Universitatea Naţională de Ştiinţă şi Tehnologie Politehnica Bucureşti
Facultatea de Electronică, Telecomunicaţii şi
Tehnologia Informaţiei

COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	**National University of Science and Technology Politehnica Bucharest**
1.2 Faculty	**Electronics, Telecommunications and Information Technology**
1.3 Department	**Applied Electronics and Information Engineering**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Masters
1.6 Programme of studies	Advanced Techniques for Digital Imaging

2. Date despre disciplină

2.1 Course name (ro) (en)				Baze de date pentru aplicaţii ştiinţifice			
2.2 Course Lecturer				S.l./Lect. Dr. Valentin PUPEZESCU			
2.3 Instructor for practical activities				S.l./Lect. Dr. Valentin PUPEZESCU			
2.4 Year of studies	1	2.5 Semester	II	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		S	2.9 Course code	1		2.10 Tipul de notare	Nota

3. Total estimated time (hours per semester for academic activities)

3.1 Number of hours per week	2.5	Out of which: 3.2 course	2.00	3.3 seminary/laboratory	0.5
3.4 Total hours in the curricula	35.00	Out of which: 3.5 course	28	3.6 seminary/laboratory	7
Distribution of time:					hours
Study according to the manual, course support, bibliography and hand notes Supplemental documentation (library, electronic access resources, in the field, etc) Preparation for practical activities, homework, essays, portfolios, etc.					56
Tutoring					0
Examinations					2
Other activities (if any):					0

3.7 Total hours of individual study	65.00
3.8 Total hours per semester	100
3.9 Number of ECTS credit points	4

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Completion and promotion of the following subjects: · Computer programming · Architecture of computing systems · Operating systems · Computer networks · Database
4.2 Results of learning	Accumulation of the following knowledge: · Application of fundamental and specialized knowledge to solve complex technical problems, specific to the field of electronic engineering, telecommunications and information technologies; · Design and implementation of applications in IT systems and databases: theory and design of databases in different implementation models (relational, object-oriented, object-relational, XML, document collection-oriented databases), for different application categories (spatial, NoSql, etc.) and with different data distribution capacities (parallel databases, distributed databases, databases in the Web system); · Responsible execution of work tasks in a multidisciplinary team, assuming roles on different hierarchical levels; · Identifying the need for continuous training and the effective use of information sources and communication resources and assisted professional training (Internet portals, specialized software applications, databases, online courses, etc.) both in Romanian and in a language of international circulation.

5. Necessary conditions for the optimal development of teaching activities (where applicable)

5.1 Course	Not the case.
5.2 Seminary/ Laboratory/Project	Not the case.

6. General objective *(Reffering to the teachers' intentions for students and to what the students will be thought during the course. It offers an idea on the position of course in the scientific domain, as well as the role it has for the study programme. The course topics, the justification of including the course in the currcula of the study programme, etc. will be described in a general manner)*

The development of database systems in the last decades represents one of the most important aspects in the field of information technology, having a decisive impact on the way of organization and operation of numerous institutions and services. Communications companies, commercial enterprises, banking services, transportation services, insurance and many others are totally dependent on the correct and uninterrupted operation of their database systems. That is why the demand for specialists with solid theoretical knowledge and experience in designing and using databases is particularly high and constantly growing.

The course curriculum responds concretely to these current development and evolution requirements, subscribed to the European service economy in the field of electronic engineering, telecommunications and information technologies. In the context of current technological progress, the possibilities of designing and creating databases are practically unlimited: databases can be developed in different models (relational, object-oriented, object-relational, xml, document collections), centralized or distributed, in own computing infrastructures or using resources from cloud systems.

In this way, the graduates are provided with adequate competences with the needs of the current qualifications and a modern, quality and competitive scientific and technical training, which will allow them to be employed quickly after graduation, being perfectly framed in the policy of the Politehnica University of Bucharest, both from the point of view of the content and structure, as well as from the point of view of the skills and international openness offered to students.

The general objective of the discipline is to provide students with the necessary knowledge for the design and implementation of databases used in scientific applications.

The way to design and create databases for scientific applications is studied, using the most appropriate models (object-oriented model, object-relational model, document collection-oriented model), languages and libraries. Through laboratory work, the aim is to obtain practical experience in the use of advanced database management systems (Oracle, MongoDB), appropriate languages (SQL, PL/SQL, Java, XML) and development toolsets.

7. Competences *(Proven capacity to use knowledge, aptitudes and personal, social and/or methodological abilities in work or study situations and for personal and proffesional growth. They refflect the empolyers requirements.)*

Specific Competences	Application of elementary knowledge, concepts and methods regarding databases, computing systems architecture, microcontrollers, programming languages and techniques.
Transversal (General) Competences	The ability to ensure the planning and management of projects in the field of applied electronics. The ability to constantly inform and document for personal and professional development by reading specialized literature. The ability to communicate and present technical content in both Romanian and English. Flexibility in using new systems and technologies within a team where members together achieve a well-defined goal while assuming different roles or tasks.

8. Learning outcomes *(Synthetic descriptions for what a student will be capable of doing or showing at the completion of a course. The learning outcomes reflect the student's acomplishments and to a lesser extent the teachers' intentions. The learning outcomes inform the students of what is expected from them with respect to performance and to obtain the desired grades and ECTS points. They are defined in concise terms, using verbs similar to the examples below and indicate what will be required for evaluation. The learning outcomes will be formulated so that the correlation with the competences defined in section 7 is highlighted.)*

Knowledge	*The result of knowledge aquisition through learning. The knowledge represents the totality of facts, priciples, theories and practices for a given work or study field. They can be theoretical and/or factual.* · List the most important stages that marked the development of the field of databases. · Defines domain-specific notions - the emphasis is placed especially on the interaction between scientific applications and the field of databases. For this purpose, the course provides important information regarding the needs of scientific applications in terms of data storage in the most efficient way for them. · Describes concepts such as existing data models within the domain of databases. · Highlights the object-relational data model (the studied solution is the one offered by the Oracle company) and the one oriented on document collections (for this model, the MongoDB database management system is studied).

Skills	*The capacity to apply the knowledge and use the know-how for completing tasks and solving problems. The skills are described as being cognitive (requiring the use of logical, intuitive and creative thinking) or practical (implying manual dexterity and the use of methods, materials, tools and intrumentation).* Select and group relevant information from the database domain. It uses specific principles in order to design and implement specific database projects. Work productively in a team. Experimentally verify identified solutions. Solve practical applications. Analyze and compare several existing data models in the field of databases. Identifies solutions and develops database design plans. Formulates conclusions on the implemented implementations. It argues the identified solutions as well as the ways of solving the data manipulation operations stored in relational databases.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* Select appropriate bibliographic sources and analyse them. Respect the principles of academic ethics, correctly citing the bibliographic sources used. Demonstrates responsiveness to new learning contexts. Demonstrates collaboration with other colleagues and teaching staff in carrying out teaching activities Demonstrates autonomy in organizing the learning situation/context or the problem situation to be solved Demonstrates social responsibility through active involvement in student social life/involvement in academic community events Promotes/contributes through new solutions related to the specialized field to improve the quality of social life. Realizes the value of its contribution in the field of engineering to the identification of viable/sustainable solutions to solve problems in social and economic life (social responsibility). Apply principles of professional ethics/deontology in the analysis of the technological impact of the solutions proposed in the specialized field on the environment. Analyses and capitalizes on business/entrepreneurial development opportunities in the specialty area. Demonstrates real-life situation management skills (collaborative vs. conflict time management). Etc.

9. Teaching techniques *(Student centric techniques will be considered. The means for students to participate in defining their own study path, the identification of eventual fallbacks and the remedial measures that will be adopted in those cases will be described.)*

Starting from the analysis of students' learning characteristics and their specific needs, the teaching process will explore both expository (lecture, exposition) and conversational-interactive teaching methods, based on discovery learning models facilitated by direct exploration and indirect of reality (experiment, demonstration, modelling), but also on action-based methods, such as exercise, practical activities and problem solving.

In the teaching activity, lectures will be used, based on Power Point presentations or different videos that will be made available to the students. Each course will start with a recap of the chapters already covered, with an emphasis on the concepts covered in the last course.

Presentations use images and diagrams so that the information presented is easy to understand and assimilate.

This discipline covers information and practical activities designed to support students in their learning efforts and the development of optimal collaborative and communicative relationships in a climate conducive to discovery learning.

It will be considered the practice of active listening and assertive communication skills, as well as feedback construction mechanisms, as ways of regulating behavior in various situations and adapting the pedagogical approach to the students' learning needs.

Teamwork skills will be practiced to solve different learning tasks.

The teaching is based on the use of the video projector (covering the communication and demonstration function).

The courses are available online on the Moodle platform.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Evolution and trends in the development of database systems for scientific applications	2
2	Active databases	2
3	Object oriented databases	2
4	Object relational databases	4
5	Spatial databases	4
6	XML databases	4
7	Databases oriented on document collections	4
8	Distributed databases	4
	Total:	28

Bibliography:

Pupezescu Valentin, Baze de date pentru aplicaţii ştiinţifice, suport de curs electronic, link-ul cursului din Moodle: https://curs.upb.ro/2023/course/view.php?id=9211

Felicia Ionescu, Baze de date relationale si aplicatii, Editura Tehnica, 2004

M. Piatini, O. Diaz (editors), Advanced Database Technology and Design, Artech House, 2005

R. Elmasri and S. B. Navathe, "Fundamentals of Database Systems", Third Edition, 2000

Oracle Documentation (www.oracle.com), anul 2022.

Valentin PUPEZESCU, Optimization for Distributed Committee Machines in The Knowledge Discovery in Distributed Databases Process, Proceedings of the 10th International Conference on Virtual Learning(ICVL-2015) din Timişoara, pp. 247-253, October 31, ISSN 1844-8933, WOS: 000380576300035, 2015.

Valentin PUPEZESCU, The Influence of Database Engines in Distributed Committee Machine Architectures, Proceedings of the 10th International Conference on Virtual Learning(ICVL-2015) din Timişoara, pp. 240-246, October 31, ISSN 1844-8933, WOS: 000380579300034, 2015.

Valentin Pupezescu, Radu Rădescu, Enhanced Protection Level by Database Replication in the Easy-Learning Online Platform, The 9th International Symposium on Advanced Topics in Electrical Engineering, pp.929-932, ISBN 978-1-4799-7514-3, WOS:000368159800172, DOI: 10.1109 / ATEE. 2015. 7133935, 2015.

Valentin Pupezescu, Advances in Knowledge Discovery in Distributed Databases, Proceedings of the 11th International Scientific Conference eLearning and Software for Education (eLSE-2015), Bucharest, April 23-24, pp.311-319, ISSN 2066-026X, WOS: 000384469000046,2015.

Valentin Pupezescu, Radu Radescu, The Influence of Data Replication in the Knowledge Discovery in Distributed Databases Process, ECAI 2016 – International Conference – 8th Edition, 30 June – 02 July, Ploieşti, ROMÂNIA, DOI: 10.1109/ECAI.2016.7861161, WOS:000402541200097, 2016.

LABORATORY

Crt. no.	Content	No. hours
1	Dezvoltarea unei baze de date in modelul relational	2
2	Defining events, conditions and actions in an active database	2
3	Developing a database in the relational model and relational objects and comparing the two projects - part 1	2
4	Developing a database in the relational model and relational objects and comparing the two projects - part 2	2
5	Developing a database in the relational model and relational objects and comparing the two projects - part 3	2
6	Development of a NoSql database as well as applications for accessing and manipulating these data in the Java programming language (the user development platform is Eclipse)	2
7	Colloquium	2
	Total:	14

Bibliography:
Pupezescu Valentin, Baze de date pentru aplicaţii ştiinţifice, suport de curs electronic, link-ul cursului din Moodle: https://curs.upb.ro/2023/course/view.php?id=9211
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R. Elmasri and S. B. Navathe, "Fundamentals of Database Systems", Third Edition, 2000
Oracle Documentation (www.oracle.com), anul 2022.
Valentin PUPEZESCU, Optimization for Distributed Committee Machines in The Knowledge Discovery in Distributed Databases Process, Proceedings of the 10th International Conference on Virtual Learning(ICVL-2015) din Timişoara, pp. 247-253, October 31, ISSN 1844-8933, WOS: 000380576300035, 2015.
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11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	Knowledge of fundamental theoretical notions; Application of theoretical notions to the practice of designing and implementing databases for scientific applications	Written exam or on the Moodle platform during the session; the topics cover the entire subject, creating a synthesis between the theoretical and practical parts of database design for scientific applications	40%
	Knowledge of fundamental theoretical notions; Application of theoretical notions to the practice of designing and implementing databases for scientific applications	Presentation of project related documentation.	20%

11.5 Seminary/laboratory/project	Knowledge of how to use languages, libraries and toolsets specific to database systems for scientific applications	Individual project with practical applicability to research the latest technologies in the field of databases for scientific applications.	40%
11.6 Passing conditions			
Obtaining 50% of the total score. Obtaining 50% of the score related to the activity during the semester.			

12. Corroborate the content of the course with the expectations of representatives of employers and representative professional associations in the field of the program, as well as with the current state of knowledge in the scientific field approached and practices in higher education institutions in the European Higher Education Area (EHEA)

Graduates are provided with adequate skills with the needs of current qualifications and a modern, quality and competitive scientific and technical training, which will allow them to be employed quickly after graduation, being perfectly framed in the university's policy, both from the point of view of content and structure, as well as from the point of view of the skills and the international openness offered to the students.

Date	Course lecturer	Instructor(s) for practical activities
25.09.2025	S.l./Lect. Dr. Valentin PUPEZESCU	S.l./Lect. Dr. Valentin PUPEZESCU

Date of department approval	Head of department
	Conf.Dr.Ing. Bogdan Cristian FLOREA

Date of approval in the Faculty Council	Dean
26.09.2025	Prof. Dr. Mihnea Udrea