Transilvania University of Braşov, Romania

Study program: CyberSecurity

Faculty: Electrical Engineering and Computer Science
Study period: 2 years (master)

1st Year

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Cryptography Fundamentals and Application Scenarios	CS101	5	2	-	2	-

Course description (Syllabus): Mathematics for cryptography: Basic number theory, Basic probability theory, Basic complexity theory, Probabilistic algorithms. Cryptographic ciphers. Cyptographic Functions.Criptographic keys: key generation algorithms, random / pseudorandom keys; Simmetric Encryption; Asymmetric Encryption; Digital signatures; Public Key Infrastructures; Study on cryptographic protocol;Protocols for identification and login; Security vulnerabilities of implemented cryptographic functions. Improving the security of cryptographic protocols

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
CyberSecurity of Information Systems and Services	CS102	6	2	-	2	1

Course description (Syllabus): Fundamentals of network security: defense model, description of security vulnerabilities for a system; Basic network concepts: client, server, network equipements,TCP/IP stack, OSI stack, HUB, switch, MAC address, ARP protocol ,Router, IP addressing, ICMP protocol, TCP / UDP protocol, DNS service, NAT translation; Data Link basic concepts: VLAN, STP protocol; Security of Local Area Network; General concepts for ensuring system security at the network level: Security of network equipments, LAN security, Firewall Implementation, Remote Desktop, VPN, SSH, Network atuhentication methods
Operating Systems fundamentals: process, virtual memory, virtual address space, page fault, buffer, buffer overflow, return address, stack, stack frame, call, ret, stack pointer, frame pointer, memory allocation, compiling, assembling, linking, disassembling, heap, function, calling convention, kernel space/mode, user space/mode, system call, register, bus.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Identity and Access Management in the Virtual Space	CS103	5	2	-	2	-

Course description (Syllabus): Virtual Space Concept ; Constitutive elements of identity in virtual space. Fictional profiles and identities. Identity theft. Stereotypes and patterns of behavior; Anonymization - an illusion of anonymity: private virtual networks, dedicated anonymization applications, Internet browsers and operating systems, hardware anonymization; Elements of interest related to the presence in the virtual space: identifying, addressing and relational circles, cyber attacks, banking, botnet, mining, ransomware, interest classification: economic, military, non-legal interests.
Implement device administration: TACAS+, RADIUS, Native AD, LDAP; Describe identity management: describe features and functionality of authentication and authorization, describe identity store options (i.e., LDAP, AD, PKI, OTP, Smart Card, local); Network access control; Extensible Authentication Protocol – EAP; Kerberos Protocol; Implementation of PKI Infrastructures; Understand and implement internal and external authentication databases; IAM systems. Single sign-on systems.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Types of Cyberattacks and Threats	CS104	4	1	-	1	-

Course description (Syllabus): Introduction – security attack definition, common cyber-security attacks – stages and patterns; Types of cyber attacks, vulnerabilites of security systems. Classification of cyber security attacks: Device compromise attacks, Service Disruption Attacks, Data Exfiltrations Attacks, Bad Data Injections, Advanced persistent threats; Device compromise attacks. Use cases; Service Disruption Attacks. Use cases; Data Exfiltrations Attacks. Use cases; Bad Data Injections. Use cases; Advanced persistent threats. Use cases; Methods of prevention against security attacks

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Academic ethics and integrity	CS105	4	1	-	-	-

Course description (Syllabus): Introduction to creativity and inventiveness; Importance and birth of an invention. Examples of famous inventions and young authors. Examples with the negative role of plagiarism; Creativity. Definitions and methods of development; Legislation; Rules for the preparation of a patent documentation. Brainstorming and role in creativity. Patenting in the US and Europe. Ethics and integrity in scientific and patent activity. Correct writing of an academic paper. Ethics in citation. Search for references, MLA citation, APA, ISO690, international databases Plagiarism, self-plagiarism, ghost authors and plagiarism recognition software. Professional ethics in team work. Principles, legislation, traps. The importance of academic ethics and integrity in scientific activities, including patenting. Presentation of conclusions on patenting and academic ethics. Analysis of elements of academic integrity in the projects presented by each student.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical placement	CS106	6	-	-	-	10

Course description (Syllabus): Practical placement

Management of Cyber Security Incidents

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Management of Cyber Security Incidents	CS207	4	1	-	1	1

Course description (Syllabus): Introduction in in Cyber Defense ; Description of Kill Chain (steps of an attack); Legacy vs modern attacks; Security architecture of cyber-defense infrastructures: Router Switch Firewall WAF NIDS/NIPS UTM/NGFW, Sandbox Proxy SIEM/SOC, Packet capture, Honeypot, Threat intelligence; Architecture and main concepts for a SIEM/SOC; Planning and concept, Security log collection, log storage, Alerting and analyze strategies, Analyze of important network services (email, DNS, HTTP, HTTPS) based on SIEM/SOC, Advanced analyze at workstation level (endpoint), Collecting strategies, Endpoint security- Patching, whitelisting, blacklisting, AV, HIDS, HIPS, user rights; Methods to identify malware actions; Register and process monitoring; Firewall services; Management of security incidents at SIEM/SOC level; Software monitoring; Scripting; Traffic monitoring; Extreme analyze instruments; Analyze of user behaviors; Post- detection analyze

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Network Security and Perimeter Defence	CS208	5	2	-	2	-

Course description (Syllabus): 1. Introduction - Perimeter Defense Concepts and Secure Network Architectures; 2. Implementing Access Lists and Firewall Technologies: IP ACL: standard, extended, complex (time-based , dynamic, reflexive);Definition and types of firewall; Firewall Context Based Access Control, Zone-based Policy Firewall; Case studies: Snort, Suricata; Implementing Intrusion Prevention IPS/IDS; Definition and types of IPS/IDS. PKG and SDF signatures; Testing, monitoring and editing IPS. Implementing Virtual Private Networks; Tunneling: IPsec / GRE; site-

to-site / remote-access; MPLS and MPLS Security;Management of Secure Networks; Securing Wireless Networks: Wireless overview; Bluetooth and ZigBee; 802.11; Wireless security

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Security of Critical Infrastructures	CS209	4	1	-	1	-

Course description (Syllabus): Principles of cyber security methodology; Implement security measures for networks and information systems; Elements of critical infrastructures – cloud, data center; Storage Types / Data Storage Methods, RAID Matrix, SCSI over IP (iSCSI), Fiber Channel, and Network Attached Storage (NAS); Fiber Channel storage networking, VLANs, VSANs, N-Port Virtualization (NPV), and N-Port Identifier Virtualization (NPIV); Redundancy methods in networks

Implementations of critical services: Case study using Windows 2016 Server: Identify application servers: Mail servers, database servers, collaboration servers, monitoring servers, threat management; o Understand Web services: IIS, WWW, and FTP, installing from Server Manager, separate worker processes, adding components, sites, ports, SSL, certificates; o Remote assistance, remote administration tools, Remote Desktop Services, multipoint services, licensing, RD Gateway, VPN, application virtualization, multiple ports; o File and print services: Local printers, network printers, printer pools, web printing, web management, driver deployment, file, folder, and share permissions vs. rights, auditing, print job management; o Server virtualization; o Virtual memory, virtual networks, snapshots and saved states, physical to virtual conversions, virtual to physical conversions, VHD and VHDX formats, nested virtualization;

Critical Infrastructure use-case: Network design for: gas-pipe management; 112 emergency systems; water supply

Course title	Code	No. of credits	Number of hours per week			
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Industrial Control Systems Security	CS210	4	1	-	2	-

Course description (Syllabus): Module 1: Security of Industrial Networks; Smart Grid Operations; Module 2: Hardware and Embedded Security; Module 3: Security of applications and implementations in the automotive industry; Module 4: IoT and Industrial IoT Security (not all modules will be performed, it depends on student interest)

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Business Process Management	CS211	3	1	-	-	-

Course description (Syllabus): Introduction to software systems modeling. Application modeling. Modeling process flows. Service-oriented modeling. Data modeling. Process life cycle management. Model of Process Simulation Analysis. Compatible assembly models based on components. Using domain rules in service-oriented architecture. The language used to specify Web services. Service-oriented and component-based architecture. Security and governance of service-oriented architecture

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical placement	CS212	6	2	-	1	-

Course description (Syllabus): Practical placement

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Secure Programming and Application Security	CS213	4	2	-	1	-

Course description (Syllabus): Security relevant C/C++ programming bugs and flaws; Exploitable security flaws; Protection principles; machine code, memory layout, stack operations; Buffer Overflow, Stack overflow; Heap overflow; Common Coding Errors & Vulnerabilities; Advice and Principles of robust programming

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Secure Web and Internet Technologies	CS214	4	-	-	-	10

Course description (Syllabus): Secure Web Architecture: Authentication in a Web Application; Access Control (Authorization); Localization; Password Encoding. Testing of Secure Web Architecture: Tests with mocks, Test Integration, Reactive method security. Web Application Security: Security Filters, Remember-Me Authentication, Basic and Digest Authentication, Cross Site Request Forgery, Security HTTP Response Headers, Session Management, Anonymous Authentication. Advanced Topics: Domain Object Security (ACLs), Pre-Authentication Scenarios, LDAP Authentication, CAS Authentication, OAuth Login, Encryptors, Key Generators, Security Context Support. Principles of Secure Web Applications: OWASP - Open Web Application Security Project.

2ndYear

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
IT Forensics	CS301	4	1	-	1	-

Course description (Syllabus): Introduction in IT Forensics; Data acquisition from storage devices; RAM memory acquisition from all Operating Systems I – Windows; RAM memory acquisition from all Operating Systems II – Linux; RAM memory analysis: Analysis of the files Pagefile.sys, Hiberfil.sys, Swapfile.sys, Extraction of the files, Extraction of the artefacts, Analysis of the connections made by the operating system, Analysis of the processes extracted from RAM, Analysis of the code injected in RAM, Extracting of the relevant information   from registry using the specific plugins, Automating the analysis process of the RAM, Operating Systems log files analysis; Registry analysis; User analysis; Network connections analysis; USB devices analysis; Timeline analysis; Shadow copy volume analysis; Anti-forensic methods identification techniques.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Data mining and data warehousing	CS302	5	2	-	2	-

Course description (Syllabus): Introduction to data mining and data warehousing, Data Visualization, Minable Data, Text Retrieval and Search Engines, Data Mining Process, Text Mining and Analytics, Pattern Discovery in Data Mining, Cluster Analysis in Data Mining, Data Mining Tools, OLTP, OLAP and Other Terminologies, Lifecycle and Rules of Data Warehouse, Data Warehouse Architecture and Flow, Data Warehouse Modeling, Data Warehouse Applications

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Ethical hacking and security audit	CS303	4	1	-	2	1

Course description (Syllabus): Introduction, Phases of penetration testing, Footprinting, Scanning, System hacking, Trojans, Sniffing the traffic, Denial of Service, Session Hijacking, Web Server Hacking, SQL Injection Attack, Wireless LAN Hacking, Mobile Devices Hacking

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Information Assurance and Risk Management	CS304	4	1	-	-	1

Course description (Syllabus): Information assurance management; Informational security components: physical, personal, INFOSEC, cooperation; Policies and concepts: analysis, particularization, development;Computer networks vulnerabilities and attacks; Evaluating investments in security; Managing risk in IT systems – introduction; Risk identification and evaluation (quantitative and qualitative); Risk monitoring; Back-up and contingency plans.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical placement	CS305	6	-	-	-	10

Course description (Syllabus): Practical placement

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
CyberSecurity of Mobile Devices	CS306	4	2	-	1	-

Course description (Syllabus): Mobile Operating Systems – Android; Mobile Operating Systems – iOS; Mobile Operating Systems - Blackberry; Mobile Operating Systems - Windows; Mobile Operating Systems - Vulnerabilities rooting/jailbreak and malware; Wireless vulnerabilities, bluetooth, NFC and GPS; Cloud data vulnerabilities; Mobile devices securing methods; Mobile devices analysis tools; Forensic elements for mobile devices – Android; Forensic elements for mobile devices – iOS; Forensic elements for mobile devices – Blackberry; Forensic elements for mobile devices - Windows

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Malware analysis	CS307	4	2	-	1	-

Course description (Syllabus): Introduction; Classification, propagation and malware analysis ; Malware Analysis Techniques – operating systems and filesystems; Malware Analysis Techniques – assembly language, PE structure and Windows API; Malware Analysis applications; Reverse Engineering for executable applications; Reverse Engineering - Protection methods used by malware; Web file and logs analysis; Scripts and documents analysis; Memory analysis; Debugging protected executables and code injection; Traffic Analysis; Automation and Hunting;

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Enterprise Architecure and Business Performance	CS308	3	1	-	-	-

Course description (Syllabus): Enterprise architecture foundational concepts; Enterprise architecture methodologies; Data security architecture for organizations; Organizational change management; Strategic planning for organization; Setting strategic directions: roles and responsibilities; Organization performance methodology: Balanced Scorecard; Data collection methods for assessing organization performance.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Data Protection and Security Legislation	CS309	3	1	-	-	-

Course description (Syllabus): The course aims to provide a thorough and critical knowledge of some of the main issues that characterize the legal and technological aspect of Data Protection, to better understand the contents, obligations and principles of the EU legal framework for data protection, as well as the process and transfer personal data, comply to European, Italian and Romanian Law. The IT Forensics perspective of the course aims to provide a thorough and critical knowledge of some of the main issues that characterize the legal aspects for the search, acquisition, storage, analysis, and evaluation of digital evidence valuable during the trial. The correct application of legal rules require every computer scientists need to know with precision the legal implications of their activities and therefore the principles of substantive law, procedural law and in particular the rules of seizure, collection and research of the evidence, to avoid errors during the investigation, often irreparable

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical placement	CS410	10	-	-	-	12

Course description (Syllabus): Practical placement

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Practical for dissertation paper preparation	CS411	10	-	-	-	12

Course description (Syllabus): Students will have to choose a practical placement where they will be able to experiment and research in the area of their dissertation theme. Practical placement can be performed also in "Transilvania" University research institute or for the IT Office of the university.

Course title	Code	No. of credits	Number of hours per week			
			course	seminar	laboratory	project
Elaboration of dissertation paper	CS412	10	–	–	–	2

Course description (Syllabus): Students will have to have periodical meetings and work with their dissertation paper coordinator in order to achieve the necessary practical results and formal criteria for a dissertation paper that can be presented in front of the examination board.