**COURSE SYLLABUS**

***SECURITY OF DATABASES***

**1. Program identification details**

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| 1.1 Higher education institution | „Ovidius” University of Constanta |
| 1.2 Faculty | Faculty Mathematics and Informatics |
| 1.3 Department | Mathematics and Informatics |
| 1.4 Field of studies | **Informatics** |
| 1.5 Cycle of studies (degree) | Master |
| 1.6 Degree program/qualification | **Cyber Security and Machine Learning** |
| 1.7 Academic year | 2022 - 2023 |

**2. Course identification details**

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| 2.1 Course title | | | **SECURITY OF DATABASES** | | | | |
| 2.2 Course code | | | **FMI.CSML.I.1.01** | | | | |
| 2.3 Instructor | | | Conf. dr. Elena BAUTU | | | | |
| 2.4 Teaching assistant | | | Conf. dr. Elena BAUTU | | | | |
| 2.5 Year | 1 | 2.6 Semester | 1 | 2.7. Evaluation type | E | 2.8 Course type \*/\*\* | DAP/DI |

*\* DF – fundamental course, DD – field course, DS – specialty course, DC – complementary course, DAP – advanced study course, DSI – synthesis course, DCA – advanced knowledge course.*

*\*\* DI – mandatory course; DO – optional course.*

**3. Estimated workload (hours per semester)**

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| 3.1 Number of teaching hours/week | | 4 | of which:  3.2 course | 2 | 3.3 applications*\*\*\** | 2 |
| 3.4 Total of teaching hours within the program/semester | | 56 | of which:  3.5 lecture | 28 | 3.6 seminar | 28 |
| **3.7 Student workload for individual study** | | | | | | 119 |
| ***Distribution of workload*** | | | | | | [hours] |
| Individual study of texbooks, handbooks/reader, bibliography and notes | | | | | | 48 |
| Additional research (library, electronic resources, fieldwork) | | | | | | 20 |
| Homework (preparing seminar presentations, portfolios, critical essays, research papers, etc.) | | | | | | 41 |
| Individual consultations (optional) | | | | | | 2 |
| Evaluations / exams | | | | | | 8 |
| Other activities | | | | | | 0 |
| **3.8 Total hours per semester** | *3.4. + 3.7*  *56+119 = 175* | |  |  |  |  |
| **3.9 Number of credits** | 7 | |  |  |  |  |

*\*\*\* S - seminar; L - laboratory; P - project*

**4. Prerequisites (if any)**

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| 4.1 Curriculum-related | Operating Systems, Databases, Database Management Systems |
| 4.2 Skills-related | - |

**5. Requirements (if any)**

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| 5.1. For running the course | Moodle/Webex/Microsoft Teams for online learning OR Classroom equipped with video projector available |
| 5.2. For running the seminar / laboratory /project  *\*The type is to be chosen according to the discipline* | Moodle/Webex/Microsoft Teams for online learning OR Laboratory room with computers available |

**6. Acquired specific skills**

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| Professional skills | Responsible execution of professional tasks, in conditions of restricted autonomy and qualified assistance.  Going through the bibliographic material and working on the laboratory projects, mastering the notions and methods în order to use them in the elaboration of database projects with security components. |
| Cross-cutting skills | Applying rigorous and efficient work rules, the norms and values of professional ethics within one's own work strategy, for the optimal and creative use of one's own potential in specific situations.  Identifying roles and responsibilities in an interdisciplinary team and applying relationship techniques and efficient work within the team. |

**7. Course goal and objectives**

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| 7.1 The general objective of the course | Understanding the issues related to database security and threats.  Understanding state of the art security technologies.  Identifying solutions to ensure the security of databases. |
| 7.2 Specific objectives | Understanding the fundamental notions of database systems security  Identifying risks and vulnerabilities of the operating system from the perspective of databases  Understanding database security models. Identifying and using specific database security mechanisms.  Case studies for Oracle/Postgres database management systems. |

**8. Contents**

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| **8.1 Lecture** | **Teaching methods** | **Number of hours** |
| 1. **Database management systems. Relational Database Management Systems**. Conceptual modeling of data: the *Entity Relationship Data Model*. Overview of the *Relational Data Model*. Relational databases. Data integrity constraints. Normal Forms. *Transactions*. ACID, RAID properties.  **Distributed databases**. Semi-structured data models. | Interactive teaching methods  Dialogue  Problem  Heuristic conversation  Case study  Methods that contribute to the development of critical thinking.  Independent learning  Cooperative learning  Synthesis / essentialization of information  Teamwork | 4 |
| 2. **Database security overview**.  General security issues.  Security policies:  3. **Database security**: user management: Profiles, Password Policies (case studies in Oracle, Postgres).  3. **Data Access Control Models for relational databases.**  Properties of Access control models.  *Discretionary Access Control.* Access Matrix Model  Mandatory Access Control  *Role Based Access Control.* Administrative policies.  Models for multi-level secure relational databases (Bell-LaPadula, etc). Implementations în RDMSs. | 2  2  4 |
| 4. **Access Control Mechanisms.**  Privileges. Authorizations graph.  Role-based access.  Case studies: Privileges and Roles în ORACLE. Roles, Privileges and Row level security în Postgres. | 4 |
| 5. **Access control mechanisms:** *Content based security în Postgres:* Column level security, views, partitioning, column data encryption | 2 |
| 6. **Access control mechanisms:** *Content based security în ORACLE:* row level security, views, Virtual Private Databases, Data encryption. | 4 |
| 7. **Backup and recovery în databases**: case study în Postgres. File System Level Backup/Restore. SQL dump. | 2 |
| 8. **Backup and recovery în databases**: case study în ORACLE. Physical Backup. Logical Backup. Specific ORACLE tools. | 2 |
| 9. **Database Auditing**. Case studies în ORACLE, Postgres. | 2 |
| Bibliography:   1. Faragallah, Osama S., El-Sayed M. El-Rabaie, Fathi E. Abd El-Samie, Ahmed I. Sallam, and Hala S. El-Sayed. Multilevel security for relational databases. CRC Press, 2014. 2. Michael Gertz and Sushil Jajodia (Editors), Handbook of Database Security: Applications and Trends , ISBN-10: 0387485325. Springer, 2007 3. Stavroulakis, Peter, and Mark Stamp, eds. Handbook of information and communication security. Springer Science & Business Media, 2010. 4. Afyouni, Hassan A. Database security and auditing: Protecting data integrity and accessibility. Nelson Education, 2005. 5. Coronel, Carlos, and Steven Morris. Database systems: design, implementation, & management. Cengage Learning, 2016. 6. Peter Ping Liu, Database Security, School of Technology, College of Business & Applied Sciences, Eastern Illinois University 7. T. Ozsu and P. Valduriez, Principles of Distributed Database Systems, Springer; 3rd Edition. edition (March 2, 2011), ISBN-10: 1441988335 8. Pfleeger, C.P., Pfleeger, S.L. and Margulies, M., "Security in Computing", 2006, Prentice Hall. Boston–MA, USA. 9. Christian Mancas, "Conceptual Data Modeling and Database Design. A   Fully Algorithmic Approach, Apple Academic Press, 2016   1. Hector Garcia-Molina, Jeff Ullman, and Jennifer Widom, “Database Systems – The Complete Book”, 2008. 2. Oracle Database Security Guide,   https://docs.oracle.com/en/database/oracle/oracle-database/19/dbseg/index.html   1. Postgres documentation,   https://www.postgresql.org/docs/ | | |

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| **8.2 Applications\* (seminar / laboratory / project)**  *\*The type is to be chosen according to the discipline* | **Teaching methods** | **Number of hours** |
| 1. Overview of the Relational Data Model. Building a relational database. Integrity constraints în relational databases. Normal forms. SQL Language (DDL, DML). | Dialogue  Problem  Heuristic conversation  Case study  Independent and cooperative learning  Synthesis / essentialization of information | 6 |
| 2. User management. Privileges management. Password management. Role management. | 2 |
| 3. Access control policies: Discretionary access control (DAC). Mandatory access control (MAC). Role-based access control (RBAC) | 4 |
| 4. Access Control Mechanisms în ORACLE, Postgres | 8 |
| 5. Implementation of a virtual private database (VPD). Case Study.  6. Backup and recovery | 2  2 |
| 7. Database audit. | 2 |
| 8. Presentation of reports / projects | 2 |
| **Bibliography:**   1. Yang, Li. "Teaching database security and auditing." Proceedings of the 40th ACM technical symposium on Computer science education. 2009. 2. Afyouni, Hassan A. Database security and auditing: Protecting data integrity and accessibility. Nelson Education, 2005. 3. Coronel, Carlos, and Steven Morris. Database systems: design, implementation, & management. Cengage Learning, 2016. 4. Oracle Database Security Guide,   <https://docs.oracle.com/en/database/oracle/oracle-database/19/dbseg/index.html>  [5] Postgres documentation, https://www.postgresql.org/docs/ | | |

**9. Correlation between the content of the course and the needs/expectations of the epistemic community, professional associations and/or significant employers relevant for the program**

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| Preparing graduates for a profession in the field of cyber security and software development. |

**10. Evaluation**

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| Type of activity | 10.1 Evaluation criteria | 10.2 Evaluation methods | 10.3 Percentage of final grade |
| 10.4 Course | Active participation | Oral | 10% |
| 10.5 Applications\*  (Seminar/Laboratory / Project)  *\*The type is to be chosen according to the discipline* | Active participation Realisation of the proposed projects | Lab quizzes  Scientific report/project | 20%  30% |
|  | Exam | | 40% |
|  | | | |
| 10.6 Minimum standard of achievement for the acquisition of the ECTS credits | | | |
| Realization and presentation of a scientific report and/or specialized project.  The final grade is computed aș a weighted average (see 10.4, 10.5). The  The exam is passed if the final grade is greater than or equal to 5. | | | |

Date of completion Course Instructor, Teaching Assistant,

20.09.2022 Conf. dr. Elena BAUTU Conf. dr. Elena BAUTU

Date of approval in the Department Head of Department

27.09.2022

Conf. dr. Crenguta Madalina PUCHIANU

Dean,

Conf. dr. Aurelian NICOLA