorough grounding in key areas of natural sciences and computing. Your study will include courses in Mathematics, Programming Basics, Problem Solving and Algorithms, Electrical Science and Electronics, Operating Systems, etc.
- **Year 2 (two semesters)**
  You will take courses that emphasize the principles of computing fundamentals. Students will cover topics such as Digital Technology, Computer Architecture, Networks, Basics of Web Programming, Databases, etc.
- **Year 3 (two semesters)**
  You will cover the essential aspects of computing science in breadth and depth by the end of this year. You will gain knowledge in Information Systems Development, Artificial Intelligence, Cloud Computing, Mobile Application Development, etc. In this academic year you will have to choose a specialization. Currently we offer the following options of specialization: Multimedia and Digital Image Processing or Software Development.
- **Year 4 (one semester)**
  Before the beginning of studies, students can attend an one-week intensive preparatory course. This course is designed to help students to develop their basic skills (mathematics, personal competence and communication) necessary to continue their studies on the BSc course level and to improve their English language knowledge.

  In this last semester you will have the opportunity to select courses from a range of elective subjects, and you will focus on the preparation of your final project, i.e. the thesis.

  To complement your education, we have created several competence centres and creative laboratories in cooperation with well-known firms in the field of informatics. By embedding up-to-date technological knowledge into the thematics of our major, optional or elective subjects, and by providing internship opportunities, we are able to offer high quality training and education for all our students.

MAIN SUBJECTS AND TOPICS

- **Basics of Informatics**
  • Data and Information • Data Structures and Algorithms • Applications and System Software • Fundamentals of Operating Systems • Computer Networks and the Internet • Cloud Technologies and Their Applications • Programming Languages and Environments • Basics of the Python Programming Language • Fundamentals of Robotics • Basics of Information Security • Software Development and Programming Fundamentals • Databases and Data Management • Information Technology Project Management • User Experience and Design • Future IT Trends in the Corporate Environment • Software Installation and Maintenance

- **Mathematics**
  • Algebraic Fundamentals and Operations • Set Algebra • Analysis of Sequences: Monotonicity, Boundedness, Limits. Series • Functions • Differential Calculus and its Applications • Integral Calculus and its Applications • Taylor Polynomials, Fourier Series • Discrete Mathematics • Differential Equations • Mathematical Modeling and Applications

- **Basics of Economics**
  • Economics and Economic Systems • Microeconomics and Macroeconomics • Market Analysis and Supply-Demand, Market Equilibrium • Consumer and Producer Decision-Making • Budgeting and Financial Planning • GDP, Unemployment, and Inflation • Money and Monetary Policy • Labor Market and Unemployment • International Trade and Exchange Rates • Economic Growth and Development • Economic and Financial Crises and Crisis Management Strategies • Fundamentals of Economics in Information Technology and Technological Development

- **Operating Systems**
  • Structure and Functions of Operating Systems • User and System Interfaces • Processes and Threads • Scheduling and Concurrency • Memory Management and Virtual Memory • File Systems and Data Storage • I/O Systems and Devices • System Calls and APIs • Multitasking and Time-Sharing • Network Communication and Protocols • System Security and Access Control • Kernel and User Space • Types of Operating Systems (e.g., Windows, Linux, macOS) • Development and Optimization of Operating Systems • Virtualization • Examples and Comparison of Operating Systems



- **Programming Basics**
  • Principles and Concepts of Programming • Programming Languages and Paradigms • Compilers and Interpreters • Data Types • Typed and Untyped Languages • Constants, Variables, and Expressions • Program Control Structures (Loops, Branches) • Functions and Procedures • Parameter Evaluation and Passing • Data Structures (Arrays, Lists, Sets, Maps) • Recursion and Iteration • Error and Exception Handling • File Handling and I/O Operations • Testing and Debugging • Documentation and Code Quality • Most Popular Programming Languages and Comparison • Execution Environments • Basics of Robot Programming • Practical Application of Programming Fundamentals

Problem Solving and Algorithms

• Problem-Solving Mindset, Methodologies of Problem Solving • Principles, Characteristics, and Methods of Algorithms, Complexity, and Efficiency • Algorithm Design Techniques • Recursion and Recursive Algorithms • Search and Sorting Algorithms • Relationship Between Data Structures and Algorithms • Graph Algorithms and Their Applications • Greedy and Dynamic Programming Methods • Backtracking and Search Strategies • NP-Complete Problems and Solution Approaches • Deterministic and Heuristic Algorithms • Analysis and Optimization of Algorithm Efficiency

Electrical Science and Electronics

• Electricity and Magnetism • Electronic Components and Circuits • Digital and Analog Electronics • Semiconductors and Transistors • Integrated Circuits and Microprocessors • Electromagnetic Waves and Optics • Measurement Instruments and Measurement Techniques • Quantum Mechanics and Solid State Physics • Photonics and Optoelectronics • Applications of Physics and Electronics in Computing

Probability Theory

• Combinatorics and Permutations • Basic Probability Concepts • Independent Events and Conditional Probability • Bayes' Theorem • Random Variables and Distributions • Expected Value and Variance • Joint Distributions and Correlation • Law of Large Numbers and Central Limit Theorem • Discrete and Continuous Probability Variables • Common Distributions (Binomial, Poisson, Normal, etc.) • Multidimensional Distributions • Correlation and Regression • Stochastic Processes and Markov Chains

Object Oriented Programming

• Principles of Object-Oriented Programming • Classes, Objects, and Instances • Attributes and Methods • Constructors and Destructors • Encapsulation and Data Hiding • Inheritance and Polymorphism • Abstract Classes and Interfaces • Composition and Aggregation • Multiple Inheritance and Mixin Classes • Exception Handling and Custom Exceptions • Object-Oriented Design and Patterns (Design Patterns) • Most Common OOP Problems and Their Solutions • Practical Application of Object-Oriented Programming

Digital Technology

• Digital Systems and Their Principles • Binary Number System and Encoding • Logic Gates and Circuits • Combinational and Sequential Logic • Registers, Counters, and Memory Units • State Machines and Design Methods • Microprocessors and Microcontrollers • A/D and D/A Converters • FPGAs and Hardware Description Languages • Bus Systems and Interfaces • Design and Simulation of Digital Systems • VLSI and SoC Technologies • Applications of Digital Technology in Informatics

Computer Architectures

• Principles of Computer Architectures • Von Neumann and Harvard Architectures • Processors and Memory • Structure and Operation of the CPU • Instruction Set Architectures • Addressing Modes and Instruction Formats • System Buses and Interfaces • Data Paths and Execution Units • Registers and Register Allocation • Pipelines and Superscalar Processors • Parallelism and Multithreading Execution • Cache and Memory Hierarchy • User and System Modes • RISC and CISC Architectures • Application-Specific Architectures

Information Security

• Principles, Concepts, and Fundamentals of Information Security • Data Security and Data Protection • Network Security and Firewalls • Cryptography and Encryption • User Identification and Authentication • Authorization and Access Control • Security Incidents and Attacks • Security Protocols and Standards • Vulnerabilities and Security Vulnerabilities • System and Application Security • Security Incidents and Response Measures • Security Audits and Testing • Prevention and Recovery of Data Loss • Computer Crime and Ethical Hacking • Organizational and Personal Security Measures • Practical Application of Information Security

Cloud Computing

• Principles of Cloud Computing • Infrastructure as a Service (IaaS) • Platform as a Service (PaaS) • Software as a Service (SaaS) • Types of Clouds: Public, Private, and Hybrid Cloud • Cloud-based Data Storage and Databases • Scalability and Flexibility • Virtual Machines and Containers • Networking and Security Considerations in the Cloud • Cloud-based Networking Technologies • Cloud Service Providers and Comparison • Management of Cloud-based Services • Cloud Migration and Transition • Cloud-based Analytics and Artificial Intelligence • Cloud Management and Automation • Comparing and Selecting Cloud Service Providers • Cloud-based Application Development and Integration • Cloud Computing and Green IT • Cloud-based Architectures and Design • Industry Applications of Cloud Services and Solutions

Information Systems Development

• Design and Analysis of Information Systems • User Needs and Requirements • Functional and Non-functional Requirements • System Architecture and Modular Design • System Integration and Interfaces • Development Methodologies (e.g., Waterfall, Iterative, Agile) • Software Development Life Cycle • Programming and Implementation • System Integration • Version Control and Code Quality • Testing and Validation • Maintenance and System Updates • System Documentation and User Manuals • Project Management and Teamwork • Quality Assurance and Quality Control • System Development Tools and Environments • Practical Application of Information System Development

Mobile Application Development

• Mobile Platforms and Devices (Android, iOS, etc.) • Mobile Development Environments and Tools • Mobile Application Design and User Experience • Native, Hybrid, and Web Mobile Applications • Lifecycle and Event Handling in Mobile Applications • Data Storage and Databases for Mobile Applications • Handling Sensors and Hardware Devices in Mobile Applications • Network Communication and API Integration • Push Notifications and Background Tasks • Security and Data Privacy in Mobile Applications • Testing, Debugging, and Publishing • Practical Application of Mobile Application Development

Artificial Intelligence

• Principles and Applications of Artificial Intelligence • Search Algorithms and Optimization • Learning-based Methods: Machine Learning and Deep Learning • Supervised, Unsupervised, and Reinforcement Learning • Neural Networks and Convolutional Neural Networks • Application Areas: Natural Language Processing, Speech Recognition and Generation, Image Recognition and Processing, Autonomous Vehicles and Robotics, Recommendation Systems and Personalization • Ethical Issues in Artificial Intelligence • Practical Applications and Industries of Artificial Intelligence • Future Challenges and Trends • Tools and Platforms for Artificial Intelligence

Business Management

• Concept and Types of Entrepreneurship • Entrepreneurial Qualities and Skills • Business Planning and Strategy • Business Environment and Market Analysis • Business Development and Growth • Marketing and Sales • Creating and Evaluating a Business Plan • Financial Planning and Budgeting • Organization and Management • Human Resources and Teamwork • Corporate Communication and Negotiation • Operational and Logistic Matters • Innovation and Growth • Risk Management and Corporate Ethics • Legal and Taxation Issues for Businesses • Information Technology Needs and Solutions for Businesses

Innovation and Project Management

• Principles of Innovation and Creativity • Technological Trends and Developments • Innovation Strategies and Business Models • Evaluation and Risk Management of Innovation • Further Developing the Process • Principles and Phases of Project Management, Project Management Methods and Tools • Project Planning and Preparation • Project Planning and Requirements Assessment, Project Objectives and Key Performance Indicators • Project Execution and Monitoring, Deadline and Budget Management • Project Closure and Evaluation • Agile and Traditional Project Management Methodologies • Project Organization and Roles, Collaboration and Teamwork in Projects • Project Communication and Stakeholder Management • Risk Management and Change Management, Project Quality and Resource Management • Project Management Software and Tools

Computer Graphics

• Principles of Computer Graphics • 2D and 3D Geometric Transformations • Projection and Camera Models • Color Theory and Color Spaces • Rasterization and Anti-Aliasing • Texture Mapping • Modeling of Light and Shadows • Ray Tracing and Global Illumination • Animation, Motion, and Rendering • Virtual and Augmented Reality • Graphic APIs, GPU, and Hardware Acceleration • Applications of Computer Graphics and Industries

Networks

• Network Principles and Architectures • OSI Model and Protocol Layers • Physical and Data Link Layers • Network and Transport Layers • Application Layer and Protocols • IP Addressing and Network Masking • Routing and Switching • Wired and Wireless Networks • LAN, WAN, and VPN Networks • Network Security and Firewalls • QoS and Network Performance • Network Management and Monitoring • Basics of Telecommunications

Basics of Web Programming

• Web Principles and Architectures • Basics of HTML and CSS • Server-side Backend Languages such as JAVA, Kotlin, C#, and Frontend Languages for web interfaces like React, Angular, Vue • JavaScript and DOM Manipulation • Client-side and Server-side Programming • HTTP Protocol and Statelessness • Web APIs and REST • Data Transmission and Formats (JSON, XML) • Web Frameworks and Libraries • Responsive and Mobile-friendly Web Design • Security and Data Privacy in Web Applications • Web Performance Optimization and Caching • Practical Application of Web Programming Fundamentals

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