University of Miskolc
Faculty of
Mechanical Engineering and Informatics

Name of the Study Program:
MSc Programme in Computer Science Engineering

The program is designed for individuals who / Introduction:
The course provides a comprehensive knowledge with sound theoretical foundations in the following areas: Software engineering methodologies, SE technologies, Optimization of algorithms, Integration of system components, Parallel algorithms, Programming on mobile platform, Programming on distributed web platform Data security, Data Analysis and DW systems, Textmining technologies. The course includes one semester final research and thesis writing.
Completing the Program, you will be able to / Career opportunities:
Software engineer on almost any field of Information Technology fields (software development, programming, OS and databases) Graduates are able to carry out and coordinate research and development tasks in computer science.

Name of the degree: Computer Science Engineering
Language of the program: English
Duration of the Study Program: 4 semesters
Structure of the Study Program

First semester

Course	Credits	Department
Complexity of Algorithms	5	Institute of Mathematics, Department of Applied Mathematics
Operating Systems and Networks	5	Institute of Information Science, Department of Information Technology
Operation Research and Optimization	5	Institute of Mathematics, Department of Applied Mathematics
Software Engineering	5	Institute of Information Science, Department of Information Technology
Architectures and Embedded Systems	4	Institue of Automation and Communication Technology
Discrete Mathematics	5	Institute of Mathematics, Department of Analysis

Second semester

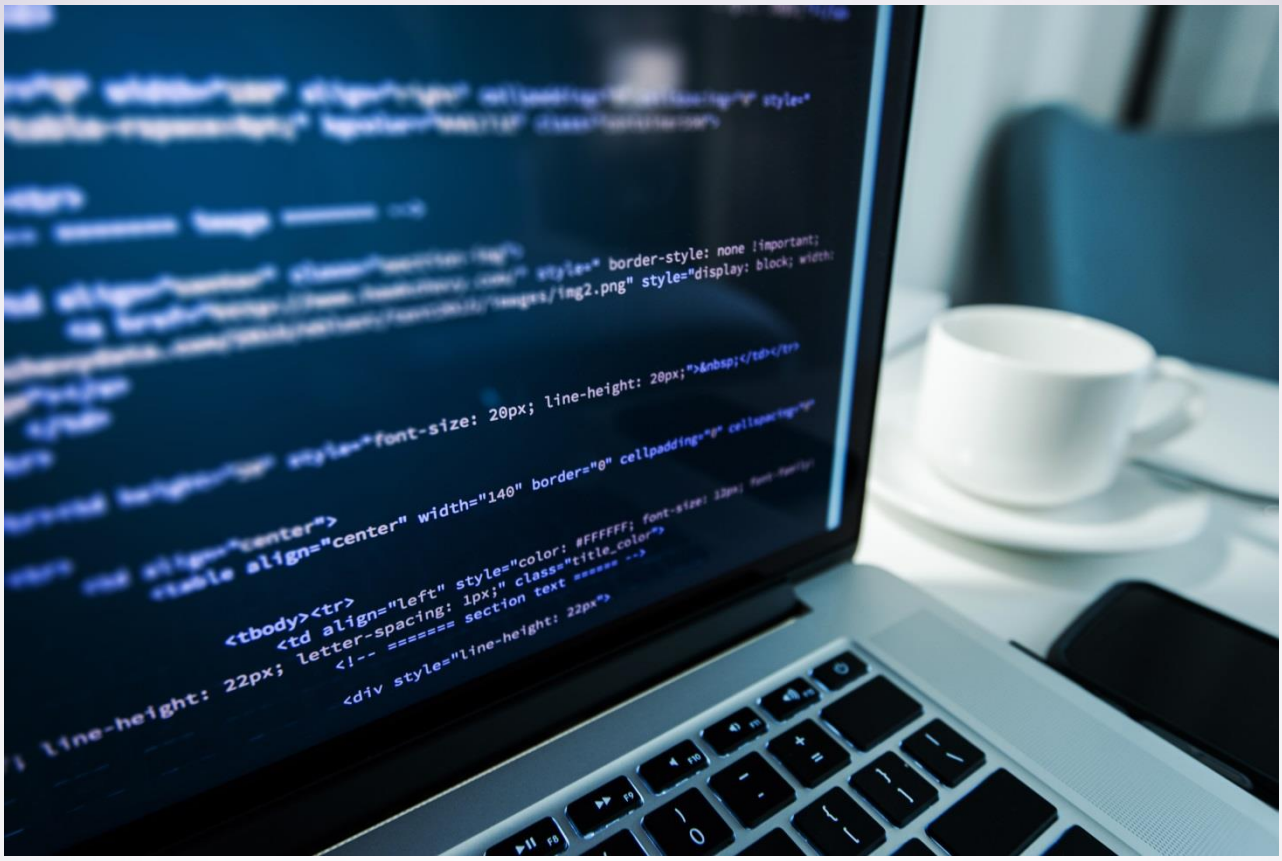
Course	Credits	Department
Enterprise Application Integration	4	Institute of Information Science, Department of Information Engineering
Database Systems	5	Institute of Information Science, Department of Information Technology
Communication Theory	5	Institue of Automation and Communication Technology
Information Theory	5	Institute of Mathematics, Department of Applied Mathematics
Geometric Modeling	5	Institute of Mathematics, Department of Descriptive Geometry
Quality Assurance for InformationTechnology	4	Institute of Information Science, Department of Information Engineering
Introduction to Technical English	3	Institute of Information Science, Department of Information Engineering
Physical Basis of Information Technology	4	Institute of Physics

Third semester

Course	Credits	Department
Protection of Information Systems	4	Institute of Information Science, Department of Information Technology
Mobile Communications	4	Institue of Automation and Communication Technology
Parallel Algorithms	4	Institute of Mathematics, Department of Applied Mathematics
Graphics Programming	4	Institute of Information Science, Department of Information Technology
Data Analysis and Data Mining	4	Institute of Information Science, Department of Information Technology
Project Work A	2	Institute of Information Science, Department of Information Technology
Degree Thesis	11	Institute of Information Science, Department of Information Technology

Fourth semester

Course	Credits	Department
Mobile Application Development	4	Institute of Information Science, Department of Information Technology
Text Mining And Analysis	4	Institute of Information Science, Department of Information Technology
Artificial Neural Network	4	Institute of Information Science, Department of Information Engineering
Degree Thesis	18	Institute of Information Science, Department of Information Technology



Course descriptions

Course: Architectures and Embedded Systems	Credit: 4
Embedded system design and design parameters, system components; Input/output interfaces, analogue signal conditioning; data processing, microcontroller and microprocesszor architectures, FPGA, signal processors; Architecture comparation; Harware-software co-design; communication interfaces; Software design process; Software architectures; Embedded system's operating systems, Real-time operating systems; model based development; system debug and system test.	

Course: Artificial Neural Network	Credit: 4

Work on artificial neural networks, commonly referred to as „neural networks“, has been motivated right from its inception by the recognition that the brain computes in entirely different way from the conventional digital computer. The fundamentals of Artificial Network (ANN) covers mainly the structural levels of organization in the brain, models of a neuron, neural networks viewed as directed graphs, feedback, network architectures, knowledge representation, visualizing process in neural networks, artificial intelligence & neural networks and historical problems. Furthermore learning process and perceptron structure are the essential parts at study of neural network.

The basic points at this study are as follows:

- Structural levels of organization in the brain,
- Network architecture,
- Vizualization processes in neural networks,
- Learning processes (error-correction learning, Hebbian learning, etc.),
- Supervised learning,
- On supervised learning,
- Correlation matrix memory,
- The perceptron structure,
- Least-Mean-Square Algorithm.

Course: Communication Theory	Credit: 5

Representation, description and types of signals. Continuous and discrete signals. Describing signals in time domain. Statistical average, time average, autocorrelation. Fourier transformation, describing signals in frequency domain. Sampling, quantization and coding. DFT. Coding, code types, error-detecting and error-correcting codes. Base concepts of data transmission. Simplex, half-duplex and full-duplex connection. Analog and digital modulation techniques. The basics of digital signal processing.

Course: Complexity of Algorithms	Credit: 5

Models of Computation (Finite automata, The Turing machine, The Random Access Machine, Boolean functions and Boolean circuits)
Algorithmic decidability (Recursive and recursively enumerable languages, Other undecidable problems, Computability in logic, Godel's incompleteness theorem)
Computation with resource bounds (Polynomial time, Other complexity classes, General theorems on space and time complexity)
Non-deterministic algorithms (Non-deterministic Turing machines, Witnesses and the complexity of non-deterministic algorithms, Examples of languages in NP, NP-completeness, Further NP-complete problems)
Randomized algorithms (Verifying a polynomial identity, Primality testing, Randomized complexity classes)
Information complexity (Information complexity, Self-delimiting information complexity, The notion of a random sequence, Kolmogorov complexity, entropy and coding)
Pseudorandom numbers (Classical methods, The notion of a pseudorandom number generator, One-way functions, Candidates for one-way functions)
Decision trees.
Algebraic computations An application of complexity: cryptography (A classical problem, A simple complexity-theoretic model, Public-key cryptography, The Rivest-Shamir-Adleman code (RSA code))

Course: Database Systems	Credit: 5

Overview of data modelling, relational data structure, relational algebra; overview of the SQL standard; Lambda calculus, LINQ API programming; Hierarchical data models; tree structure, LDAP architecture, LDAP model; LDAP data management (schema and security), LDAP API; Overview of XML, Basics of XML schema, Overview of jQuery language, ; Data persistency API, JAPI, mapping XML; JPA API elements; JSQL architecture; JSAL API programming; Object relational data model; Oracle RDBMS; logical model of ORDBMS; CREATE TYPE command, definition of methods; nested tables; reference types, SQL extensions; Deductive databases; relational calculus; DLV programming; Ontology; RDF and OWL language, Protégé Programming.

Course: Data Analysis and Data Mining	Credit: 4
Overview of data analysis tools and levels, basic statistical tools, Bayesian network, comparison of OLAP and OTLP; decision support tools, MD data model, semantic MD models, MD algebra, Oracle PE OLAP commands, programming MD databases in PE, Architecture of MS SQLServer OLAP DW, overview of MDX language; basic MDX queries, derived sets and measures; complex MDX functions; building a data warehouse; schema integration, ETL processes, Transformation methods; M Integration server, overview of data mining, data clustering methods, SOM, data classification methods, BPNN, SVM, mining association rules, detection of outliers, dimension reduction methods, PCA, SVD.	

Course: Discrete Mathematics.	Credit: 5
Sets and relations, partial and linear orders, equivalences, elementary combinatorics, exclusion-inclusion formula, Pascal's triangle, Fibonacci and Catalan numbers, semigroups and groups, the symmetric and alternating groups, Lagrange and Cauchy theorems for finite groups, rings and fields, number fields, the algebra of polynomials, Euclidean algorithm, irreducible factorizations of polynomials, introduction to graph-theory, trees, the greedy algorithm, planar graphs, the chromatic number, bipartite graphs, matchings, the Turán problem, basic Ramsey theory, graphs and matrices, Boolean functions, polynomial form, disjunctive and conjunctive normal forms, clones of Boolean functions, maximal clones, completeness, Post lattice.	

Course: Enterprise Application Integration	Credit: 4
Different level of software integration: data level integration, application interface level integration, method call and GUI level integration. Examining middleware's and EAI technology. Inspecting EAI design patterns: message delivery, transformation, creation, message queues, endpoints, system management patterns. Service Oriented Architecture (SOA) design and Enterprise Service Bus. Context of practical classes is to use an opens source ESB systems in practice e.g. JBoss ESB.	

Course: Geometric Modeling	Credit: 4
Coordinate systems, homogeneous coordinates, matrix representation of point and coordinate transformations. Description of curves, interpolating and approximating curves, spline curves. Osculating plane, arc length, curvature, torsion, Frenet frame. Definition and properties of Hermite arc, Ferguson and Overhauser splines. Parametric description and properties of Bézier curves, de Calteljau algorithm. Parametric form and properties of B-spline curves. Description of surfaces, tangent plane, normal, surfaces swept by a moving curve. Interpolating and approximating surfaces: Coons patch, Bézier and B-spline surfaces. Generation of rational Bézier and B-spline surfaces and their properties. Surface and solid modeling in CAD systems.	

Course: Graphics Programming	Credit: 4
Computer graphics fundamentals; Framebuffer; Platform specific display, the pipeline model of the graphics card; Resources, memory management. Drawing states, overview of Developer Tools and Platforms, Programming graphics cards in OpenGL environment; Elements of graphics rendering in platform independent environment; Texturing basics;The general structure and design of a graphical game engine. Relationship of models and entities. 2D visualization, animation, visibility and collision detection; Font management; Image synthesis, and graphics frameworks designs questions in 3D environments; Camera handling and speed optimization. Multi-texturing; Lightning and shadows; Visibility algorithms and space subdivision; Terrain mapping, Particle System. Applying the GLSL shading language. Dynamic lighting, shadows, post-processing effects using GLSL. Alternative display technologies: ray tracing, voxel-based visualization. Extending game engine with scripting.	

Course: Information Theory	Credit: 5

Source coding : entropy, I-divergence, classification of codes, Kraft-McMillan inequality, source coding theorem, Shannon-Fano coding, Gilbert-Moore coding, Huffman coding, Extended Huffman coding. McMillan's theorem;

Channel capacity: joint and conditional entropies, mutual information. types of discrete memoryless channels, BSC, BEC, channel capacity, Arimoto-Blahut algorithms.

Channel coding: Hamming weight, Hamming distance, minimum distance decoding, single parity codes, Hamming codes, repetition codes, linear block codes, cyclic codes, syndrome calculation, encoder and decoder;

Continuous source, entropy, channels, minimum entropy method.

Course: Mobile Application Development	Credit: 4

Overview of .NET framework and XAML standard. Principles of layout management. Data binding and applications, MVVM pattern and dependency injection. Unit testing of ViewModels. EntityFramework, cloud services.

Summary of Java language. Structure of Android applications, programming activities. Overview of Android services. Building android GUI interfaces. Testing Android applications.

Overview of Objective-C language. Introduction XCode IDE. Structure of iOS applications. Memory management, ARC. MVC pattern overview. Notifications and KVO. Build settings, schemas, targets. GUI structure, storyboarding. Integrating cocoapods. Testing iOS applications.

Course: Mobile Communications	Credit: 4

An overview of the development of mobile communications systems. The mobile radio channel characterization (types, classification and model). Propagation characteristics for mobile radio channel (propagation and simulation model). The propagation attenuation and fading. Diversity techniques. The concept of multiple accesses (FDMA, TDMA, CDMA). Modulation and channel coding procedures. The spread spectrum modulation. Public and closed cellular radio systems: GSM (HSCSD, GPRS), TETRA, DECT, UMTS/IMT-2000. Cellular GSM mobile system. Background and standardization of WCDMA. UMTS services and applications (multimedia, video phone, image, etc.). Radio access network (UTRAN) and architecture. Mobile network design. Mobile ATM, wireless data transmission (mobile IP), WAP, Ad hoc networks, WLAN networks. Mobility security issues. Call routing and mobility management. QoS in the 3-G systems. 4-G systems.

Course: Operating Systems and Networks	Credit: 5

Introduction to mainframe architectures and technologies (Massive Parallel Processing, hardware redundancy, RAID technologies, clustering, storage networks, managing backups), basics of embedded operation systems, real-time operating systems, details of virtualization technologies, overview of modern file system structures, and also presentation of common OS security mechanisms. Introduction to the basic concepts of Computer Networks. Theoretical and design aspects. OSI and TCP/IP network models. Medias of physical layer; Data link layer protocols; Media Access Control sublayer (802.3, 802.11); Network layer (IPv4 and IPv6), addressing schemes, devices of the network extension; Transport layer (UDP, TCP), congestion control schemes.

Course: Operation Research and Optimization	Credit: 5

Optimization models. Gradient vector, Hessian matrix. Positive, negative definite matrix. Classical optimization methods. Unconstrained optimization methods. Constrained optimization methods. Linear programming. Primal and dual problem. Duality theorem. Shadow price. Graph theory, labeling technique. Critical Path Method. Maximal flow - minimal cut problem. Kőnig problems (Marriage problem and its generalization). Conveyor, assignment, transportation problem. Hungarian method.

Course: Parallel algorithms	Credit: 4

Parallel architectures, parallel softwares and environments. Data parallelism. Algorithms of matrices, directions. Communication of processes. Pipeline communication, methods for system of linear equations. Data partitioning. Synchronous parallelism. Relaxed methods and algorithms. Multicomputer architectures, message-passing programs. Parallel numeric algorithms. Parallel Virtual Machine.

Course: Physical Basis of Information Technology	Credit: 4

The course is an introduction to the fundamental concepts, phenomena, models and laws of electrodynamics and modern physics, especially some basic elements of condensed matter physics. Based on these the students can understand the operation of the most important parts of the computer hardware, e.g. the CPU and the hard disk.

Course: Protection of Information Systems	Credit: 4

Protection from physical damage, unauthorized access. Data loss; intruders; attack against security systems; advice from DEC; source of danger, risks, threats, costs; Confidentiality, integrity, availability, functionality. concept of protection, expand concept of protection; „Need to Know”; protection domain; Access Matrix and permissions; implementation of Access Matrix: Global Table, Access Control List, Capability List; Formal methods: Bell LaPadula, Biba; MAC, DAC; Firewalls; components of firewalls; Packet filtering firewall; Circuit level gateway; Application level gateway; stateless and stateful packet filtering firewall; High Availability firewalls; VPN; Deep Packet Inspection Firewall; TCSEC, ITSEC, Common Criteria; Attack methods: DoS, SYN flood, ICMP flood, OOB Nuke, sniffer, address spoofing, DDoS; steganography, cryptography; Kerckhoff; symmetric and asymmetric cryptography; problems of key share; solutions: Diffie-Hellman-Merkle, public key infrastructure; PGP, NTFS-EFS, digital signature and the Hash; the certificates; virus search methods.

Course: Quality Assurance for Information Technology	Credit: 3

The definition of Quality, Quality Management. Factors contributing to quality. The definition of Information Science. The role of quality in the global competitive market. Computer Aided Quality Assurance and its integration.

The quality aspects of software products and software development process. Software process models. Modelling methods of computer application development. Capability Maturity Model. Quality standards of software products. Software specifications. Quality improvements of software development process. Software metrics. Human resources in the software development. Coding standards.

Course: Software Engineering	Credit: 5

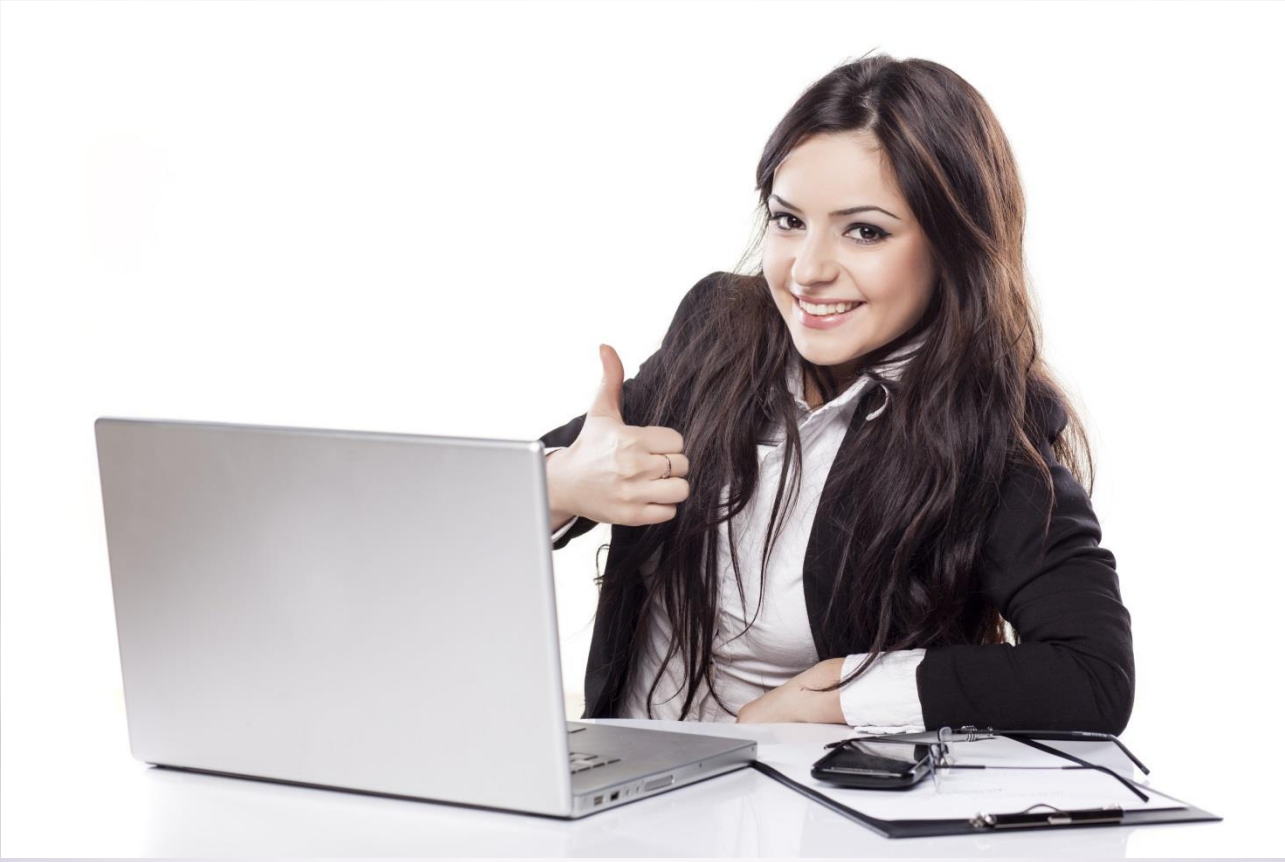
Basic concepts of software engineering. Features of software as a product. The software development steps and life cycle models: waterfall model, Evolutionary software development, Component-based software development, incremental (iterative) development approach. The spiral model. Process Activities. Presentation of Software requirements. Functional, non-functional requirements, user and system requirements, the requirements planning process. Exploration and analysis. The requirements document and feasibility study. Scenarios ethnography. Requirements Validation of Software Design. Architectural design, system build models. Modular decomposition, functioned piping, controlling types, object-oriented design. Rapid software development. Agile Software Development, Extreme Programming, verification and validation. Static and dynamic techniques. V & V design, the concept of software quality. The process and product quality.

Course: Introduction to Technical English	Credit: 4

The subject covers a wide range of lessons on “Classic literature in Technical Science” and “Information Science & Technology” using texts and materials taken from textbooks, newspapers, computer magazines and websites. Classic literature in Technical Science mainly focuses on the comprehensive learning of materials needed to set up students’ language skills and ability in classic engineering sciences. The lessons are based on those materials which taken from different textbooks, they include material science, solid mechanics, fluid mechanics, electric, electronic & computer science, oil industry, energy and innovative engineering sciences. The covering topics of Information Science and Technology involve principles on computer architecture, computer application, operating system, application programs, networks, communication systems, and IT (recent and future developments). The main aim of the subject is to provide students’ ability in expanding their knowledge in R&D (Research and Development) using the English language.

Course: Text Mining and Analysis	Credit: 4

This course builds on the knowledge gained in Data Mining. Namely, text mining is a special field of data mining where information needs to be retrieved, extracted and summarized from unstructured textual data (documents). For this reason techniques of natural language processing are studied first, then classic information retrieval and extraction methods are matched to text mining problems. The clustering and classification of documents are the next issues to consider, mentioning here the standards and benefits of using ontologies. Also text summarization and abstraction methods are examined. At last but not least the operation of web search engines is analyzed. During the course students get an insight into the text mining modules of some major DBMSs and they have the possibility to take part in a text mining project using the services of GATE (gate.ac.uk).



Admission requirements:

BSc level degree in Computer / Software /Electricall Engineering

The applicants must fill out and save all requested information on the online application form in English. A recent photo of the applicant taken not later than six months ago must also be uploaded.

Motivation Letter: A minimum of one page typed in Times New Roman with a font size of (12) in English.

A copy of proof of language proficiency minimum B2 level IELTS, or other internationally accepted certificates. If the instruction language at home country is English, there is no need for any certification. Scanned clearly.

The original copy of the BSc transcripts of Records and their translation in English. The translation should also be sealed and stamped by the Ministry of High Education and confirmed by the Ministry of Foreign affairs. All the documents must be scanned clearly.

Scanned original copy of a medical certificate of satisfactory health condition

Copy of passport : The original copy of two first pages plus the **VISA CONTAINED PAGE** of the applicants' passport, scanned clearly. Having a picture and all the other data stamped sealed officially by the authorities.

Entrance exam

The entrance examination process is supervised by the corresponding Examination Board of the Faculty. The examination process consists of four phases:
verification of the documents
evaluation the results achieved in BSc level study
oral examination / motivation interview with the candidate via Skype
final rating
The final decision is made by the Examination Board.

Graduation requirements

The duration of the study period is 14 weeks for each semester. The Master students have to fulfill two years (four semesters) to succeed and get their Master degree in the selected profession.
All the students are required to pass exams for taken subjects during each semester.
Each subject requires pre- and final exams.

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Each subject requires pre- and final exams.

The time of pre-exams are due to professor decision during the semester, but the usual time for finishing pre-exam is two weeks before the end of the semester.
The students in their third semester chose the topic of their interests calling the professor attention whom they want to perform their Thesis Work.

Students completed all the compulsory, thesis and elective course requirements, achieved a minimum of 120 ECTS credits.

Students submitted and successfully defended a Thesis Work.

Students fulfilled all the administrative and financial requirements towards the University

Application/Tuition fee: Please visit: http://englishstudyprogrammes.uni-miskolc.hu
Available Scholarship: Please visit: http://stipendium.uni-miskolc.hu
Contact: : kovacs@iit.uni-miskolc.hu