Course:

Accreditation and certification - selected chapters

Teacher:Živković D. Nedeljko

Course status: Optional

ECTS points: 10

Prerequisites: None

Course objective:

Understanding the process of accreditation and certification.

Learning outcomes:

Gaining knowledge in the field of accreditation and certification.

Course structure and content:

Theoretical instruction:

Accreditation - definition, classification and importance. Normative regulation in the field of accreditation and certification. Accreditation of laboratories for testing. Accreditation of laboratories for calibration. Accreditation of medical laboratories. Accreditation of inspection bodies. Accreditation of certification bodies for management systems. Accreditation of certification bodies for personnel. Accreditation of certification bodies for products. Certification of management systems. Certification of personnel. Certification of products. Concluding remarks.

Practical instruction:

The chapters are the same as within the theoretical instructions. Other kinds of teaching are also included, as well as research study.

Literature/Readings:

1. International organization for standardization, „The series of ISO 17000".

2. IAF, EA, ATS „Instructions and recommendations"

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods: Theoretical instructions, practical instructions, interactive teaching, seminar works, team work and discussion.

Evaluation/Grading (maximum 100 points)

Oral exam: 40, Seminar work: 40, Prezentation: 20.

Course:

Tools And Methods of Software Engineering - selected topics

Teacher:Đurić O. Dragan

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective:

Understanding and mastering tools and methods of software engineering.

Learning outcomes:

Students' ability to use contemporary tools and methods of software engineering in practical and research-oriented projects.

Course structure and content:

Theoretical instruction

MDA methodology and tools. Functional programming methods and tools. Software maintenance tools and methods. Software configuration tools and methods. Software project management tools and methods. Tools and methods for tracking software process (tools for software process modelling, tools for software management, integrated CASE environments). Software quality tools and methods. Heuristic methods based on structure, data, functions, objects and specific domains. Formal methods. Prototype methods. Study example.

Research-related software. Tools and methods of software engineering in research software projects.

Practical instruction: labs, research study, other instruction

Demonstration of specific application of techniques and methods of software engineering. Practical project.

Literature/Readings:

- I. Sommerville: Software Engineering (9th ed) Addison-Wesley, 2010
- Digital learning resources available at the course CD.
- Open source software frameworks and tools, as well as their documentation and useful tutorials are freely available on the Web.
-

The *number of class hours* per *week*	**Lectures:** 3	**Research study:** 4

Teaching methods: Classical teaching or mentoring, depending on the number of registered students.

Evaluation/Grading (maximum 100 points)

Individual practical project / seminar

Course:

Algorithms and Complexity

Teacher:Stojanović A. Milica,Manojlović P. Vesna

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective: Presentation of the basic elements of the numerical complexity and analysis of the algorithms. Teaching students to make algorithms in different fields (graph theory, algebra, geometry, sequences, set theory)

Learning outcomes: After course, students will be able to create algorithms and to determine their numerical complexity.

Course structure and content:

Theoretical instruction:

1. Time and space complexity of an algorithm and a problem. 2. Deterministic and nondeterministic Turing machine. 3. NP class of problems. NP completeness and NP hard problems. 4. Construction of algorithms by the induction, examples. 5. Strengthening the inductive hypothesis; proving correctness of the algorithm. 6. Algorithms on the graphs: detour in graph; the shortest paths; problem of the matching in the graph. 7. Transportation network; Hamiltonian paths. 8. Geometrics algorithms: problems with polygon; convex hull. 9. Algebraic algorithms: problems with polynomials. 10. Problems with matrices. 11. Problems with sets 12. Algorithms over sequences. 13. Parallel algorithms; algorithms for computer networks. 14. Some of the algorithms in cryptography.

Practical instruction:

Creating algorithms in field which were studied theoretically and analysis of their complexity. Seminar work.

Literature/Readings:

1. M. Živković: Algorithms, Math. Faculty, Belgrade, 2000. (in Serbian)
2. Z. Ognjanović, N. Krdžavac: Introduction into theoretical computer science, FON, Belgrade, 2004. (in Serbian)
3. Leung Joseph, ed.: Handbook of scheduling: algorithms, models, performance analysis, Boca Raton [etc.]: Chapman and Hall/CRC, 2004.
4. M. Vujošević: The Methods of Optimization in Engeenering Menagement, AINS FON, Belgrade, 2012.

The number of class hours per week	**Lectures:** 3	**Research study: 4**

Teaching methods: mentor and/or classical

Evaluation/Grading (maximum 100 points)

Seminar work: 50 points Oral exam: 50 points

Course:

Algorithms in the Geometry

Teacher:Stojanović A. Milica

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective: Actual methods of showing geometry objects. Solving geometry problems by computer.

Learning outcomes: After course, students will be able to create algorithms and problems for solving geometry problems.

Course structure and content:

Theoretical instruction: 1. Arrangements of the hyperplanes. Counting points, faces and incidence.

2. Zones in arrangements. Constructing arrangements.

3. Graphs. Finding the shortest path in the graphs.

4. Finding the biggest convex subset in the plane, space, *n*-dim. space.

5. Constructing the convex hull in the plane, space, *n*-dim. space.

6. Finding the nearest neighbors in the plane, space, *n*-dim. space.

7. Voronoi diagram in the plane, space, *n*-dim. space.

8. Applying Voronoi diagram in the plane: „Post Office" problem.

9. Applying Voronoi diagram to the space problems.

10. Polygon: algorithms for triangulation in the plane, triangulation by the Voronoi diagram.

11. Polyhedron: When the triangulation is possible?

12. Minimal and maximal triangulation in the space. Triangulation of the set of points.

13. *n*-dimensional triangulation. Hypercube.

14. Problems in spaces of higher dimension. Applying Voronoi diagram.

Practical instruction:

Creating algorithms in field worked on the theoretical classes.

Literature/Readings:

1. Edelsbrunner, H., Algorithms in Combinatorial Geometry, Springer – Verlag, Heidelberg, 1987.
2. Dragan Acketa, Snežana Matić – Kekić, Geometry for informaticars, University in Novi Sad, PMF, Novi Sad 2000. (in Serbian)

<table>
<tr><td colspan="3">3. Trott, Michael, The Mathematica guide book for graphics, Springer, 2004.
4. Foley, James, Computer Graphics, Addison-Wesley, 1996.</td></tr>
<tr><td>The number of class hours per week</td><td>Lectures: 3</td><td>Research study: 4</td></tr>
<tr><td colspan="3">Teaching methods: mentor and/or classical</td></tr>
<tr><td colspan="3">Evaluation/Grading (maximum 100 points)

Seminar work: 50 points Oral exam: 50 points</td></tr>
</table>

Course:

Automatization of Information System Development

Teacher:Nešković N. Siniša,Vučković Đ. Milica

Course status: elective for study group Information Systems

ECTS points: 10

Prerequisites: none

Course objective:

To attain practical knowledge and skills required in automatization of information systems development

Learning outcomes:

Students will be enabled to analyze, select existing or develop their own and successfully apply advanced methods and tools for automatization of IS development.

Course structure and content:

. The concepts and goals of automatization of IS development. Categories of CASE software: tools, workbenches and integrated development environments. Components of CASE software. Basic elements of IS development methodology. Life cycle of IS development. OMG SPEM 2.0 standard. Methods and languages for IS modeling. Model driven development. OMG MDA 4-level standard architecture. Domain specific languages. UML profiles. Model transformations. M2M and M2T transformations. Model transformation languages: QVT operational and QVT relational. Software production lines. Feature models and variability models. Software production line development process. Development environments for automatization of IS development.

Literature/Readings:

1. Slajdovi sa predavanja u e-formi
2. A. Kleppe, J. Warmer, W. Bast, MDA Explained: The Model Driven Architecture, Addison Wesley 2003, ISBN 0-321-19442-X
3. K.Pohl , G. Böckle, F. Linden, Software Product Line Engineering: Foundations, Principles and Techniques, Springer, 2005, ISBN 978-3-540-28901-2
4. Richard C. Gronback, ECLIPSE MODELING PROJECT: A Domain-Specific Language Toolkit, Addison Wesley 2009,ISBN-13: 978-0-321-53407-1

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Conventional lecturing combined with laboratory exercises and mentoring. Case studies in which students will individually work on a research topic in the area of automatization of IS development.

Evaluation/Grading (maximum 100 points)

Project	**50**	**Oral exam**	**50**

Course:

Artificial Intelligence

Teacher:Jovanović M. Jelena,Tomić B. Bojan,Ševarac V. Zoran

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective:

Introduction to the basic concepts and fields of Artificial Intelligence (AI).

Deeper exploration of concepts, methods and techniques of an AI field chosen by the student; for the selected field, the objectives include (i) introduction to the field's methods and techniques, and their typical applications, as well as the known strengths and weaknesses of the individual methods and techniques; (ii) development of practical skills in the application of the considered methods and techniques.

Development of knowledge and skills required for independent research work in chosen AI field.

Learning outcomes:

Students will develop an understanding of the main AI concepts and fields. They will also develop knowledge about the selected AI field – its concepts, methods and techniques – as well as skills required for the practical application of those methods and techniques. Finally, students will gain an insight into some of the research challenges in the chosen AI field, and will be ready to start their independent research work in that field.

Course structure and content:

Artificial Intelligence (AI): an overview of the field.

Knowledge representation and reasoning.

Problem solving. Search of the solution space.

Probability in AI: probabilistic models and probabilistic inferencing.

Machine learning: supervised learning, unsupervised learning, and reinforced learning.

Neural networks.

Hidden Markov models.

Text mining.

Applied AI.

Literature/Readings:

<table>
<tr><td colspan="3">- S. Russell, P. Norvig. Artificial Intelligence - A Modern Approach; the 3rd Edition. Prentice Hall, Englewood Cliffs, New Jersey, 2009.
- Papers published in the IEEE Intelligent Systems journal (http://www.computer.org/portal/web/computingnow/intelligentsystems)
- Papers published in the Proceedings of the AAAI Conference on Artificial Intelligence (http://www.aaai.org/Conferences/AAAI/aaai.php)</td></tr>
<tr><td>The number of class hours per week</td><td>Lectures: 3</td><td>Research study: 4</td></tr>
<tr><td colspan="3">Teaching methods: Lectures or mentoring work, depending on the number of students</td></tr>
<tr><td colspan="3">Evaluation/Grading (maximum 100 points)

Individual practical project / research study</td></tr>
</table>

Course:

Multi-criteria Optimization and Decision Making

Teacher:Stanojević J. Milan,Martić M. Milan,Vujošević B. Mirko

Course status: Mandatory

ECTS points:

Prerequisites: none

Course objective:

Formal and practical understanding of decision making process in situations where multiple criteria for decision evaluation exist. Three basic cases are considered: when it is needed to chose one decision among a set of predefined decisions, when the set of decisions is discrete and when the set of decisions is continuous.

Learning outcomes:

The candidate will get understanding of one significant area of operations researches and he will be capable of independent scientific work in this field.

Course structure and content:

Introduction and basics of multicriteria optimization. Vector orders. Principles of efficiency and dominance. Waited sum method. Scalarization techniques. Non-dominance based definitions of multicriteria optimality. Multicriteria linear programming. Multicriteria simplex method. Multiobjective combinatorial optimization. Multiobjective versions of some common combinatorial problems.

Literature/Readings:

1. M. Ehrgott, Multicriteria Optimization, Springer Berlin Heidelberg New York, 2005.
2. M. Vujošević, M. Stanojević, N. Mladenović, Optimization Methods: Network, Location and Multi-criteria Models, Yugoslav Operational Research Society, 1996. (in Serbian)
3. Y-J. Lai, C-L. Hwang, Fuzzy Multiple Objective Decision Making – Methods and Application, Springer, 1996.
4. J. Figueira, S. Greco, M. Ehrgott (Ed.), Multiple Criteria Decision Analysis: State of the Art Surveys, Springer, 2005.

The number of class hours per week	**Lectures:** 30	**Research study:** 30

Teaching methods: Lectures – classic ex cathedra, research study – work with supervisor

Evaluation/Grading (maximum 100 points)

Oral exame (50 points), seminar paper – in the form and level of conference or journal article (50 points).

Course:

Time series and fractals - selected topics

Teacher:Radojičić A. Zoran,Filipović Ž. Vojislav

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

The course objective is to enable each student to enhance his quantitative scientific knowledge related to time series analysis and fractals and apply the selected methods and techniques to real world business problems in organizational systems.

Learning outcomes:

The acquired knowledge of time series analysis and fractals will enable students to make appropriate models for prediction and control in organizational systems using ICT.

Course structure and content:

The course is organized in the form of traditional mentoring for the selected research topics but not limited to:

Linear time-invariant models, Linear time-variant models, Nonlinear models, Long term memory models, Model identification and estimation, Prediction, Multivariate time series analysis, Moving average and filters, Extreme value theory, Markov chains, Monte Carlo simulation, Wavelets, Deterministic fractals, Stochastic fractals, Fuzzy fractals, Multifractals.

Literature/Readings:

1) G. E. P. Box, G. M. Jenkins, G. C. Reinsel, Time Series Analysis: Forecasting and Control – fourth edition, Wiley, 2008.

2) R. S. Tsay, Analysis of Financial Time Series – second edition, Wiley, 2005.

3) J. D. Hamilton, Time Series Analysis, Princeton University Press, 1994.

4) M. K. Simon, Probability Distributions Involving Gaussian Random Variables: A Handbook for Engineers and Scientists, Springer, 2006.

5) D. Straumann, Estimation in Conditionally Heteroscedastic Time Series Models, Springer, 2005.

6) D. P. Kroese, T. Taimre, Z. I. Botev, Handbook of Monte Carlo Methods, Wiley, 2011.

7) B. B. Mandelbrot, Fractals and Scaling in Finance: Discontinuity, Concentration and Risk, Springer, 1997.

The number of class hours per week	**Lectures:**	**Research study:**
	3	4

Teaching methods: Lectures, Reaserch project, Mentoring
Evaluation/Grading (maximum 100 points) Seminar paper (30%), written exam (30%), project presentation (40%)

Course:

Global Optimization

Teacher:Vujčić V. Vera,Čangalović M. Mirjana,Mladenović M. Nenad

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

The objective is to give an introduction to main theoretical concepts and computational methods of global optimization.

Learning outcomes:

Students gain expertise in exact and heuristic methods for global optimization problems.

Course structure and content:

Teaching topics:

Global optimization problems. Local and global optima. Exact methods. Covering methods. Branch and reduce methods. Penalty function methods. Random search methods. Convergence to global optimum. Metaheuristics for global optimization. Simulated annealing methods. Tabu search methods. Variable neighborhood search methods. Genetic algorithms. Software for global optimization.

Exercises:

Testing software packages BARON, GLOB, GENOCOP and others on benchmark examples of global optimization problems.

Literature/Readings:

1. R. Horst, P.M. Pardalos, N. V. Thoai, Introduction to Global Optimization, Kluwer Academic Publishers, 2000.

2. C. A. Floudas et al., Handbook of Test Problems in Local and Global Optimization, Kluwer Academic Publishers, 1999.

3. Gendreau M., Jean-Yves P. (Ed.), Handbook of Heuristics, Springer, 2010.

The number of class hours per week	**Lectures:** 3	**Research study**: 4

Teaching methods: Classroom lectures and consultations
Evaluation/Grading (maximum 100 points) Oral exam: 50 Seminar: 50

Course: **Dynamical models of financial markets**		
Teacher:Petrović J. Bratislav		
Course status: Elective		
ECTS points: 10		
Prerequisites: none		
Course objective: The aim of this course is to provide students with the necessary theoretical knowledge of the concepts, methods and techniques for modelling price dynamics in financial markets, solving problems of dynamic portfolio optimization and dynamic optimization of optimal ownership structure in corporations.		
Learning outcomes: The acquired knowledge will enable students to model, simulate and control financial systems.		
Course structure and content: One period model, Multi-period model, Continuous models. Brownian motion, Wiener process. Ito's lemma. Financial arbitrage and Efficient-market hypothesis. Preference functions. Portfolio selection and optimizaton. Hamilton–Jacobi–Bellman equation, Martingale approach. Static equilibrium models of financial markets. Dynamic equilibrium models in the absence of moral hazard. Dynamic monopoly in stock markets in presence of moral hazard, consisteny of solution in discrete and continuous time approach.		
Literature/Readings: 1) J. Cvitanic, F. Zapatero, Introduction to the Economics and Mathematics of Financial Markets, MIT Press 2004. 2) S. Benninga, Financial Modeling, MIT Press, 1997. 3) D. Duffie, Dynamic Asset Pricing Theory - third edition, Princeton University Press, 2001. 4) L. Oakshott, Essential quantitative methods: for business, management and finance, Palgrave Macmillan, 2006.		
The number of class hours per week	**Lectures:** 3	**Research study:** 4
Teaching methods: Lectures, Reaserch project, Mentoring		
Evaluation/Grading (maximum 100 points)		

Course:

Discrete mathematics

Teacher:Čangalović M. Mirjana,Manojlović P. Vesna

Course: DISCRETE MATHEMATICS

Teacher : Mirjana Cangalovic, Vesna Manojlovic

Course status: elective

ECTS points: 10

Prerequisites: Master degree

Course objective

Students will be acquanted with those mathematical skills that are necessary for the development and implementation of a high level of formalization of different types in the area of information systems and computer science.

Learning outcomes

Students will learn some very important applications of mathematical formalization in the organization and searching databases in the field of automated reasoning, cryptography, etc..

Course structure and content

Theoretical instruction:

Formal theories. Basic definitions. Proofs in formal theories. Decidable formal theories. Examples of formal theories. The resolution principle. Herbrand's theorem.

Recursive and computable functions. Basic definitions. Arithmetisation of formal theories and decidability problem. Lambda calculus and its application in representation of recursive functions. Recursive processing lists.

Relational algebra. The notion of a relation. Operations on one and several relations. Functional dependencies in relations. The key of a relation. Multivalued functional dependencies.

Elements of numerical complexity theory. Complexity of problems and algorithms. Polynomial problems.

Turing machine. Church thesis. Class NP. NP-complete and NP-hard problems.

Applications to Cryptography: Classical cryptography. Random code. DES and RSA algorithms.

Practical instruction:

Essay on the application of the tools of discrete mathematics in selected problem in the field of information systems and computer science.

Literature/Readings

Selected chapters from the following books:
D. Cvetkovic, S. Simic, *Discrete Mathematics, Mathematics for Computer Sciences*, Libra, Belgrade, 2000

P. Janicic, *Mathematical Logic in Computer Sciences*, Mathematical faculty, Belgrade 2004

Z. Ognjanovic, N. Krdzavac, *Introduction to Theoretical Computer Science*, Faculty of Organizational Sciences, Belgrade 2004

M. Cangalovic, V. Manojlovic, V. Baltic, *Discrete mathematical structures*, Faculty of Organizational Sciences, Belgrade 2009

A.J. Anderson, *Discrete Mathematics with Combinatories*, Faculty of Computer Science, Belgrade 2005

J.A. Dossey, A.D. Otto, L.E. Spence, C. Vanden Eynden, *Discrete Mathematics*, Pearson, Addison Wesley, Boston 2006

Number of class hours per week				**Other classes:**
Lectures:	**Labs:**	**Workshops:**	**Research study:**	
2	2			

Teaching methods

Lectures and practical applications

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points 50**	**Final exam**	**Points 50**
Participation in class	**10**	written exam	
Participation in labs		oral exam	**50**
Seminars	**40**		

Course:

E-Banking

Teacher:Barać M. Dušan,Vasković R. Vojkan,Knežević P. Snežana

Course status: Elective

ECTS points: 10

Prerequisites: -

Course objective: The aim of the course is to enable students to apply modern information and communication technologies to complex e-banking systems. The specific objective is to teach students to perform research, and write successful research papers and dissertations in the field of e-banking.

Learning outcomes:

The students will be able to design and implement complex e-banking systems, as well as perform scientific research in this area of study.

Course structure and content:

Introduction to the methodology of scientific research in the field of e- banking. Models, services and applications of electronic banking. Advanced models and e-banking system architecture. Hardware and software infrastructure of e-banking. Payment systems at large. Interoperable model payment systems. Safety aspects of e-banking. Advanced reporting services in e-banking. Business analytics in e-banking. Credit Bureau. Mobile banking. E-banking standards. Design of complex services and applications of e-banking. Models and application architecture of e-banking. Implementation and integration of modules in-app payments electronic commerce. Model development of interoperable payment systems. Designing the infrastructure of e-banking. RFID and NFC mobile payments. Analysis of the ISO8583 standard. Overview of the most important results of scientific exploration work in the field of e-banking and the analysis of the results of the most current international projects.

Literature/Readings:

1. E-resoruces from moodle.elab.fon.bg.ac.rs
2. V. Vasković, Payment systems in e-business, FON Beograd, 2007.
3. Encyclopedia of E-Commerce, E-Government, and Mobile Commerce, Mehdi Khosrow-Pour Information Resources Management Association, USA, 2012.
4. A. Ruiz-Martínez, Ó.Reverte, A.Gómez-Skarmeta, Payment frameworks for the purchase of electronic products and services, Computer Standards & Interfaces, 34(1), 80-92. Elsevier, 2013.
5. M. Balderas, PayPal APIs: Up and Running: A Developer's Guide, O'Relly, 2011.
6. O. Merrouche, E. Nier, Payment systems, inside money and financial intermediation Journal of Financial Intermediation, 21(3), 359-382, Elsevier, 2012.
7. J. Kondabagil, Risk Management in Electronic Banking: Concepts and Best Practices, John Wiley & Sons 2007.
8. M. Galbiati, K. Soramäki, An agent-based model of payment systems, Journal of Economic Dynamics and Control, 35(6), 859-875, 2011.
9. L. David, Electronic Value Exchange, Origins of the VISA Electronic Payment System, Springer 2011.
1. 10. M. Nakajima, Payment System Technologies and Functions: Innovations and Developments, IGI Global, 2011.

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods: Lectures. Discussions. Case studies. Lab sessions. Independent research work.
Evaluation/Grading (maximum 100 points) • Homework - **20 points** • Written exam - **20 points** • Seminar paper/project - **30 points** • Publishing research results in conference proceedings or a scientific journal - **30 points**

Course:

E-health

Teacher:Radenković LJ. Božidar,Žarković P. Miloš,Arsović A. Nenad,Vujin D. Vladimir

Course status: Elective

ECTS points: 10

Prerequisites: -

Course objective:

The aim of this course is to train students to conduct independent scientific researchers work and resolve current research problems in the field of e-health. In addition, the goal of this course is to enable students to design and implement e-health systems.

Learning outcomes:

Students are able to conduct scientific research work in the field of e-health.

Course structure and content:

Methodology of scientific research in the field of e-health. Analysis of the concepts of e-health systems. E-health management. Costs of e-health system. The presentation of healthcare institutions on the Internet. E-marketing in healthcare. The electronic medical record. OpenEMR. Document management. E-business in the pharmaceutical industry. Quality control of e-health services. Standards in e-health. Issues of interoperability in e-health. Semantic web and ontologies in e-health. Data mining in e-health. Mobile technologies in e-health (m-health). The use of sensors and sensor networks in e-health. Diagnostic information systems. Telemedicine systems. The virtual reality in healthcare. MevisLab. DICOM. Analysis of legal and ethical standards in e-health. A review of current scientific research areas and analysis of the most cited papers. A review of current scientific research projects in the field of e -health.

Literature/Readings:

10. E-resoruces from moodle.elab.fon.bg.ac.rs
1. T.Stojadinovic, V.Radonjic, B.Radenkovic, *E-business in the Regulation of Medicines in Serbia*, Drug information journal, Vol.44, No.2, pp.177-187, 2010, ISSN 0092-8615.
2. N.Wickramasinghe, *Critical Issues for the Development of Sustainable E-health Solutions (Healthcare Delivery in the Information Age)*, Springer, ISBN-10: 1461415357, ISBN-13: 978-1461415350, Publication Date: December 31, 2011, Edition: 2012.
3. A.Moumtzoglou, A.Kastania, *E-Health Systems Quality and Reliability: Models and Standards*, IGI Global, ISBN-10: 1616928433, ISBN-13: 978-1616928438, Edition: 1, 2010.
4. W.Pease, M.Cooper, R.Gururajan, *Biomedical Knowledge Management: Infrastructures and Processes for E-Health Systems*, IGI Global, ISBN-10: 1605662666, ISBN-13: 978-1605662664, Edition: 1, 2010.
5. A.R.Shark D.P.A., S.Toporkoff, *eHealth - A Global Perspective*, CreateSpace, ISBN-10: 1451540299, ISBN-13: 978-1451540291, 2010.
6. D.C.Bangert, R.Doktor, M.Valdez, *Human And Organizational Dynamics in E-health (Book With Cd-rom)*, Radcliffe Publishing, ISBN-10: 1857756665, ISBN-13: 978-1857756661, 2005.
11. Srdjan Krčo, Health Care Sensor Networks – Architecture and Protocols Journal on Ad Hoc & Sensor Wireless Networks, OCP. 2005. pp. 1-25. ISSN 1551-9899

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods: Lectures. Discussions. Case studies. Lab sessions. Independent research work.		
Evaluation/Grading (maximum 100 points) • Homework - **20 points** • Written exam - **20 points** • Seminar paper/project - **30 points** • Publishing research results in conference proceedings or a scientific journal - **30 points**		

Course:

E-business-selected chapters

Teacher:Despotović-Zrakić S. Marijana,Bogdanović M. Zorica,Barać M. Dušan,Labus B. Aleksandra,Vukmirović V. Dragan

Course status: Compulsory

ECTS points: 10

Prerequisites: -

Course objective:

The aim of the course is to introduce students to the methodology of scientific research in the field of electronic commerce, e-business infrastructure, modern and innovative business models, as well as current scientific research activities in these fields of study.

Learning outcomes:

The students will be able to execute independent scientific research in the e-business field of study.

Course structure and content:

Lectures and practical exercises: The methodology of scientific research in the field of E-business. Modern infrastructure for E-business. Analysis of innovative business models for E-business. Analysis of services and applications of E-business. Modern architecture of the system of elec E-business. Models of mobile business. Analysis of key performance identifiers in E-business. Security systems in e-business. Knowledge management systems in E-business. E-business systems based on agents. Models of E-business on social networks. Social computing. Crowdsourcing. Advanced Internet Technologies in E-business. Framework for the implementation of e-business systems. Semantic interoperability in e-business systems. Semantic interoperability in B2B networks. Reengineering of e-business systems. Project management of E-business. Overview of current research topics in the field of E-business. Analysis of the results of the most current international projects.

Literature/Readings:

12. E-resoruces from moodle.elab.fon.bg.ac.rs
13. Editors, Note Radenković, Internet and modern business, monographs, Technical Faculty "Mihajlo Pupin", Zrenjanin 1998.
14. D.Chaffey, E-Business and E-Commerce Management (4th Edition), Prentice Hall, 2009.
15. D.Taylor, A.D.Terhune, Doing e-business : strategies for thriving in an electronic marketplace, John Wiley & Sons, New York, 2001.
16. K.C.Laudon, C.G.Traver, E-commerce 2012. Business. Technology. Society, Pearson, 2012.
17. Shiguo Lian, Xi Chen, Katina Michael, Editorial: special issue on Service-Based Electronic Commerce Systems, Volume 13, Issue 2, pp 125-127, Electronic Commerce Research, Springer, 2013.
18. L. Li, Introduction: Advances in E-business engineering, Information Technology and Management, June 2011, Volume 12, Issue 2, pp 49-50, Springer, 2011.
19. C. K. Georgiadis, P. Chau, Introduction to the special issue on User Experience in e-Business Environments, Information Systems and e-Business Management, Volume 11, Issue 2, pp 185-188. Springer, 2013.
20. S. Huang, J.Hua, H. Will, and J.Wu, Metamodeling to Control and Audit E-Commerce Web Applications, International Journal of Electronic Commerce, Volume 17, Number 1, p. 83-118, 2012.
21. A. Crespo, B. Mezcua, J. Lopez-Cuadrado, I. Gonzalez-Carrasco , Semantic model for knowledge representation in e-business, Knowledge-Based Systems, Volume 24, Issue 2, Pages 282-296, Elsevier 2011.

The number of class hours per week	**Lectures:** 3	**Research study:** 4
Teaching methods: Lectures. Discussions. Case studies. Lab sessions. Independent research work.		
Evaluation/Grading (maximum 100 points) • Homework - **20 points** • Written exam - **20 points** • Seminar paper/project - **30 points** • Publishing research results in conference proceedings or a scientific journal - **30 points**		

Course:

E-education - selected chapters

Teacher:Despotović-Zrakić S. Marijana,Bogdanović M. Zorica,Labus B. Aleksandra

Course status: Elective

ECTS points: 10

Prerequisites: -

Course objective:

The aim of this course is to enable students for research work in the field of e-education, and the application of modern information and communication technologies in education.

Learning outcomes:

The students will be able to execute independent scientific research and apply modern pedagogical approaches in the e-learning field of study.

Course structure and content:

Theoretical and practical teaching methodology of scientific research in the field of e-learning. Classification of e -learning. E-education in the development of employees. Psychic aspects of ICT in education. Formal and informal learning. Standards in e-learning. Designing learning objects. Communication and collaboration in e -learning. Personalized and adaptive e-learning. Learning styles in e -learning. E-learning infrastructure. E -learning technologies. Educational software. Mixed learning. Education through the game. Mobile education. Student's relationships management. The use of social networks in e -learning. System design of mobile education. Semantic annotation and semantic search of learning materials in e-learning. Problems and risks in the design and implementation of e-learning. Current trends in electronic education. Analysis of current scientific research in e -learning. The analysis of the most cited papers and current scientific research projects.

Literature/Readings:

22. E-resoruces from moodle.elab.fon.bg.ac.rs
23. Milosavljević, G., Vocational education at a distance, FON, 2000.
24. Moore, M. G, William, G., Handbook of distance education, Lawrence Erlbaum Associates, 2003.
25. Despotović M., Development of methods postgraduate field of education distance learning based on Internet technologies, PhD thesis, FON, 2006.
26. Bogdanović Z., Business intelligence in adaptive e-learning, PhD thesis, FON, 2011.
27. M.Despotovic-Zrakić, A.Markovic, Z.Bogdanovic, D.Barac, S.Krco, Providing Adaptivity in Moodle LMS Courses, Educational Technology & Society Journal, Vol 15, Issue 1, pp 326-338, 2012.
28. Despotovic-ZrakicM,SimicK,LabusA,MilicA,Jovanic, Scaffolding Environment for e-Learning through Cloud Computing, Educational Technology & Society, vol. 16, no. 3, pgs. 301-314, 2013.
29. Bogdanović, Z., Barać, D., Jovanić, B., Popović, S. and Radenković, B. Evaluation of mobile assessment in a learning management system. British Journal of Educational Technology, Vol 45, Number 2, pp 231-244, 2014.

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Lectures. Discussions. Case studies. Lab sessions. Independent research work.
Evaluation/Grading (maximum 100 points) • Homework - **20 points** • Written exam - **20 points** • Seminar paper/project - **30 points** • Publishing research results in conference proceedings or a scientific journal - **30 points**

Course:

E-government - selected chapters

Teacher:Bogdanović M. Zorica,Vukmirović V. Dragan,Vasković R. Vojkan

Course status: Elective

ECTS points: 10

Prerequisites: -

Course objective: The goal of course is to enable students to design e-government systems and perform scientific research in this field.

Learning outcomes:

The students will be able to design and implement complex e-government systems, as well as perform scientific research in this area of study.

Course structure and content:

Methodology of scientific research in the field of e-governance. Analysis of the basic concepts of electronic business in the public administration(e government). Processes and communication in public administration. E-business models in public administration. E-business government with legal entities (G2B), with citizens (G2C) and between the public administrations (G2G). E-identification. Social networks in e -government. E-recruitment in the civil service. Interoperability problems in e-business public administration. Semantic integration of information in e -government. Mobile Management. The use of the Internet technology of intelligent devices in the administration. Standards in e -government. E-democracy. Experience of e-commerce in public administration of the European Union. Methods for measuring the development of e-government. Organization model and infrastructure for the introduction of e-business in public administration in Serbia. Analysis of current scientific research questions in e -government. A review of current scientific research projects in the field of e -government.

Literature/Readings:

30. E-resoruces from moodle.elab.fon.bg.ac.rs
31. R.Christopher (Eds.), Comparative E-Government, In Series: Integrated Series in Information Systems, 25, Springer, 2012.
32. A.Gronlund, PA.Hershey, Electronic Government, Idea Group Publishing, 2002.
33. K.Layne, JW.Lee, Developing fully functional E-government: A four stage model, Government Information Quarterly Vol. 18 No.2 pp. 122-136, 2001.
34. J.Dadić, A.Labus, K.Simić, B.Radenković, M.Despotović-Zrakić, A Model For Structuring Information Resources in E-Government, Innovative Issues and Approaches in Social Sciences, Vol.5, No.2, pp.104-117, 2012.
35. C.Lambrinoudakis, S.Gritzalis, F.Dridi, G.Pernul, Security requirements for e-government services: a methodological approach for developing a common PKI-based security policy, Computer Communications Vol. 26 No.16 pp 1873-1883, 2003.
36. J. Dadić, M. Despotović-Zrakić, D. Barać, L. Paunović, A. Labus, Managing eGovernment Information Resources Using Faceted Taxonomy, In Proceedings of the 12th European Conference on eGovernment, Mila Gasco (Editor) pp 169-175, Published by Academic Publishing International Limited, Reading, UK, 2012.
37. R. Bolívar, M. Pedro (Eds.), Measuring E-government Efficiency, Springer, 2014.
38. J. R. Gil-Garcia, E-Government Success Factors and Measure: Theories, Concepts, and Methodologies, IGI Global, 2013.
39. V. Tomas, P. Vassilios, T. Konstantinos (Eds.), Semantic Technologies for E-Government, Springer, 2010.
40. A.Saïd, B. Imed, B.Isabelle (Eds.), Practical Studies in E-Government, Springer, 2011.

The number of class hours per week	**Lectures:** 3	**Research study:** 4
Teaching methods: Lectures. Discussions. Case studies. Lab sessions. Independent research work.		
Evaluation/Grading (maximum 100 points) • Homework - **20 points** • Written exam - **20 points** • Seminar paper/project - **30 points** • Publishing research results in conference proceedings or a scientific journal - **30 points**		

Course:

Computer Systems Security – Selected Topics

Teacher:Simić B. Dejan

Course status: Elective

ECTS points: **10**

Prerequisites: none

Course objective:

Introduction and analysis of the advanced protection and security of computer systems, obtaining the knowledge necessary for the effective analysis and use of modern security methods and techniques.

Learning outcomes:

Students are prepared for the use of preventive security measures, as well as for the analysis and comprehensive evaluation of security methods and techniques in modern computer systems.

Course structure and content:

Management of protection and security. Protection fundamentals and computer security. Identification and Authentication. Authentication and Authorization. Access Control Models. Database Security. Software Security. Security Models. Bell-LaPadula Model. Security Evaluation. Cryptology. Applied Cryptography. Functions for Data Integrity Check. Digital Signatures. Qualified electronic signatures. Kerberos. Public Key Infrastructure (*PKI*). Communication Security. Network Security. Intrusion Detection. Tools for Security of Computer Systems. Web Security. Mobile Application and Device Protection and Security. Protection and Security of Electronic Payment Systems. *HSM* technology. The use of open source software for computer systems security (*OpenLDAP*, *OpenAM*, *OAuth*, *OpenID*, *SAML*, *XACML*). Unimodal and Mutlimodal Biometric Systems. Analysis of selected professional and scientific papers.

Literature/Readings:

1. Dieter Gollmann, "*Computer Security*", 3rd edition, John Wiley & Sons, Ltd, 2011.
2. Richard Bejtlich, "*Practice of Network Security Monitoring: Understanding Incident Detection and Response*", No Starch Press, 2013.
3. Bruce Schneier, "*Schneier's Cryptography Classics Library: Applied Cryptography, Secrets, and Lies, and Practical Cryptography*", Wiley, 2007.
4. William Stallings, "*Cryptography and Network Security: Principles and Practice*", 6th edition, Prentice Hall, 2013.
5. William Stallings, "*Network Security Essentials: Applications and Standards*", 5the edition, Pearson Education Limited, 2013.
6. Shuangbao (Paul) Wang, Robert S. Ledley, "*Computer Architecture and Security: Fundamentals of Designing Secure Computer Systems*", John Wiley & Sons, 2013.
7. Selected professional and scientific papers

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Lectures. Consultation. Mentoring. Practical work. Solving specific cases. Case studies. Working on projects. Working in teams. Discussion. Methods for distance education. The collection and study of relevant literature with providing critical review of the resolution of specific problems. Creative workshops.
Evaluation/Grading (maximum 100 points) Analysis of the cases, models or specific practices /Homeworks/Seminar/Project. Oral exam.

Course:

Engineering Economics

Teacher:Milićević K. Vesna,Ilić J. Bojan

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective:

The study of the essence and specificities of engineering economics in terms of business decision making by engineers.

Learning outcomes:

Understanding problems of engineering economics and developing abilities to apply methods and techniques of engineering economics.

Course structure and content:

Theoretical instruction:

The principles and the most important development trends of engineering economics. Concepts of contemporary business. Analysis of supply and demand. Economics of information. Contemporary production and costs. Cost functions. Engineering decision making based on cost information. Measures to reduce costs. Managerial decision making on prices. Alternative pricing strategies. Optimal capital structure for a company. The complexity of newer approaches and methods of measuring business performance. Increase of revenues and improvement of profitability. Importance of IT support to decision making in the field of engineering economics. Digitization of business. New types of businesses on the Internet, and competitive business strategies. Business networks and Internet infrastructure.

Practical instruction:

Research study.

Literature/Readings:

Milićević V., Ilić B., Ekonomika poslovanja (selected chapters), Fakultet organizacionih nauka, Beograd, 2009.

Ilić B., Milićević V., Menadžment troškova – strategijski okvir (selected chapters), Fakultet organizacionih nauka, Beograd, 2009.

J.A. White, K.E. Case, D.B. Pratt, Principles of Engineering Economic Analysis, Wiley, 2009

Milićević V., Internet ekonomija, Fakultet organizacionih nauka, Beograd, 2002.

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods: Lectures, consultations, mentoring, research.
Evaluation/Grading (maximum 100 points) Class participation (10 points), writing seminar paper (40 points), defense of seminar paper and oral exam (50 points)

Course:

Integrated Operations Management

Teacher:Ilić R. Oliver

Course status: Elective

ECTS points: **10**

Prerequisites: none

Course objective:

Gaining knowledge and experience in integrated managing production and operations.

Learning outcomes:

Improved knowledge, skills and competences of candidates in the integrated management of production operations and services.

Course structure and content:

Introduction. History and Trends. A Tutorial on IOM. **Linking Operations Management to Customer Expectations.** Developing a Customer Orientation. Supply-Chain Strategy: Aligning Operations with Customer Expectations and Supplier Processes. Operations Strategy: Aligning Operations within the Firm. Designing the Product-Service Bundle. **Systems and Tools for the Improvement of Customer Satisfaction.** Total Quality Management. Quality Improvement Tools. **The Physical Design of Operational Systems.** Designing the Value-Adding System. Building the Global Supply Chain: Facility Location and Capacity Decisions. Facility Layout Decisions. Job Design. **The Mangement of Operational Systems.** Aggregate planning. Supply-Chain Coordination: Master Scheduling and Inventory Decisions. Planning and Control in Just-In-Time Systems. Planning and Control in Synchronous Value-Adding Systems. Planning and Control in Material Requirements Planning Systems.

Literature/Readings:

1. HANNA, M. D. AND W. R. NEWMAN, *Integrated Operations Management*, Prentice-Hall, Upper Saddle River, N. J., 2001.
2. DAVIS, M.M. AND J. HEINEKE, *Operations Management: Integrating Manufacturing and Services*, 5/e, McGraw-Hill/Irwin, Boston, 2005.
3. REID, R. D. AND N. R. SANDERS, *Operations Management: An Integrated Approach*, 3/e, John Wiley & Sons, Inc. Hoboken N. J., 2007.
4. BROWNE, J., J. HARHEN AND J. SHIVNAN, *Production Management Systems: An Integrated Perspective*, 2/e, Addison-Wesley, Harlow, England, 1996.

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Lectures, creative workshops, and laboratory experiments.

Evaluation/Grading (maximum 100 points)

Classroom Activity (11-20 points), A Seminar Paper (21-40 points) and an Oral Examination (21-40 points). The final grade is determined by the sum total of points, as follows:

	No. points	[0-50]	[51-60]	[61-70]	[71-80]	[81-90]	[91-100]	
	Grade	**5**	**6**	**7**	**8**	**9**	**10**	

Course:

Human-computer interaction - selected chapters

Teacher:Starčević B. Dušan,Minović V. Miroslav,Milovanović M. Miloš

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Deepening previously acquired knowledge and skills in the field of human-computer interaction. Enabling students to critically evaluate and apply available approaches and techniques in developing user interface.

Learning outcomes:

Students will deepen their previously acquired knowledge and skills in the field of human-computer interaction for analysis, design, implementation and evaluation of user interface elements.

Course structure and content:

Theoretical study.

Fundamentals of Human-Computer Interaction . Human. Computer . Interaction . Paradigms and principles . The design process . User models in the design process . Modelling user requirements . Socio-technical models . Soft systems methodology . Participatory design . Cognitive models . Linguistic models . Physical models and device models. Task analysis . Digital notation and design . System models . Implementation support. Evaluation techniques . Areas of application . Groupware . CSCW . Multimodal communication . Speech. Handwriting recognition . Computer Vision . Comprehensive Computing . Virtual reality . Hypertext . Multimedia. WWW. Animation . Digital video . Computer aided learning . Natural user interfaces .

Research work.

Research work is done in Laboratory for multimedia communication. The work includes design methodology of user interface design of cognitive systems architecture. Student is required to explore a given problem, present the problem state in the form of seminar paper and practically implement the given task in the field of human-computer interaction. Seminar paper needs to be prepared in the form suitable for scientific conference presentation or journal publication.

Literature/Readings:

1. *Sears, J.A. Jacko, The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications, CRC Press, 2012*
2. *Daniel Widgor, Dennis Wixton, Brave NUI World: Designing Natural User Interfaces for Touch and Gesture, Morgan Kaufmann, 2011*
3. *Ž. Obrenović, Interakcija čoveka i računara, FON, Beograd, 2004*

The number of class hours per week	Lectures: 3	Research study: 4

Teaching methods:

Classes are held in the form of lectures or in the form of individual consultations based on teaching units. The

research part involves collecting and studying the relevant with researcher's own critical review in the form of seminar paper suitable for publication. Pracitical part includes implementation of human-computer communication example
Evaluation/Grading (maximum 100 points) Seminar work – 40 poena Work prepared for publication – 20 poena Oral exam - theory and assignments combination – 40 poena

Course:

Internet Economics - Selected Chapters

Teacher:Milićević K. Vesna

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective:

Acquisition and expansion of knowledge related to the Internet economy, its principles, methods and models.

Learning outcomes:

Training students for independent scientific research in the field of the Internet economics with acquired competences related to economic analysis and improvement of business performance in Internet economy conditions.

Course structure and content:

Theoretical instruction:

Aproaches to the Internet economy. Impact of the Internet on the transformation of contemporary business. Economics of information. New business models in the Internet economy. Business networks and Internet infrastructure. The theory of intellectual capital and the complexity of its measurement. Cost reduction and economies of "increasing returns". Exchange of information on the Internet, extranet and intranet as a source of value creation. Virtualization of business and virtual value chain. Creating online business strategy. Competitive advantages in the area of services in the Internet economy. The impact of the Internet on business performance. Improving business performance in the global Internet market, and new methods of measuring performance. Operations of global companies on the Internet.

Practical instruction:

Research study.

Literature/Readings:

Milićević V., Internet ekonomija, Fakultet organizacionih nauka, Beograd, 2002.

Weinhardt C., Blau B., Conte T., Filipova-Neumann L., Meinl T., Michalk W., Business Aspects of Web Services (selected chapters), Springer-Verlag, 2011

Thompson K., The Networked Enterprise:Competing for the Future Through Virtual Enterprise Networks (selected chapters), Meghan-Kiffer Press, 2008

Chaffey D., E-Business and e-Commerce Management, Strategy, Implementation and Practice (selected chapters), Prentice Hall, Financial Times, Harlow, 2011

The number of class hours per	**Lectures:** 3	**Research study:** 4

week		
Teaching methods: Lectures, consultations, mentoring, research.		
Evaluation/Grading (maximum 100 points) Activity during lectures (10 points), writing seminar paper (40 points), defense of seminar paper and oral exam (50 points)		

Course:

Internet of things-selected chapters

Teacher:Radenković LJ. Božidar,Barać M. Dušan,Krčo M. Srđan,Vujin D. Vladimir,Labus B. Aleksandra

Course status: Elective

ECTS points: 10

Prerequisites: -

Course objective: The aim of the course is to provide the students with the knowledge and skills to perform independent scientific research, model new solutions and solve current problems in the domain of application of Internet of Things and automation of smart environments.

Learning outcomes:

The students will be able to design innovative models of IoT infrastructure, develop IoT applications and services, as well as perform scientific research in this area of study.

Course structure and content:

Lectures and practical exercises: The methodology of scientific research in the field of internet of things. Internet technology of internet of things. Analysis standard of internet of things. Modeling the infrastructure of smart environments. Designing a wireless sensor network. Smart infrastructure management environment. Modeling and implementation services for the collection, storage, processing and use of data from the Internet of things using M2M platform and publicly available data from different sensors, actuators, and microcontrollers microprocessors. Connecting the read data from the sensors and applications. The development of web and mobile applications for managing internet of things in smart environments. The use of internet of things in the Internet business, education, medicine, government and transportation. Analysis of the results of the most current international projects in this field. Review and analysis of the most important references.

Literature/Readings:

41. E-resoruces from moodle.elab.fon.bg.ac.rs
42. J.P.Vasseur, A.Dunkels, Interconnecting Smart Objects with IP, Elsevier, Inc. 2010.
43. D.Boswarthich, O.Elloumi, O.Hersent, M2M Communications A Systems Approach John Wiley & Sons, 2012.
44. S. S.Iyengar, N.Parameshwaran,Vir V. Phoha, N. Balakrishnan, C.D.Okoye, Fundamentals of Sensor Network Programming Applications and Technology, John Wiley & Sons, Inc., 2011.
45. L.Spaanenburg, H.Spaanenburg, Cloud Connectivity and Embedded Sensory Systems, Springer Science+Business Media, LLC, 2011.
46. FP7 SENSEI deliverables: www.sensei-project.eu.
47. Gluhak A., Krco S., Nati M., Pfisterer D., Mitton N., Razafindralambo T., A survey on facilities for experimental internet of things research, IEEE Communication Magazine, Volume: 49, Issue: 11. pp. 58 – 67, 2011.
48. Z.Qian, R.Wang, Q.Chen, Y.Liu , W.Qin, IOT Gateway: Bridging Wireless Sensor Networks into Internet of Things, IEEE/IFIP International Conference on Embedded and Ubiquitous Computing, pp. 347-352, 2010.
49. Srđan Krčo, David Cleary, Daryl Parker, Enabling Ubiquitous Sensor Networking Over Mobile Networks through Peer-2- Peer Overlay Networking, Computer Communications. Volume 28 Issue 13, pp. 1586-1601, 2005.

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods: Lectures. Discussions. Case studies. Lab sessions. Independent research work.
Evaluation/Grading (maximum 100 points) • Homework - **20 points** • Written exam - **20 points** • Seminar paper/project - **30 points** • Publishing research results in conference proceedings or a scientific journal - **30 points**

Course:

Internet marketing and social media-selected chapters

Teacher:Bogdanović M. Zorica,Labus B. Aleksandra,Vukmirović V. Dragan,Janičić R. Radmila

Course status: Compulsory

ECTS points: 10

Prerequisites: -

Course objective: The aim of the course is to enable students to design and implement businesses on the Internet using modern Internet technologies, techniques of internet marketing and social media services.

Learning outcomes:

The students will be able to design and implement internet marketing methods, utilize social media, as well as perform scientific research in this area of study.

Course structure and content:

Lectures and practical exercises: The methodology of scientific research in the field of Internet marketing. Models and strategies of Internet marketing. The methodology of defining and implementing internet marketing plan. Methods of marketing with the research on the Internet. The model of integration of components and services interent marketing.Social computing. Methods and techniques of mobile marketing. Applications and services in mobile business internet marketers. Models of customer relationship management. Analysis of consumer behavior on the Internet. Systems recommendations. Applying the concepts of ubiquitous computing, and expanded reality in internet marketing:retargeting, marketing, real-time localization, personalization, video marketing, advanced SEO, integration of marketing channels, etc. The application of advanced business analytics techniques in internet marketing.Big data in internet marketing. Application development and internet marketing services by using Google and Facebook API. The application of the concepts of the semantic web in internet marketing. Analysis of the results of the most current international projects in the field of internet marketing. Review and analysis of the most important references.

Literature/Readings:

50. E-resoruces from moodle.elab.fon.bg.ac.rs
51. D.M.Scott, The New Rules of Marketing and PR. John Wiley & Sons, 2007.
52. D.Chaffey, Internet Marketing: Strategy, Implementation and Practice (3rd Edition), Prentice Hall, 2006.
53. J.Strauss, R.Frost, E-Marketing 5th Edition. Prentice Hall, 2009.
54. T.L.Tuten, M.R.Solomon, Social Media Marketing. Pearson International edition, 2013.
55. A.J.Bradley, M.P.McDonald, The Social Organization: How to Use Social Media to Tap the Collective Genius of Your Customers and Employees. Harvard Business Press Books, 2011.
56. C.Holloman, The Social Media MBA: Your Competitive Edge in Social Media Strategy Development and Delivery. A John Wiley & Sons, Ltd, 2012.
57. B. Osatuyi, Information sharing on social media sites, Computers in Human Behavior, Volume 29, Issue 6, Pages 2622-2631. Elsevier, 2013.
58. K. Peters, Y.Chen, A. M. Kaplan, B. Ognibeni, K. Pauwels, Social Media Metrics — A Framework and Guidelines for Managing Social Media, Journal of Interactive Marketing, Volume 27, Issue 4, Pages 281-298. Elsevier, 2013.
59. K. Corley, Z. Jourdan, R. Ingram, Internet marketing: a content analysis of the research, Electronic Markets, Volume 23, Issue 3, pp 177-204, Springer, 2013.

The number of class hours per	**Lectures:** 3	**Research study:** 4

week		
Teaching methods: Lectures. Discussions. Case studies. Lab sessions. Independent research work.		
Evaluation/Grading (maximum 100 points) • Homework - **20 points** • Written exam - **20 points** • Seminar paper/project - **30 points** • Publishing research results in conference proceedings or a scientific journal - **30 points**		

Course:

Internet technologies-selected chapters

Teacher:Radenković LJ. Božidar,Despotović-Zrakić S. Marijana,Barać M. Dušan,Krčo M. Srđan,Vujin D. Vladimir

Course status: Elective

ECTS points: 10

Prerequisites: -

Course objective: The aim of the course is to enable students for independent scientific research in the field of Internet technology.

Learning outcomes:

The students will be able to independently analyze current problems of web-based information systems, to interconnect and apply acquired knowledge, as well as perform scientific research in this area of study.

Course structure and content:

Lectures and practical exercises: The methodology of scientific research in the field of Internet technology. Advanced models and software architecture in the Internet environment. Modeling and business process reengineering. Advanced design techniques web applications. The development of sophisticated web services. Interoperability and integration of information systems. Advanced aspects of safety, security, scalability and reliability of web applications. Comparative analysis framework for application development. The management of digital identities. Technology for information integration. Semantic web. Ontologies. Advanced technologies for visualizing data in web applications. Architecture optimization and application performance. Complex web services. Advanced concepts of web programming. Developing applications on cloud computing infrastructure. Review and analysis of the most significant scientific research papers in the field of Internet technology. Analysis of the results of the most current international projects in this field.

Literature/Readings:

1. E-resoruces from moodle.elab.fon.bg.ac.rs
2. M.Despotović-Zrakić, V.Milutinović, A.Belić, (Eds), High performance and cloud computing in scientific research and education, monografija, IGI Global, 2014.
3. J. Jackson, Web Technologies: A Computer Science Perspective , Pearson Education, 2011.
4. V.Sugumaran, J.Gulla, Applied Semantic Web Technologies, CRC 2012.
5. B.Porebski, K.Przystalski, L.Nowak, Building PHP Applications with Symfony, CakePHP, and Zend Framework, Wiley,2011.
6. W.Maya, G.Lausen, A uniform framework for integration of information from the web, Information Systems, 29(1), 59–91, Elsevier, 2004.
7. D.Duggan, Service-Oriented Architecture, Chapter in Enterprise Software Architecture and Design: Entities, Services, and Resources, 207–358, John Wiley & Sons Inc, 2012.
8. R.Buyya , C.Vecchiola , S.T.Selvi, Advanced Topics in Cloud Computing, Chapter in Mastering Cloud Computing: Technologies and Applications Programming, 373–427, Morgan Kaufman, 2013.
9. R. Hervás, J.Bravo, Towards the ubiquitous visualization: Adaptive user-interfaces based on the Semantic Web, Interacting with Computers, 23 (1), 40–56, Elsevier, 2011.
10. R.Karunamurthy, F.Khendek , R.Glitho, A novel architecture for Web service composition, Journal of Network and Computer Applications, 35 (2), 787–802, Elsevier, 2012.

<table>
<tr><td colspan="3">11. M.Despotović-Zrakić, D.Barać, Z.Bogdanović, B.Jovanić, B.Radenković, Web-based Environment for Learning Discrete Event Simulation, Journal of Universal Computer Science, vol. 18, no. 10, pp. 1259-1278, 2012.
12. M. Milutinović, A. Labus, V. Stojiljković, Z. Bogdanović, M. Despotović-Zrakić, Designing a mobile language learning system based on lightweight learning objects, Multimedia Tools and Applications, 2013.</td></tr>
<tr><td>The number of class hours per week</td><td>Lectures: 3</td><td>Research study: 4</td></tr>
<tr><td colspan="3">Teaching methods:

Lectures. Discussions. Case studies. Lab sessions. Independent research work.</td></tr>
<tr><td colspan="3">Evaluation/Grading (maximum 100 points)

• Homework - 20 points
• Written exam - 20 points
• Seminar paper/project - 30 points
• Publishing research results in conference proceedings or a scientific journal - 30 points</td></tr>
</table>

Course:

Interoperability of Enterprise Systems and Applications

Teacher:Marjanović M. Zoran,Aničić M. Nenad,Ivezić D. Nenad,Nešković N. Siniša

Course status: elective for study group Information Systems

ECTS points: 10 points

Prerequisites: none

Course objective:

This course will provide knowledge about different aspects of interoperability of enterprise systems and applications. Interoperability is perceived on three aspects: business systems (their models), applications and data.

Learning outcomes:

Students will be capable to apply appropriate methods and techniques for integration and interoperability of enterprise systems and applications to solve different problems in practice according to recognized defined standards.

Course structure and content:

Interoperability – term and definitions. Methods, tools and frameworks for modeling interoperability of enterprise systems and their applications. ATHENA (Advanced Techologies for Interoperability of Heterogenius Enterprise Networks and their Application) Interoperability Framework (AIF) and three basic approaches: (1) conceptual integration – models, meta-models and languages; (2) technical integration – modeling tools and runtime environments; (3) application integration – methodologies and selected case studies. Enterprise architecture. Integration and application interoperability. Integration and interoperability of business entities. Standards in integration and interoperability of enterprise systems. Problem areas in interoperability and selected case studies.

Literature/Readings:

1. Group of authors, D.A1.1.1: First Version of State of the Art in Enterprise Modelling Techniques and Technologies to Support Enterprise Interoperability, Version 1.2, 2004.

2. Group of authors, D.A4.1: Requirements for Interoperability Framework, product-based and process-based Interoperability Infrastructures, Interoperability Life-cycle Services, Version 1.0, 2005.

3. Group of authors, D.A6.3: Model-driven and Adaptable Interoperability Framework, Version 1.0, 2006.

4. Group of authors, D.A1.5.1: MCPE Specification, Version 1.0, 2004.

The number of class hours per week	**Lectures: 3**	**Research study: 4**
Teaching methods: Lectures and labs.		

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Seminar presentation	**50**	Oral exam	**50**

Course:

Software quality – selected topics

Teacher:Devedžić B. Vladan,Lazarević D. Saša

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective:

Introduction to models and features of software quality. Understanding and mastering the process of software quality management.

Learning outcomes:

Student's capability to understand software quality. Practical experience in applying the process of software quality management.

Course structure and content:

Theoretical instruction

Basics of software quality. Ethics and culture of software engineering. Software quality standards. Relationship between ISO 9126/25000 and CMMI standards. The value and cost of quality. Models and features software quality (quality of the software process, quality of a software product). Quality improvement. Software quality management process: software quality assurance. Verification and validation. Review and monitoring of software quality (management review, technical review, inspection of anomalies, evaluation of products, testing of software products). Practical considerations: requirements for software quality (factor affecting software quality, dependences, software integrity levels). Features of defects (error, fault, failure, mistake). Techniques of software quality management (static techniques, user-oriented techniques, analytical techniques, dynamic techniques, testing). Measuring software quality (statistics , trend analysis and prediction). Case study.

Practical instruction: labs, research study, other instruction

Demonstration of specific application of techniques and methods of software quality management. Practical project.

Literature/Readings:

- M. Chemuturi, Mastering Software Quality Assurance: Best Practices, Tools and Techniques for Software Developers, J. Ross Publishing, 2010.
- P.M. Duvall, S. Matyas and A. Glover, Continuous Integration: Improving Software Quality and Reducing Risk, Addison-Wesley Professional, 2007.
- S.H. Kan, Metrics and Models in Software Quality Engineering (2nd Edition), Addison-Wesley Professional, 2002.

The *number of class hours* per *week*	**Lectures:** 3	**Research study:** 4

Teaching methods: Classical teaching or mentoring, depending on the number of registered students.

Evaluation/Grading (maximum 100 points)

Individual practical project / seminar

Course:

Quantitative models and methods in management

Teacher:Martić M. Milan,Bulajić V. Milica,Savić I. Gordana,Kuzmanović S. Marija,Makajić-Nikolić D. Dragana,Radojičić A. Zoran

Course status: Elective

ECTS points: 10

Prerequisites: Operational research

Course objective: The aim is to introduce modern mathematical and optimization methods and methods as a support for business and production decision making.

Learning outcomes:

Students will be able to make model of optimization problems, as well as adequate analyses of results and software application as decision support.

Course structure and content:

Lectures:

Mathematical modelling of business, production and service systems. Mathematical modelling for measuring efficiency and performance benchmarking of business systems. Specific problems of planning and scheduling. Nonlinear, integer and mixed integer programming. Quantitative models of advanced performance evaluation including non-linear DEA models. Algorithms for finding exact solution of nonlinear problems. Heuristics. Metaheursitics. Modern software for comparative efficiency analyses, planning, scheduling and statistical analyses of obtained results.

Literature/Readings:

1. J. Petrić, S. Zlobec, Nelinearno programiranje, Naučna knjiga, 1983.

2. V. Vujčić, M. Ašić, N. Miličić, Matematičko programiranje, Matematički institut SANU, 1980.

3. Oakshott L., Essential Quantitative Methods: For Business, Management and Finance, Palgrave Macmillan; 4 edition (27 Mar 2009), ISBN: 978-0230218185;

4. A. Sofer, S. Nash, Linear and Nonlinear Programming, McGraw Hill, 1996.

5. T. Hurlimann, Mathematical Modeling and Optimization, Kluwer Academic Publishers, 1999.

6. Zue J, " Quantitative Models for Performance Evaluation and Benchmarking: Data Envelopment Analysis with Spreadsheets - Applications and implementations issues ", Springer, 2009.

7. Bogetoft P, "Performance Benchmarking - Measuring and Managing Performance", Springer, 2012.

The number of class hours per week	**Lectures:** 3	**Research study: 4**
Teaching methods: Ex-cathedra teaching, laboratory classes, workshops, case studies.		
Evaluation/Grading (maximum 100 points) Research study: 50 Oral exam: 50		

Course:

Combinatorial Optimization

Teacher:Čangalović M. Mirjana,Stanojević J. Milan,Mladenović M. Nenad

Course status: Mandatory

ECTS points: 10

Prerequisites: none

Course objective: Introducing students with basic combinatorial optimization problems and metods for their solving.

Learning outcomes: Students are educated to implement some contemporary techniques for solving various combinatorial optimization problems.

Course structure and content: Integer programming. Integral polytopes. Branch and Bound methods. Cuting Plane methods. Branch and Cut methods. Implicite enumeration methods. Minimum Spanning Trees and greedy algorithms. Shortest path problems. Maximum Flow problem and Minimum Cost Flow problem in a network. The Network Simplex method. Optimal Matchings in bipartite and arbitrary graphs. Optimal Matching problems on weighted graphs. Hamiltonian circuits in graphs. Traveling Salesman problem (TSP) and its relaxations. Lin-Kernighan heuristic for TSP. TSP with several salesmen. Coloring of graphs. Edge and vertex colorings of graphs. Chromatic number of a graph. Interval vertex coloring of a graph. Some applications of the graph coloring. Introduction to the Theory of Numerical Complexity. P and NP classes.

Literature/Readings:

1. Cvetković D., Čangalović M., Dugošija Đ., Kovačević-Vujčić V., Simić S., Vuleta J., Kombinatorna optimizacija, Matematička teorija i algoritmi, DOPIS, Beograd, 1996.

2. Schrijver A., Combinatorial Optimization, Vol. A,B,C, Springer, 2003.

3. Korte B., Vygen J., Combinatorial Optimization, Theory and Algorithms, Springer, 2012

4. Vujošević M., Metode optimizacije u inženjerskom menadžmentu, AINS,FON, Beograd, 2012

The number of class hours per week	**Lectures: 3**	**Research study: 4**

Teaching methods: Classical lessons and research studies gided by mentors

Evaluation/Grading (maximum 100 points)

Oral exam: 50

Essay: 50

Course:

Concurrent and distributed programming - selected chapters

Teacher:Radenković LJ. Božidar,Krčo M. Srđan

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Aim of this course is to introduce methodology of scientific research in technical and technological sciences to students and enable them to write and publish scientific research papers and write proposals of scientific researches and projects.

Learning outcomes:

Students are capable to analyze and solve problems in area of distributed computing systems and concurent progrmming, link and apply gained knowledge, as well as to conceptualise and implement researches in area of advanced distributed computing systems and concurent programming.

Course structure and content:

The methodology of scientific research in the field of competitive and distributed programming. Advanced hardware architecture. Kernel of multi-system. Advanced organization of multiprocessors. Typical problems of communication and synchronization process. Architectural means for controlling access to a critical region. System resources. Monitors. Securing distribution, linear scalability and reliability in modern computer systems. Distributed computing systems. Components of distributed computer systems. Distributed shared memory. Coordination and synchronization of processes in distributed computing systems. Distributed file systems. Service-oriented architecture and distributing business logic. Distributed databases. Review and analysis of the most significant references in this field. Analysis of the results of current scientific research projects in this field.

Literature/Readings:

1. E-resources, available at www.elab.rs
2. A.Tanenbaum, M.Steen, *Distributed Systems Principles and Paradigms (Second Edition)*, Pearson Prentice Hall 2007.
3. M. Ben-Ari , *Principles of concurent and distributed programming*, New York: Prentice-Hall 1991.
4. Fred B. Schneider, *On Concurrent Programming*, Springer 1997.
5. W. Ahmed, Y. W.Wu, *A survey on reliability in distributed systems* , Journal of Computer and System Sciences, 79(8), 1243-1255, Elsevier, 2013
6. L. Lopriore, *Object protection in distributed systems*, Journal of Parallel and Distributed Computing, 73 (5), 570-579, Elsevier 2013, ISBN: 0080454704,
7. D.L.Galli, *Distributed Operating Systems*, Concepts & Practice, Prentice Hall 2000.
8. A. Puder, K. Römer, F. Pilhofe, *Distributed Systems Architecture: A Middleware Approach*, Elsevier 2006.
9. G. Coulouris, J.Dollimore, T. Kindberg, G.Blair, *Distributed Systems: Concepts and Design*, Pearson Education, 2011. ISBN:0133001377
10. Michael Philippsen, *A survey of concurrent object-oriented languages,* Concurrency: Practice and Experience, 12(10), 980, John Wiley & Sons, 2000.

The number of class hours per week	**Lectures:** 3	**Research study: 4**
Teaching methods Lectures, exercises, case studies, lab exercises in classrooms with computers, project / seminar papers, distance education		
Evaluation/Grading (maximum 100 points) • Assignments 20 points • Written exam 20 points • Seminar paper / project 30 points • Publishing results of scientific work in proceedings of conference or in scientific journal 30 points		

Course:

Software Construction - selected topics

Teacher:Đurić O. Dragan,Lazarević D. Saša,Tomić B. Bojan

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective:

Understanding and mastering principles, methods and tools of software construction.

Learning outcomes:

Students' ability to use contemporary tools and methods of software constructionin practical and research-oriented projects.

Course structure and content:

Theoretical instruction

Software construction basics. Minimizing complexity. Anticipating change. The techniques for anticipating change (communication, programming languages, platforms, tools). Software verification. Software construction standards (OMG, IEEE, ISO). Software construction management. Models, plans, metrics. Practical considerations: projects, construction languages (configuration language, toolkit languages, programming languages…). Programming language notations (linguistic, formal, visual…). Coding – source code writing techniques. Finding bugs. Testing. Reusability. Quality. Integration.

Practical instruction: labs, research study, other instruction

Demonstration of specific application of techniques and methods of software engineering. Practical project.

Literature/Readings:

1, I. Sommerville Software Engineering Addison-Wesley 2005

2, S. McConnell Code Complete: A Practical Handbook of Software Construction Microsoft Press 2004

The *number of class hours* per *week*	**Lectures:** 3	**Research study:** 4

Teaching methods: Classical teaching or mentoring, depending on the number of registered students.

Evaluation/Grading (maximum 100 points)

Individual practical project / seminar

Course:

Logistics – selected topics

Teacher:Vasiljević V. Dragan

Course status: Elective

ECTS points: 10

Prerequisites: some of the courses of logistics management, operations management or management science.

Course objective:

Acquisition of advanced knowledge of logistics systems design and logistics and supply chain operations management. Also, preparing students for research and consulting work in the field of logistics engineering and management.

Learning outcomes:

Advanced knowledge, laboratory experience and skills needed for logistics systems design and logistics operations management. Using these outcomes doctoral students will be able to perform individual and team scientific research and consulting work, and to identify and solve complex problems of logistics systems management and controlling.

Course structure and content:

Logistics and information aspects of integrated operations management: CIL (Computer Integrated Logistics) and CIM (Computer Integrated Manufacturing). Advanced concepts in sale planning and logistical operations planning. Some extensions of MRP (Material Requirements Planning). Logistics in e-business environment. Concept of LCI (Life Cycle Integration). The new framework of e-maintenance. CBM+ (Condition Based Maintenance+). E-maintenance improvement using LCI. The modern standards in logistics. The modern logistics strategies. Modeling and designing of logistics systems. Supply chain with a closed loop. Web based Interactive Electronic Technical Manual. Web based B2B logistics support. Web based Integrated Product Design. Hybrid systems of manufacturing performances monitoring: some extensions of OEE (Overall Equipment Effectiveness). The improvement of reports creation in ERP (Enterprise Resources Planning) environment. Advanced information and communications technologies in logistics. Information system of integrated logistics. Virtual logistics systems. The selected logistics games. Actual trends in logistics.

Literature/Readings:

1. Vasiljevic D., Jovanovic B., *Logistics and Supply Chain Management*, ISBN 978-86-7680-150-3, FOS, Belgrade, 2008. (in Serbian)
2. Bowersox D., Closs D., Cooper M., *Supply Chain Logistics Management*, McGraw Hill, USA, 2007.
3. Daganzo C., *Logistics Systems Analysis*, Springer, Germany, 2005.
4. Jonsson P., *Logistics and Supply Chain Management*, McGraw Hill, USA, 2008.
5. Kappauf J., Lauterbach b., Koch M., *Logistics Core Operations with SAP: Inventory Management, Warehousing, Transportation, and Compliance*, Springer, Berlin, 2012.

6. Langevin A., Riopel D., *Logistics Systems: Design and Optimization*, Springer, USA, 2005.

7. *Logistics Engineering Handbook*, (edited by Don Taylor G.), CRC Press, Taylor and Francis Group, USA, 2008.

8. *Logistics operations and management: concepts and models*, (edited by Farahani R. Z., Rezapour S., Kardar L.), Elsevier, USA, 2011.

9. Schroeder R., *Operations management: Contemporary Concepts and Cases*, McGraw Hill, USA, 2007.

10. Vollman T., Berry W., Whybark D., Jacobs R., *Manufacturing Planning and Control for Supply Chain Management*, McGraw Hill, USA, 2005.

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods: ex cathedra, analysis of real-world case study, laboratory work, consultations.

Evaluation/Grading (maximum 100 points)

Classroom tasks (10 points), laboratory work (10 points), seminar (40 points), oral exam (40 points).

Method of knowledge evaluation:

Grades	**5**	**6**	**7**	**8**	**9**	**10**
Points	[0-55]	[56-65]	[66-75]	[76-85]	[86-95]	[96-100]

Course:

Marketing and customer relationship management

Teacher:Filipović S. Vinka,Kostić-Stanković M. Milica,Štavljanin B. Velimir,Damnjanović Ž. Vesna,Cicvarić Kostić M. Slavica,Vukmirović A. Jovanka

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

The aim of the course is theoretical and practical understanding of new concepts and techniques, as well as new marketing philosophy focused on developing and maintaining long-term relationships with customers. Special emphasis is placed on preparing students for modern software application support and analysis of the best examples in business environment

Learning outcomes:

Improvement of theoretical and practical knowledge in the field of customer relationship, identifying the factors that influence the establishment of long-term marketing strategies that are based on added value for customers.

Course structure and content:

Theoretical instruction:

The role of the new trends in marketing. Theoretical basis for long-term marketing relationships. Customer lifetime value. Retention strategy for existing customers. Marketing and corporate customer management. The concept of loyalty and added value for customers. Strategic approach to developing long-term relationships with customers. Customer relationship development model. Implementation of the program for customer relationships development. Customer relationship management (CRM) on Internet and in information communication technologies. Customer relationship management in sales and marketing. Profitability analysis of long-term marketing relationships strategies.

Research work:

Research work involves the practical application of methods, techniques, procedures, and tools in customer relationship management. The student is required to investigate a given problem in the field of marketing and customer relationship management (CRM) and to present their proposals for a solution in form of a research.

Literature/Readings:

1. Filipović V., Kostić-Stanković M., *Marketing menadžement*, FON, Beograd, 2012.
2. Kostić-Stanković M., *Marketinško komuniciranje u upravljanju odnosima sa kupcima*, Zadužbina Andrejević, Beograd, 2013.
3. Lovreta S., Berman B., Petković G., Veljković S-, Bogetić Z., *Menadžement odnosa s kupcima,* Ekonomski fakultet Beograd, 2010
4. John, E., *Relationship Marketing*, Harlow, Pearson Education Limited, 2009
1. Johnoson, M., *Relationship selling and sales management*, New York, McGraw Hill, 2008
2. Neumeier, M, *ZAG - the number one strategy of high-performance brands*, Pearson Education, 2007

The number of class hours per week	**Lectures:** 3	**Research study:** 4
Teaching methods: Classical lectures and labs. Presentations, discussions and research work presentation.		
Evaluation/Grading (maximum 100 points) Research work – project assignments through out semester – 50 points Exam (or tests in semester) – 50 points		

Course:

Marketing Information Systems

Teacher:Janičić R. Radmila,Vukmirović A. Jovanka,Štavljanin B. Velimir,Radojičić A. Zoran

Course status: Chosen

ECTS points: 10

Prerequisites: Knowledge about Management and Marketing.

Course objective

Course objective is improving knowladge about use of information systems in process of marketing planning. Special objective is development of marketing planning by on the base of information systems, as support. Specific objective is to cover all approach of buiding informaton systems, including defining information systems, collect data, analysis of data, control of collecting process and implementation process on the base of research.

Learning outcomes

Understanding of marketing research methodology as process of continuing process of data collecting and buidling, as well as, process of conclusion on the base of informations. Developing of marketing planning on the base of marketing information systems.

Course structure and content

Theoretical instruction: Marketing research –definition, methodology and process. Marketing information systems. Data base according to sources and contents, statistical data, informations as part of information systems, marketing information systems, marketing decision making based on marketing information systems. Analysis of data sources and methodology of collecting data and processing into the informations. Decision process and chosing the informations from the data base. Model of CRM, as base for informations about clients, customers, consumers, partners, distributors, agencies, concurents and other private and public institutions. On the base of nformations about customers/consumers companies can predict future behaviour and use different strategies to improve there position on the market place and to improve connection with consumers/customers. Also, analysis of concurency on the market place is important by information systems, as well as, analysis of relationship marketing activities with partners in business process. Marketing research is holistic process that include research of market place, concurention, environment, relationship with others instituions, partners, customers/consumers, as well as, internal process in companies. This holistic approach gives opportunities for developing process of marketing decision making. Marketing research on the base of marketing information systems in base for sucessful implementation of marketing strategies on market place. Marketing information systems gives us opportunities for controling marketing decision process and implemetation of strategies and it is the best feedback as control process, which will impact other marketing decision in the future. Marketing information systems is support for concept of relationship marketing with partners, distributors and others subjects on the market place. Marketing information systems is support for prediction of future customer behavior and implementation of new trend according to customers needs. Appropriate use of marketing information systems can improve companies decision making and improve connections with all subjects on market place, as well, as improve companies position on market and rase awareness about companies products and services. *Practical instruction:* Research work on the real case studies from practice. Comparative analysis of case studies.

Literature/Readings

Vukmirović J., Vukmirović D., Marketing istraživanje, BPŠ, 2011.

Filipović V., Kostić – Stanković M., *Marketing menadžment*, FON, 2008;

Kotler Ph., Keller R., *Marketing Management*, DataStatus, 2008.

Hanić H., *Istraživanje tržišta i MIS,* Ekonomski fakultet, 2004.

Teaching methods

Lectures, Interactive discussions, presentations, analysis of case studies from practice

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final Exam**	**Points**
ractical research-project work	**60**	**40**	**100**

Course:

Machine learning – selected chapters

Teacher:Delibašić V. Boris,Suknović M. Milija

Course status: Optional

ECTS points: 10

Prerequisites: none

Course objective:

Develop understanding and skill for applying basic and advanced machine learning algorithm concepts, for mining knowledge from data.

Learning outcomes:

Students have acquired the skill to implement machine learning algorithms and to improve existing algorithms with the goal of improving the efficiency and add new functionalities.

Course structure and content:

1. Introduction to machine learning; 2. Supervised learning, standard evaluation measures, optimal predictors; 3. Comparison of regression and classification, nearest neighbor method, linear and non-linear regression; 4. Logistic regression; 5. Neural network feed-forward architecture, simple training methods, backpropagation learning; 6. Machine learning process, overtraining, regularization, bias-variance decomposition, bagging, learning curve; 7. Support vector machines; 8. Bayes networks; 9. Continuous latent variables; 10. Bayes regression; 11. Mixture models and expectation maximization algorithm; 12. Sequential data models.

Project work: Students have to complete a research writing in form of a research proposal, and can focus on theoretical aspects or applications of machine learning algorithms.

Literature/Readings:

Delibašić B, Suknović M (2009) Algoritmi mašinskog učenja za otkrivanje zakonitosti u podacima, FON.

Mitchell T (1997) Machine Learning, McGraw-Hill

Bishop C.M. (2007)Pattern Recognition and Machine Learning, Springer

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Classic lecture, computer lab exercises.

Evaluation/Grading (maximum 100 points)

Presentation of a scientific paper, 30 points

Written exam, 30 points Project work, 40 points

Course:

Soft computing - selected topics

Teacher:Vujošević B. Mirko,Radojević Dragan,Stanojević J. Milan

Course status: Optional

ECTS points: 10

Prerequisites: none

Course objective: to introduce students to contemporary soft comuting approaches, primarily to solve problems of optimal decision making.

Learning outcomes: Students are trained to model and solve problems of optimal decision making under conditions of uncertainty and ambiguity using the methods of fuzzy sets, neural networks and evolutionary computation.

Course structure and content: Approaches to modeling uncertainty, vagueness and imprecision. Management problems in terms of vagueness. Fuzzy sets and fuzzy logic. Probability and possibility measures. Fuzzy mathematical programming. Decision-making systems based on fuzzy rules. Neural networks. The problems of classification and prediction. Fuzzy-neural systems. Evolutionary computing. Genetic algorithms. The ant algorithms

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Literature/Readings:

1. M. Vujošević, Operaciona istraživanja – izabrana poglavlja, FON, Beograd, 1999.
2. R. Hecht-Nielsen, Neurocomputing,Addison-Wesley, New York, 1990
3. G. Deco, D. Obradovic, An information-theoretic approach to neural computing, Springer Verlag, Berlin, 1996.
4. G. J. Klir, B. Yuan, Fuzzy sets and fuzzy logic – theory and applications, Prentice Hall, Upper saddle River, 1995
5. Xiang-Sun Zhang, Neural Networks in Optimization, Kluwer Academic Publishers, London, 2000
6.

The number of class hours per week	**Lectures:** 3	**Research study: 4**

Teaching methods: Theoretical classes are taught as a block or mentoring, depending on the number of students. Student are obliged to make a case study project.

Evaluation/Grading (maximum 100 points)

Project: 50

Oral examine: 50

Course:

Managerial Stress

Teacher:Mihailović M. Dobrivoje

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective: Acquiring fundamental knowledge about stress as inevitable appearance of human behavior and managerial stress as its specific manifestation. Stress prevention and stress management in work environment. Management without stress.

Learning outcomes: Capabilities for individual application of acquired knowledge about stress within managerial activities. Competencies for personal stress protection and protection of other employees in work teams and organizations. Application of "no stress management" model.

Course structure and content:

Dimensions and functions of management. Theoretical comprehension of stress. Types and sources of stress. Physiological, psychological and psycho-physiological aspects of stress. Consequences of stress. Stress and human health. Stress and managerial competencies. Conflicts as causes and consequences of stress. Stress management. Managerial stress disease. Organizational and personal approach to avoiding and managing stress. Management without stress. Useful changes in behavior and management. Secrets of success – stress prevention.

Literature/Readings:

1. Mihailović D, Borovnjak V, Managerial Stress, FOS, Belgrade, 2008.
2. Grupa autora, Stress – characteristics - disease, Belgrade 2008.
3. Slepčević V, Stress, Characteristics, Belgrade, 2008.

The *number of class hours* per *week*	**Lectures:** 3	**Research study:** 4

Teaching methods: Lectures, assignments, trainings, essays, and case studies. Analysis of personal stress and individual avoiding techniques.

Evaluation/Grading (maximum 100 points)

Essey 30 points, Oral exam 70 points

Course: **Electronic business management – selected chapters**
Teacher:Marković M. Aleksandar
Course status: elective
ECTS points: 10
Prerequisites: none
Course objective: To deepen knowledge and specialize in management of e-business and e-commerce. To give the integrative view of management in organizations and companies involved in electronic business. To discuss and explain the key decisions made by managers in companies and organizations that carry out their business over the Internet. To explain the processes and activities in which such decisions can be made. To identify the main problems and ways of solving them in e-business.
Learning outcomes: Upgrading skills for scientific work in the field of electronic business. Improving knowledge and skills of managers and IT managers who manage or plan to manage companies and organizations in the field of e-commerce and e-business. To enable them to utilize their knowledge to increase competitiveness through the application of innovative information and communication technologies within organizations or in connection with partners and customers.
Course structure and content: Introduction - A brief overview of the basic concepts of e-business management: changes in management caused by using the Internet; its influence on the phase of the management process and management levels; Introduction to e-business and e-commerce. Managing e-business infrastructure. Analysis of the environment of e-business. The development of e-business. Supply chain management in e-business. Management of e-procurement. Customer relationship management. Change management in e-business. Analysis and design of e-business. Implementation and maintenance of e-business applications.
Literature/Readings: Chaffey, Dave, E-Business and E-Commerce Management, IV edition, FT Prentice Hall, UK, 2009. Chaffey, D., Mayer, R., Johnston, K. and Ellis-Chadwick, F.,Internet Marketing Strategy,Implementation and Practice, 4th edn. Financial Times Prentice Hall, Harlow, 2009. Marković, Aleksandar (2013), Menadžment elektronskog poslovanja - materijali u elektronskoj formi, http://www.elab.rs/, FON, Beograd. Rayport, J. and Jaworski, B., Introduction to E-Commerce, 2nd edn.McGraw-Hill, NewYork, 2003. Timmers, P., Electronic Commerce Strategies and Models for Business-to-Business Trading. Series on Information Systems,Wiley, Chichester, 1999. Turban, E., Lee, J., King, D. and Chung, H., Electronic Commerce: A Managerial Perspective. Prentice-Hall, Upper Saddle River, NJ. Chapter 1 introduces industry structures and models for e-commerce, 2000.

The number of class hours per week	**Lectures:** 3	**Research study: 4**

Teaching methods: Lectures. Discussion. Case studies, methods for distance education. Creative workshops.
Evaluation/Grading (maximum 100 points) • Essay / Project: 50 points • Oral exam: 50 points

Course:

Management Information Systems

Teacher:Marjanović M. Zoran

Course status: elective for study group Quantitative Management

ECTS points: 10 points

Prerequisites: none

Course objective:

This course will provide knowledge about all phases in information systems development, databases, knowledge base and management information systems (MIS). Students will learn MIS architecture, phases in MIS development and ways in which MIS increases quality of manager tasks.

Learning outcomes:

Students will be capable to identify needing for MIS in practice, to suggest steps for its implementation and introduction, to monitor its use and to improve existing MIS.

Course structure and content:

Life cycle of information system development (planning, analysis, logical design, physical design, implementation, functioning and maintaining). Relations between MIS and business information system. Relations between MIS and decision support systems. Relations between MIS and expert systems. MIS architecture. Business intelligence and analytical tools. Methods and techniques for design, development and maintaining of big databases and data warehouses. Comparison between normalized and unnormalized data structures. Comparative analysis of different data models. MIS implementation approaches.

Literature/Readings:

1. O'Brien J., Management Information Systems – Managing Information Technology in the Internetworked Enterprise, Irwin McGraw-Hill 1999.
2. Larman, C., Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design, Practice Hall 2001.
3. Lazarević B., Marjanović Z., Aničić N., Babarogić S., Baze podataka, FON, Beograd 2010.

The number of class hours per week	**Lectures: 3**	**Research study: 4**	
Teaching methods: Lectures and labs.			
Evaluation/Grading (maximum 100 points)			
Pre-exam requirements	**Points**	**Final exam**	**Points**
Seminar presentation	**50**	Oral exam	**50**

Course:

Human Resource management – selected chapters

Teacher:Mihailović M. Dobrivoje,Milosavljević Đ. Gordana,Šantrić-Milićević Milena

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective: Adoption of theoretical knowledge and practical skills in multidisciplinary field with human resource management as central area inside organizational sciences with application in health care system.

Learning outcomes: Enabling students for independent scientific work in the field and leading work and expert teams and organizations on human resource management positions in health care organizations.

Course structure and content:

Relations between science and phenomena of human resources. Scientific field of human resources in social sciences and humanities. Origins, development and perspectives of human resource management. Strategic approach to human competencies. Characteristics of human resource management. Basic organizational and operational functions of human resource management. Job analysis, job design and planning. Job classification and systematization. Recruitment and selection of human resources. Placement and employee orientation. Material stimulation and developmental motivation of employees. Training and education of employees. Employees' career management. Human resource management functions. Employees' profiles in department for human resource management. Main problems in human resource management in health care: conflicts, communication, job satisfaction. Human resource management in health care system. The future of human resource management in health care system.

Students engage in research work in Center for Human Resource Management and in business systems with departments of human resource management. Through seminar paper students conduct research of defined problem and formulate it as appropriate for scientific conferences.

Literature/Readings:

1. Orlić R., Human Resource Management, FOS, Belgrade, 2007.
2. Vujić D., Human Resource Management, DPS, Belgrade, 2010.
3. Mihailović D., Management – Human Side, FTN, Novi Sad. 2005.
4. De Cenzo/Robins., Human Resource Management, Yon Wiley, 1999.
5. Burgard Horst, Handbuch Personalmarketting, Gebler, Wisbaden, 1998.

The *number of class hours* per *week*	**Lectures:** 3	**Research study:** 4

Teaching methods: Lectures, assignments, trainings, essays, projects and case studies.
Evaluation/Grading (maximum 100 points) • Activities in class **10 points** • Test **20 points** • Essay **30 points** • Written exam **40 points**

Course:

Development management

Teacher:Levi-Jakšić I. Maja,Marinković P. Sanja

Course status: Elective

ECTS points: 10

Prerequisites: -

Course objective

Presentation and transfer of knowledge in the field of development management at different levels - society, economy, industry, with a focus on issues of organizational and business development. Presenting and gaining knowledge about the basic theoretical assumptions, principles, models and indicators of growth and development, as well as primary context of environmental factors and internal capacities of an organizations which are relevant for its growth and development. Introduction to the key principles and indicators of sustainable business development based on sustainable technology development.

Learning outcomes

Students are able to follow the latest findings and actively apply the results in the field of development management at different levels: in companies, at the level of the national economy, the region, within the associations, unions, chambers of commerce and other organizations. Acquiring knowledge and skills in defining development strategies, as well as the realization of projects of sustainable, long-term oriented development based on secure technologies.

Course structure and content

Theoretical instruction: Theories, approaches, models, factors of growth and development; Development of society, economy and competitiveness based on knowledge, new technologies and competences; Science, Technology and Development; Development Indicators; Growth factors; Value chain; Development strategies of organizations; R&D management and development of products, services and processes; Sustainable development - the basic concept, philosophy, principles; Sustainable business development - principles, strategies, models, competences; Sustainable management and technology development; Approaches based on life cycle assessment (LCA); Technological competitiveness and sustainable development.

Practical instruction: Approaches to the assessment of technology and organization life cycles; Expanded concept of technology life cycle for sustainable development; Models of the value chain and competences; Implementation of sustainable development activities; Indices of technological capabilities - comparison and synthesis of existing approaches; Indicators of sustainable development - analysis and comparison of existing approaches; Innovation indices; Development and improvement of development indicators.

Literature/Readings:

Levi Jakšić, M., Menadžment tehnologije i razvoja, Čigoja, Beograd, 2010. (izabrana poglavlja)

Levi Jakšić, M., Strateški menadžment tehnologije – inovacije, menadžment i preduzetništvo, FON, Beograd, 2001.

Levi Jakšić, M., Marinković, S., Petković, J., Menadžment inovacija i tehnološkog razvoja, FON, Beograd, 2011.

Levi Jakšić, M., Marinković, S., Menadžment održivog razvoja, FON, Beograd, 2012.

Rainey, D. L., Sustainable Business Development, Cambridge University Press, 2006.

Penrose, E., The Theory of the Growth of the Firm, Oxford University Press, 1995.

Saviotti, P., Nooteboom, B., Technology and Knowledge, Edward Elgar, 2000.

Gilsing, V., The Dynamics of Innovation and Interfirm Networks, Edward Elgar, 2005.

Smith, H. L., Technology Transfer and Industrial Change in Europe, McMillan Press, 2000.

Forbes, N., Wield, D., From Followers to Leaders, Routledge, London, 2002.

Heizer, J., Render, B., Operacioni menadžment, Univerzitet u beogradu, Ekonomski fakultet, Beograd, 2011. (orig. Operations Management, Prentice Hall, 8th edition)

Hollanders, H., Es-Sadki, N., Innovation Union Scoreboard, Belgium: European Union, 2013.

Cornell University, INSEAD, and WIPO, The Global Innovation Index 2013: The Local Dynamics of Innovation, Geneva, Ithaca, 2013.

Pervez, G., Gronhaug, K., Research Methods in Business Studies, Prentice Hall, 2010.

The number of class hours	Lectures: 3	Research: 4

Teaching methods: Lectures supported by IT, presentation and analysis of best practice, case studies, discussions, teamwork, various forms of student involvement in independent work, presenting results of research students on given topics.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Essay			
Attendance			
Activities and tests	40	Exam	60

Course:

Metaheuristics

Teacher:Mladenović M. Nenad,Čangalović M. Mirjana,Stanojević J. Milan

Course status: Elective

ECTS points: 10

Prerequisites:

Course objective: Introducing students to modern heuristic methods for solving NP - hard problems.

Learning outcomes:

Students will learn the basic principles of metaheuristic approaches to solving problems and train for application of some of the metaheuristic methodology in diverse real problems with the help of computers.

Course structure and content:

Lectures:

Elements of computational complexity. The classes P and NP. Basic principles of heuristic approach for solving problems. The term heuristics. Examples of special heuristics. Basic principles metaheuristic methodology. The term environment. The principle of local search. Avoiding the pitfalls of local extremes. The general scheme metaheuristic method. Simulated annealing. Tabu search. Variable neighbourhood search. Genetic algorithms and other evolutionary methods. The ant and bee algorithms. Artificial neural networks. Heuristics based on Lagrangian relaxation. Some applications metaheuristic the methodology. Backpack problem. The traveling salesman problem. Scheduling problems. Continuous global optimization problems. Measuring the effectiveness of heuristic methods. Analytical methods. Empirical testing.

Practical instruction:

The use of existing software packages for heuristic problem solving combinatorial and continuous optimization.

Literature/Readings:

1. Cvetković D., Čangalović M., Dugošija Đ., Kovačević-Vujčić V., Simić S., Vuleta J., Kombinatorna optimizacija, Matematička teorija i algoritmi, DOPIS, Beograd, 1996. (In serbian)

2. Voss S., et al., Meta-Heuristics: Advances and Trends in Local Search Paradigms for Optimization, Kluwer Academic Publishers, 1999.

3. Gendreau M., Jean-Yves P. (Ed.), Handbook of Heuristics, Springer, 2010.

4. Günther Z., Roland B., Michael B., Metaheuristic Search Concepts, Springer, 2010.

The number of class hours per week	**Lectures:** 3	**Research study: 4**

Teaching methods: Ex-cathedra teaching, laboratory classes, workshops, case studies.

Evaluation/Grading (maximum 100 points) Research study: 50 Oral exam: 50

Course:

Security methods in electronic business – selected topics

Teacher:Simić B. Dejan,Starčević B. Dušan

Course status: Elective

ECTS points: **10**

Prerequisites: none

Course objective:

The aim of this course is to introduce students to identify and analyze the methods and protection in e-business.

Learning outcomes:

Students are able to analyze, identify threats and vulnerabilities, design and management of the security in e-business systems.

Course structure and content:

Introduction. Threats and vulnerabilities of modern e-business systems. Control access models. Topics in cryptography. Applying cryptography to protect electronic business systems. Email server security (PGP, S/MIME). Database security. Web security. Transport Layer Protection (SSL/TLS). Public Key Infrastructure (PKI). Key management. Digital certificates (X509v3). Digital signature and qualified electronic signature. Protection of wireless networks as infrastructure in electronic business systems. Security management in electronic business systems. Case study – applying PCI DSS and PA DSS standard to protect transactions in card-based electronic payment systems. The use of cryptography in Java. The use of symmetric algorithms (3-DES, AES). The use of asymmetric algorithms (RSA). The use of hashing (SHA-2). Risk management methods. Authentication methods. Working with tools for network security (Wireshark, Metasploit, Nessus). Analysis of selected professional and scientific papers in the field of protection in e-business systems.

Literature/Readings:

1. Stallings W., Brown L., Computer Security – Principles and Practice, 2nd ed., Pearson Prentice Hall, New Jersey, 2012.
2. Dieter Gollmann, "Computer Security", 3rd edition, John Wiley & Sons, Ltd, 2011.
3. M. S. Obaidat, N. A. Boudriga, Security of e-Systems and Computer Networks, Cambridge University Press, 2007.
4. A. Belapurkar, A. Chakrabarti, H. Ponnapalli, N. Varadarajan, S. Padmanabhuni, S. Sundarrajan, Distributed Systems Security Issues, Processes and Solutions, John Wiley & Sons Ltd., 2009.
5. William Stallings, Network Security Essentials: Applications and Standards, Pearson Education, Inc., 2011.
6. David G. Rosado, Daniel Mellado, Mario Piattini, Security Engineering for Cloud Computing: Approaches and Tools, IGI Global Snippet, 2013.
7. Selected professional and scientific papers

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Lectures. Consultation. Discussion. Methods for distance education. The collection and study of relevant literature with providing critical review of the resolution of specific problems. Creative workshops.
Evaluation/Grading (maximum 100 points) Homeworks/Seminar/Project. Oral exam.

Course:

Methodology of Scientific Research

Teacher:Mihailović M. Dobrivoje

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective: Embracing theoretical knowledge and practical skills in designing and implementing scientific research. Application of scientific research methods, techniques and procedures in organizational sciences.

Learning outcomes: Capabilities for independent scientific research and leading project teams. Competencies for application of fundamental and applied research methods, statistical techniques and practical procedures.

Course structure and content:

Nature of scientific knowledge and scientific reality. Relationship between science and methodology of scientific research. Research activities and their role in development of science. Scientific research projects. Phases of scientific research: design and implementation of scientific research. Structure of research project, operational plan and research procedures. Usage of statistics and informatics in scientific research. Fundamental and applied scientific methods: observation, examination, experiment, case study, content analysis.

Project paper. Draft of scientific idea. Design of questionnaire/interview.

Literature/Readings:

4. Mihailović, D. (2012) Methodology of Scientific Research, FOS, Belgrade.
5. Mihailović, D. (1999) Methodology of Scientific Research Projects, SP, Belgrade.

The *number of class hours* per *week*	**Lectures:** 3	**Research study:** 4

Teaching methods: Lectures, assignments, trainings, papers, project papers, analysis of research projects.

Evaluation/Grading (maximum 100 points)

- Activities during class **20 points**
- Practical assignments **20 points**
- Test **20 points**
- Project paper **20 points**
- Oral exam **20 points**

Course:

Methodology of scientific research in technical and technological sciences

Teacher:Despotović-Zrakić S. Marijana,Milutinović M. Veljko,Jovanić R. Branislav,Mihailović M. Dobrivoje

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Aim of this course is to introduce methodology of scientific research in technical and technological sciences to students and to enable them to write and publish scientific research papers and writing proposal of scientific research projects.

Learning outcomes:

Students are capable for planning and realization of research in area of technical and technological sciences

Course structure and content:

Relation among science and methodology of scientific research. Phases in scientific research. Design and implementation in scientific research. Methods of scientific research in technical and technological sciences. Scientific research projects. Structure of the research project. Preparation of research projects proposal based on national and international practice. Preparation of project proposals based on standards in context of the current international projects. Scientific research projects management. Communication in scientific research projects. Project documentation. Planning and realization of scientific research. Critical analysis of literature in field of scientific interest. Planning and realization of experiments. Use of quantitative and qualitative methods to analyze research results. Analysis of results and conclusions. Composition of scientific work and research reports. Writing research papers in the field of technical and technological sciences. Publication of scientific research results in leading international journals. Presentation of scientific research results and research projects results. Preparation and publication of scientific research papers.

Literature/Readings:

1. Materijali u e-formi, sa sajta www.elab.rs
2. V.Milutinović, *A Good Method to Prepare and Use Transparencies for Research Presentations,* IEEE TCCA Newsletter, pp. 72-79, March 1997.
3. V.Milutinovic, *The Best Method for Presentation of Research Results,* IEEE TCCA Newsletter, pp.1-6 september 1997.
4. D.Mihailović, *Metodologija naučnih istraživanja*, Fakultet organizacionih nauka, 1999.
5. A.M. Novikov, D.A. Novikov, *metodologiя naučnogo issledovaniя, Moskva, 2010. ISBN 978-5-397-00849-5.*
6. D.Howitt, D.Cramer, *Introduction to Research Methods*, 3rd Edition, Pearson Education Ltd., 2010.
7. N.Salkind, *Exploring Research: Pearson New International Edition*, 8rd Edition, Pearson Education Ltd., 2013.

The number of class hours per week	**Lectures**: 3	**Research study: 4**

Teaching methods
Lectures, exercises, case studies, lab exercises in classrooms with computers, project / seminar papers, distance education
Evaluation/Grading (maximum 100 points) • Assignments 20 points • Written exam 20 points • Seminar paper / project 30 points • Publishing results of scientific work in proceedings of conference or in scientific journal 30 points

Course:

M-business-selected chapters

Teacher:Radenković LJ. Božidar,Bogdanović M. Zorica,Barać M. Dušan,Krčo M. Srđan,Vujin D. Vladimir

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Aim of the course is to enable students for independent scientific research in field of mobile business. They will study advanced methodologies, models and principles of implementing solutions in area of mobile business. Specific objective is to enable students for successful writing research papers and doctoral dissertations in field of mobile business.

Learning outcomes:

Students are capable to analyze existing approaches and mobile business models, as well as to project and implement mobile business systems. Students are enabled for individual scientific and research work in area of mobile business.

Course structure and content:

Lectures and practical exercises: methodology of scientific research in mobile business. Analysis of techniques and technologies of wireless transmission. Analysis of mobile operating systems, development platforms and environments. Methodologies for development of mobile business applications. Models of knowledge management and data in mobile environments, web services in a mobile environment. Ubiquitous computing. Context-Aware Systems. Security, scalability and reliability of mobile and wireless networks. Mobile education. Mobile cloud computing. Analysis of trends in the mobile business. Wearable computing. Gamification aplications. Adaptive mobile computing. Embedded systems. Models and programming paradigm of pervasive computing applications. Pervasive computing. Context-aware computing. Crowdsourced mobile computing. Nomadic computing. Object recognition. Smart spaces and intelligent environments. Mobile grid. Management of digital identities in a mobile environment. Applications of mobile business. Prompt launching of mobile applications by using web technology. Framework for integration with smart devices. Stylization and design of uniform user experience. Analysis and optimization of interaction with the user. Development of applications based on web API. The utilization of cloud storage / data processing. Advanced aspects of security applications. Analysis of operational data applications. Integration with mobile payment systems. Legal aspects of the development of mobile applications - license libraries, synchronization architecture. Use of mobile technology identification. Implementation of cloudlets and Weblets. Review and analysis of the most important references. Analysis of results of the most important projects in this field.

Literature/Readings:

1. E-resources, available at www.elab.rs
2. M. Despotović-Zrakić, V.Milutinović, A. Belić (Eds), *High performance and cloud computing in scientific research and education*, monografija, IGI Global, March 2014.
3. S.Conder, L.Darcey, *Android Wireless Application Development Volume II: Advanced Topics* (3rd Edition), Addison-Wesley, 2012.

4. D.Siewiorek, A. Smailagic, Thad Eugene Starne, *Application Design for Wearable Computing*, Morgan and Claypool Publishers, ISBN: 978-1598291209, 2008
5. J. Barbosa, F. Dillenburg, G. Lermen, A.Garzão, C. Costa, J.Rosa, *Towards a programming model for context-aware applications*, Computer Languages, Systems & Structures, 38 (3) 199–213, Elsevier 2012.
6. H. Dinh, C. Lee, D. Niyato, P.Wang, *A survey of mobile cloud computing: architecture, applications, and approaches*, Wireless communications and mobile computing, 13(18), 1587–1611, John Wiley & Sons, 2011.
7. P. Yua, X. Maa, J. Caob, J. Lua, *Application mobility in pervasive computing: A survey*, Pervasive and Mobile Computing, 9(1), 2-17, Elsevier 2013
8. K. Elgazzar, S. Hassanein, P. Martin, *DaaS: Cloud-based mobile Web service discovery*, Pervasive and Mobile Computing, Elsevier, 2013.
9. F. Resatsch, *Developing and Evaluating Near Field Communication Applications*, Ubiquitous Computing, Springer 2010. ISBN: 978-3-8349-2167-3
10. M. Milutinović, A. Labus, V. Stojiljković, Z. Bogdanović, M. Despotović-Zrakić, *Designing a mobile language learning system based on lightweight learning objects*, Multimedia Tools and Applications, DOI: 10.1007/s11042-013-1704-5, 2013, ISSN 1380-7501

The number of class hours per week	**Lectures:** 3	**Research study: 4**

Teaching methods

Lectures, exercises, case studies, lab exercises in classrooms with computers, project / seminar papers, distance education

Evaluation/Grading (maximum 100 points)

- Assignments 20 points
- Written exam 20 points
- Seminar paper / project 30 points
- Publishing results of scientific work in proceedings of conference or in scientific journal 30 points

Course:

Mobile computing - selected chapters

Teacher:Starčević B. Dušan,Minović V. Miroslav,Milovanović M. Miloš

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Deepening previously acquired knowledge and skills in the field of computer networks and mobile computing. Enabling students to critically evaluate and apply available approaches and techniques in mobile computing technology application.

Learning outcomes:

Students will deepen their previously acquired knowledge and skills in the field of data exchange between computer systems and user interfaces design, with emphasis on mobile access devices. Acquired knowledge and skills will enable quality design and implementation of data exchange systems that fullfil the "anywhere, anyhow, anytime" principle.

Course structure and content:

Theoretical study.

Mobile Computing. Industry trends. Hardware. Software. Security. Networks. Development environments. Introduction to iOS and Android development environments. iOS and Android operating systems. Wireless local area networks and global wireless network. Network standards. Wi-Fi. IEEE 802.11. MAC protocol. Mobility within the subnet. Bluetooth. IEEE 802.15, IEEE 802.16, IEEE 802.20. Cellular networks: standards and technologies. Principles of mobility management. Mobility management in cellular networks. XHTML, Objective-C, Java. Development of mobile applications. XML Web services and mobile computing.

Research work.

Research work is done in Laboratory for multimedia communication. The work includes practical implementation of chosen mobile computing technologies in laboratory conditions. Student is required to explore a given problem, present the problem state in the form of seminar paper and practically implement the given task in the field of mobile computing.

Literature/Readings:

1. J. McWherter, S. Gowell, Professional Mobile Application Development, Wrox, 2012
2. A.F. Molisch, Wireless Communications, Wiley, 2010
3. Kurose, Ross, Umrežavanje računara, CET, Beograd, 2009

The number of class hours per week	Lectures: 3	Research study: 4

Teaching methods:

Classes are held in the form of lectures or in the form of individual consultations based on teaching units. The research part involves collecting and studying the relevant literature with researcher's own critical review in the form of seminar paper suitable for publication. Pracitical part includes implementation of mobile computing example.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Project	**40**	Oral exam - theory and assignments combination	**40**
Work prepared for publication	**20**		

Course:

Modeling business processes in e-business - selected chapters

Teacher:Vasković R. Vojkan,Stefanović D. Nenad

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Aim of this course is to teach students about theoretical and practical knowledge necessary for modeling business processes in e-business systems and to introduce them to basic techniques for automation of processes**.**

Learning outcomes:

Students are capable to analyze and solve problems in area of business modeling, link and apply gained knowledge, as well as to conceptualise and implement researches in area of advanced busines processes modeling.

Course structure and content:

Methodologies and techniques for management and analysis of business processes. Models of metrics of business systems. Designing a model of KPI. Modeling business processes using Business Process Modeling Notation (BPMN). Defining patterns in order to improve business processes. Business Model Innovation. Business Analysis. Re-engineering of business processes in e-business systems. Service-oriented architecture. Implementation of complex web services. Process-oriented software development. Types of events, activities. Business processes integration. Choreography and orchestration processes. Model business process automation. Process optimization. Analysis of the standard for modeling business processes. BPEL. Languages and notations for describing business systems. UML examples. UML activity diagram. Specification of the business domain, user requirements, business transactions. BPMN 2.0 in example of e-business application. Tools for modeling business process. WebSphere Studio. Power Designer – examples. ebXML – examples. Business processes modeling in cloud environment. Advanced topics in area of business process modeling: asynchronous SOA, parallel activities, BPEL event management, error management, compensation process, SOA callbacks and other. Analysis of results of currently most significant international projects in this field. Review and analysis of the most significant references.

Literature/Readings:

1. E-resources, available at www.elab.rs
2. M.Havey, Essential Business Process Modeling, O'Reilly Media, 2005.
3. T.Erl, *Service-Oriented Architecture (SOA): Concepts, Technology, and Design*, Prentice Hall, 2005.
4. M.Laguna, J. Marklund, *Business Process Modeling, Simulation and Design*, Second Edition, CRC Press, 2013.
5. R.Ko, S.Lee, E. Lee, Business Process Management (BPM) Standards: A Survey, Business Process Management Journal, 15(5), Emerald Group Publishing Limited, 2009.
6. M. Muehlena, M. Indulskab, *Modeling languages for business processes and business rules: A representational analysis*, Information Systems, 35 (4), 379–390, Elsevier 2010.
7. J.Solís-Martínez, J. Espada, B. G-Bustelo, J. Manuel, *BPMN MUSIM: Approach to improve the domain expert's efficiency in business processes modeling for the generation of specific software applications*, Expert Systems with Applications, 41(4), 1864–1874, Elsevier, 2014.
8. G.Redding, M.Dumas, A.Hofstede, A. Iordachescu, A flexible, object-centric approach for business process modelling , Service Oriented Computing and Applications, 4(3), 191-201, Springer 2013.
9. P. Antunesa, D. Simõesb, L.Carriçob, J. Pinoc, An end-user approach to business process modeling, Journal of Network and Computer Applications, 36(6) 1466–1479, Elsevier 2013.

The number of class hours per week	**Lectures:** 3	**Research study: 4**
Teaching methods Lectures, exercises, case studies, lab exercises in classrooms with computers, project / seminar papers, distance education		
Evaluation/Grading (maximum 100 points) • Assignments 20 points • Written exam 20 points • Seminar paper / project 30 points • Publishing results of scientific work in proceedings of conference or in scientific journal 30 points		

Course:

Enterprise Modeling

Teacher:Marjanović M. Zoran,Ivezić D. Nenad

Course status: elective for study group Information Systems

ECTS points: 10 points

Prerequisites: none

Course objective:

This course will provide knowledge about different aspects of interoperability of enterprise system models. It considers advantages and disadvantages of available modeling tools.

Learning outcomes:

Students will learn methods, models and tools for interoperability/intraoperability of enterprise systems.

Course structure and content:

Methods, models and tools for interoperability/intraoperability of enterprise systems. ATHENA (Advanced Technologies for Interoperability of Heterogeneous Enterprise Networks and their Application) framework. EKA (Enterprise Knowledge Architecture) basic concepts for presenting models, meta-models, meta-meta-models and etc. Logical model of EKA framework. POP* (Process, Organization, Product and others) meta-model and MPCE (Modeling Platform for Collaborative Enterprises) as mechanism for achieving interoperability of different semantic models of enterprise systems: (1) usage of POP* meta-model as exchange format; (2) POP* as language for enterprise architecture. Comparative analysis of interoperability models (Metis, GRAI, MOOGO, ARIS, etc.).

Literature/Readings:

1. Object management group, Business Process Definition Metamodel, 2004.
2. Berio G., Deliverable D 3.1; Requirements analysis: initial core constructs and architecture, 2003.
3. Lillehagen F., Solheim H., Deliverable DA1.5.1: MPCE, 2004.
4. Asbjørn R., Andersen B., Enterprise Modeling: Improving Global Industrial Competitiveness, Springer 2000.
5. Lankhorst M., Enterprise Architecture at Work: Modelling, Communication and Analysis, Springer 2005.

The number of class hours per	**Lectures: 3**	**Research study: 4**

week		
Teaching methods: Lectures and labs.		
Evaluation/Grading (maximum 100 points)		

Pre-exam requirements	**Points**	**Final exam**	**Points**
Seminar presentation	**50**	Oral exam	**50**

Course:

Multivariate Analysis

Teacher:Bulajić V. Milica,Vukmirović V. Dragan,Radojičić A. Zoran,Jeremić M. Veljko

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

The introduction to models and methods of multivariate analysis and their application in different area.The application of SPSS software in this area.

Learning outcomes:

The course denotes the wide applicability of methods and models of multivariate analysis in different area and prepares students for their application.

Course structure and content:

Lectures:

L-01: Random variables and their distributions. Statistical inference. L-02: Multivariate distributions. Types of data and measuring scales. L-03: The classification of methods of multivariate analysis. L-04: Multivariate linear regression model. The method of least squares L-05: ANOVA. L-06: Canonical correlation analysis. L-07: MANOVA. L-08: Discriminative analysis. L-09: Factor analysis. Principal component analysis. L-10: Cluster analysis. Hierarchical methods of clustering. L-11: Non-hierarchical methods of clustering. L-12: I-distance. Vector coefficient of correlation. L-13: Distance based analysis (DBA). L-14: The multivariate analysis with SPSS software. L-15: Bootstrap and jack-knife in DBA method.

Practical work: Follows the lectures.

Literature/Readings:

1. Kovačić Z., *Multivarijaciona analiza*, Ekonomski fakultet, 1998.
2. Kovačić Z., *Analiza vremenskih serija*, Ekonomski fakultet, 1998.
3. Valim de Freitas L., Barbosa Rodrigues de Freitas A. P., *Multivariate Analysis in Management, Engineering and the Sciences*, InTech, 2013.
4. Jember T. G., *Multivariate Data Analysis Using R Software: Practical Exercises for Multivariate Analysis*, Lambert Academic Publishing, 2012.
5. Johnson R. A., Wichern D. W., *Applied Multivariate Statistical Analysis*, Pearson, 2007.
6. Hair J., Black W., Babin B., Anderson R., *Multivariate Data Analysis*, Pearson, 2013.
7. Keller G., *Statistics for management and economics*, South-Western Cengage Learning, 2012.
8. Bulajić M., Jeremić V., Radojičić Z., *Advance in Multivariate Data Analysis – Contributions to Multivariate Data Analysis*, FON, 2012.

The number of class hours per week	**Lectures:** 3	**Research study: 4**

Teaching methods: Depending on the number of students, teaching method is classical and mentoring, or only

mentoring. The student project, carried out in consultation with the teacher, is required.
Evaluation/Grading (maximum 100 points) **Project:** 70 points **Oral exam:** 30 points

Course:

Multimedia communications - selected chapters

Teacher:Starčević B. Dušan,Štavljanin B. Velimir,Minović V. Miroslav,Milovanović M. Miloš

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Deepening previously acquired knowledge and skills in the field of business communication. Enabling students to critically evaluate and apply available approaches and techniques of multimedia communications.

Learning outcomes:

Understanding operation and ways of using multimedia communition in modern business. Acquiring knowledge and skills needed for using advanced communication systems.

Course structure and content:

Theoretical study.

Digital Economy and multimedia communications. Multimedia phenomenon, as a dominant mode of representation , accommodation, transport, presentation and perception of information. Human-Computer Interaction. Multimodal communication . Multimedia data types: text and hypertext. Graphics. Animation. Sound. Video. The standards for storage and transmission of multimedia data . Multimedia technologies. Internet and mobile telephony . User interface . Tools. Examples of applications : Application Areas . Gropware. CSCW . Speech. Handwriting recognition . Computer Vision . Comprehensive Computing . Virtual reality . Hypertext . Multimedia. WWW. Animation . Digital video . Computer aided learning (CAL) .

Research work.

Research work is done in Laboratory for multimedia communication. The work includes examining possibilities for practical implementation of multimedia communication technologies in laboratory conditions. Student is required to explore a given problem, present the problem state in the form of seminar paper and practically implement the given task in the field of multimedia communications.

Literature/Readings:

1. Starčević, D., Štavljanin, V., (2013), „Multimediji“, FON, Beograd
2. R. Steinmetz, K. Nahrstedt, Multimedia Application, Springer Verlag, 2004
3. F. Hallsall, Multimedia Communications, Addison Wesley, 2001
4. Pantović V., Dinić S.,Starčević D., Savremeno poslovanje i Internet tehnologije, InGraf, Beograd, 2002
5. Suzan Tajler, Istman, Daglas A. Ferguson, Robert A. Klajn, Promocija i marketing elektronskih medija, Klio, 2004

The number of class hours per week	Lectures: 3	Research study: 4

Teaching methods:

Classes are held in the form of lectures or in the form of individual consultations based on teaching units. The research part involves collecting and studying the relevant literature in the field of multimedia communications with researcher's own critical review in the form of seminar paper suitable for publication. Pracitical part includes implementation of business multimedia communication example.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Seminar work	**25**	Oral exam	**50**
Work prepared for publication	**25**		

Course:

Multimedia - selected chapters

Teacher:Starčević B. Dušan,Štavljanin B. Velimir,Minović V. Miroslav,Milovanović M. Miloš

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Deepening previously acquired knowledge and skills and enabling students to critically evaluate available approaches, techniques and technologies in the field of multimedia.

Learning outcomes:

Students are enabled to understand the work and they are enabled to independently design and implement multimedia systems and applications, as well as integrate them into available systems.

Course structure and content:

Theoretical study.

Contemporary trends in multimedia systems. Acquisition of digital data. Media representation and media formats. Digital image. Digital video. Digital audio. Compression (image, video, audio, graphics). Multimedia networking. MPEG 4. Multimedia databases. Multimedia metadata. MPEG 7 standards for describing multimedia content. Multimedia systems. Multimedia frameworks. MPEG 21. Digital item (identification, adaptation, processing). Managing digital rights.

Research work.

Research work is done in Laboratory for multimedia communications. The work includes examining the possibilities for practical application of multimedia technology in the laboratory conditions. Student is required to explore a given problem, present the problem state in the form of seminar paper and practically implement the given task in the field of multimedia. Seminar paper should be in the form suitable for scientific conference or journal publication.

Literature/Readings:

Chapman, N., Chapman J. (2004), Digital Multimedia, Chichester: John Wiley & Sons

Havaldar, P., Medioni, G. (2010), Multimedia Systems: Algorithms, Standards, and Industry Practices, Boston, MA: Course Technology, Cengage Learning

Kosch, H. (2004), Distributed Multimedia Database Technologies, CRC Press

Shuen, A. (2008), Web 2.0: A Strategy Guide, Sebastopol, CA: O'Reilly Media Inc.

Steinmetz, R., Nahrstedt K., (2002), Media Coding and Content Processing, Upper Saddle River, NJ: Prentice Hall

Steinmetz, R., Nahrstedt K., (2004), Multimedia Systems, Springer

Steinmetz, R., Nahrstedt K., (2004), Multimedia Applications, Springer

Starčević, D., Štavljanin, V., (2013), „Multimediji“, FON, Beograd

The number of class hours per week	Lectures: 3	Research study: 4

Teaching methods:

Classes are held in the form of individual consultations based on teaching units. The research part involves collecting and studying the relevant literature in the field of multimedia, with researcher's own critical review in the form of seminar paper suitable for publication. Pracitical part includes implementation of example multimedia system.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Seminar work	**40**	Final exam	**40**
Work prepared for publication	**20**		

Course:

Advanced cloud infrastructures and services

Teacher:Radenković LJ. Božidar,Despotović-Zrakić S. Marijana,Vujin D. Vladimir

Course status: Elective

ECTS points: 10

Prerequisites: -

Course objective:

The aim of this course is to train students to conduct scientific research, model new solutions and solve current problems in the implementation of cloud computing infrastructures and services in e-business. Students can design innovative models of cloud infrastructure, applications, cloud services for e-business, and services for collecting, searching and processing large amounts of data in electronic commerce (Big Data).

Learning outcomes:

The students will be able to apply innovative models of cloud infrastructure and service-based e-business applications.

Course structure and content:

Methodology of scientific research in the field of cloud infrastructure and services. Virtualization of resources. Analysis of standards in cloud computing. Modeling cloud infrastructure. Analysis of private, public and hybrid cloud models. Infrastructure as a service. Platform as a service. Software as a service. Managing cloud infrastructure. Modeling and implementation of services for collecting, searching, processing and use of large amounts of data in electronic business (Big Data). Non-relational databases. Apache Hadoop. Parallel and distributed data mining. Map reduce algorithm. Java MapReduce API. Safety and risk management in cloud computing. Modeling the e-business processes in the cloud environment. The development of e-business applications in the cloud environment using Amazon, Google and Windows Azure services. The application of cloud computing infrastructure and services in business, science and education. Review and analysis of relations of cloud computing and Internet of Things. Analysis of results of the latest research in the field of cloud computing with an overview of the most important references.

Literature/Readings:

13. E-resoruces from moodle.elab.fon.bg.ac.rs
14. M.Despotović-Zrakić, V.Milutinović, A.Belić (Eds), *High performance and cloud computing in scientific research and education*, monografija, IGI Global, 2014.
15. Despotovic-Zrakic M,Simic K,Labus A,Milic A,Jovanic B, Scaffolding Environment for e-Learning through Cloud Computing, Educational Technology & Society, vol. 16, br. 3, str. 301-314, 2013.
16. V.Vujin, *Elektronsko obrazovanje u računarskom oblaku*, Zadužbina Andrejević, 2013.
17. B.Furht, A.Escalante (Eds), *Handbook of Cloud Computing*, Springer publishing company, 2010.
18. T.White, *Hadoop: The Definitive Guide*, O'Reilly Media, 2009.
19. R.Buyya, J.Broberg, A.Goscinski (Eds), *Cloud computing Principles and Paradigms*, Wiley 2011.
20. R.Buyya, CS.Yeo, S.Venugopal, J.Broberg, I.Brandic, *Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility*, Future Generation Computer Systems, Vol 25, No 6, 2009, pp 599-616, ISSN 0167-739X, http://dx.doi.org/10.1016/j.future.2008.12.001.
21. G.Reese, *Cloud Application Architectures*, O'Reilly, 2009.
22. J.Dean, S.Ghemawat, *MapReduce: Simplified Data Processing on Large Clusters*, OSDI'04: Sixth Symposium on Operating System Design and Implementation, San Francisco, CA, December, 2004.

http://research.google.com/archive/mapreduce.html		
The number of class hours per week	**Lectures:** 3	**Research study:** 4
Teaching methods: Lectures. Discussions. Case studies. Lab sessions. Independent research work.		
Evaluation/Grading (maximum 100 points) • Homework - **20 points** • Written exam - **20 points** • Seminar paper/project - **30 points** • Publishing research results in conference proceedings or a scientific journal - **30 points**		

Course:

Advanced biometric technologies

Teacher:Starčević B. Dušan,Simić B. Dejan,Minović V. Miroslav,Milovanović M. Miloš

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Acquiring higher level knowledge and skills in domain of designing, implementing and evaluation of advance biometric systems.

Learning outcomes:

Students will acquire knowledge and skills needed for design, implementation and evaluation of advance biometric systems.

Course structure and content:

Theoretical study.

Introduction to advanced biometric systems. Classification of biometric methods. Modeling and development of algorithms for acquisition, analysis and comparison of biometric samples. Development of fusion methods in multimodal biometrics. Development of evaluation techniques in unimodal and multimodal biometric systems. Optimization of operating parameters in biometric systems. Methods and techniques for usability evaluation of biometric system. Analysis and evaluation of emerging biometric systems and modalities and possibilities for improvement.

Research work.

Research work is done in Laboratory for multimedia communication. The work includes analysis of available approaches, as well as practical implementation of chosen biometric technologies in laboratory conditions. Student is required to explore a given problem, present the problem state in the form of seminar paper and practically implement the given task in the field of biometric technologies. Seminar paper should be in the form suitable for scientific conference or journal publication.

Literature/Readings:

1. D. Maltoni, D. Maio, A. K. Jain, S. Prabhakar, "Handbook of Fingerprint Recognition", Springer-Verlag London Limited, 2009.

2. A. K. Jain, P. Flynn, A. A. Ross, “Handbook of Biometrics”, Springer, New York, 2008.

3. J. N. Pato, and Lynette I. Millett, Editors, “Biometric Recognition Challenges and Opportunities”, The National Academy of Sciences, Washington, 2010;

4. Zeljko Obrenovic, Dusan Starcevic, Emil Jovanov, “Multimodal Presentation of Biomedical Data”, Chapter in Metin Akay (Ed.) Wiley Encyclopedia of Biomedical Engineering, Wiley, 2006.

5. Stan Z. Li, Editor, A. K. Jain, Editorial Advisor, "Encyclopedia of Biometrics", Springer, New York, 2009.

The number of class hours per week	Lectures: 3	Research study: 4

Teaching methods:

Classes are held in the form of lectures or in the form of individual consultations based on teaching units. The research part involves collecting and studying the relevant literature with researcher's own critical review in the form of seminar paper suitable for publication. Pracitical part includes implementation of example biometric system.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Seminar work	**40**	Oral exam	**40**
Work prepared for publication	**20**		

Course:

Advanced Data Structures and Algorithms

Teacher:Nešković N. Siniša

Course status: elective for study group Information Systems

ECTS points: 10

Prerequisites: none

Course objective:

To study advanced data structures and algorithms and their application in practice.

Learning outcomes:

Students will be enabled in solving practical problems to analyze, select and successfully apply data structures and algorithms which are the most suitable for solving the given problem.

Course structure and content:

. Basics. Algorithm analysis, basic data structures, trees and graphs. Selected topics of advanced data structures. Hash tables, special trees. Multidimensional and spatial data structures. String searching. Dynamic structures. Application of data structures. Databases. WEB searching. Geographic IS. Data mining. Computer graphics and geometry.

Literature/Readings:

1. Dinesh P. Mehta, Sartaj Sahni (editori), Handbook of data structures and applications, Chapman & all/CRC, 2004, ISBN: 978-1584884354
2. Goodrich M., R. Tomassia, Data Structures and Algorithms in Java, 5th edition, Wiley, 2010, ISBN: 978-0470383261
3. Jocković M., Uvod u strukture podataka, Institut za nuklearne nauke Boris Kidrič, 1992

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Teaching is in the form of combination of lecturing and mentoring per teaching units. Research part done by students consists of collecting and studying relevant literature with own critical review given in a seminar paper.

Evaluation/Grading (maximum 100 points)

Project	**50**	**Oral exam**	**50**

Course:

Management Science

Teacher:Vujošević B. Mirko,Stanojević J. Milan,Martić M. Milan

Course status: obligatory

ECTS points: 10

Prerequisites: none

Course objective: Introduction to basic methods of management science and their applications in solving theoretical and practical managerial problems

Learning outcomes: Students are introduced to the methodology of scientific work and research, particularly in the areas of management; they will be enabled to model and efficiently solve management problems by using modern methods, techniques, and information technologies.

Course structure and content: Historical development of management science. Research subject and objectives of management science. The methodology of management science. Understanding management problems. Modeling as a method of scientific research. Development and use of mathematical models. Development and use of other formal models. Decision problem. Optimization approach to solving management problems. Classical methods of operations research: linear programming, nonlinear programming, dynamic programming, integer programming. Constraint programming. Stochastic programming. Multi-criteria optimization and decision making. Modeling and analysis process. Modeling unstructured problems. Approaches to solving the problem of multi-criteria optimization. Classical and modern forecasting methods. Computer support for the study and solution of management problems. Modeling systems, modeling languages and solvers

Literature/Readings:

1. D. R. Anderson, D. J. Sweeney, Th. A. Williams, *An Introduction to Management Science: Quantitative Approaches to Decision Making* (with CD-ROM and InfoTrac) (Introduction to Management Science), South-Western College Pub; 11 edition (March 12, 2004)
2. S. Krčevinac i dr., *Operaciona istraživanja*, Fon, Beograd, 2004.
3. S. I. Gass, C. M. Harris, *Encyclopedia of Operations Research and Management Science*, Kluwer Academic, 1996.
4. M. Vujošević, *Metode optimizacije u inženjerskom menadžmentu*, AINS, Beograd, 2012.
5. *** Management Science, Marketing Science, Decision Science, Operations Research; Journals published by INFORMS, USA

The number of class hours per week	**Lectures:** 3	**Research study: 4**

Teaching methods: Depending on the number of students, classes are taught classical and mentoring.

Evaluation/Grading (maximum 100 points)

Student first take the oral qualifying exam and then work and defend a written student project. Oral Exam: 30;
Project 60;
Presentation of the project 10

Course:

Nonlinear programming

Teacher:Vujčić V. Vera,Mladenović M. Nenad

Course status: compulsory

ECTS points:: 10

Prerequisites: none

Course objective:

The objective is to give an overview of theoretical foundation and computational methods of nonlinear programming.

Learning outcomes:

Students learn necessary and sufficient conditions for optimality and the duality concept, as well as the main classes of nonlinear programming methods. An outcome of the course is the ability to model real-life problems as nonlinear programming problems and analyze them using nonlinear programming methods.

Course structure and content:

Teaching topics:

Classical optimization. Stationary points. Method of Lagrange multipliers. **Unconstrained optimization.** Methods of Hooke-Jeeves, Nelder-Mead, Cauchy, Newton. The class of variable neighborhood methods. **Convex programming**. Main properties. Necessary and sufficient optimality conditions. Duality. **Multicriteria convex programs**. Lexicographic optimization. Pareto optimum. **Nonconvex programs**. Necessary and sufficient optimality conditions. **Nonlinear programming methods**. Feasible directions methods. Exterior point penalty function methods. Interior point penalty function methods. Augmented Lagrangian methods. Interior point linear programming methods. Quadratic programming. Separable programming. Geometric programming. Semidefinite programming.

Exercises:

Modeling of real-world problems. Testing standard software packages on selected problems.

Literature/Readings:

1. S. Zlobec, J. Petrić, Nonlinear programming, Scientific Publishers, Belgrade, 1989.

2. V. Vujčić, M. Ašić, N. Miličić, Mathematical Programming, Mathematical Institute of the Serbian Academy of Sciences and Arts, Belgrade, 1980.

3. A. Sofer, S. Nash, Linear and Nonlinear Programming, McGraw Hill, 1996.

<table>
<tr><td colspan="3">4. T. Hurlimann, Mathematical Modeling and Optimization, Kluwer Academic Publishers, 1999.

5. D. Bertsekas, Nonlinear Programming, Athena Scientific, 2004

6. M:S: Bazaraa, H.D. Sherali, C:M: Shetty, Nonlinear Programming: Theory and Algorithms, John Wiley & Sons, 2006</td></tr>
<tr><td>The number of class hours per week</td><td>Lectures: 3</td><td>Research study: 4</td></tr>
<tr><td colspan="3">Teaching methods:

Classroom lectures and consultations</td></tr>
<tr><td colspan="3">Evaluation/Grading (maximum 100 points)

Oral exam: 50

Seminar: 50</td></tr>
</table>

Course:

Neural networks and systems – selected topics

Teacher:Radojević Dragan,Filipović Ž. Vojislav

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

The aim of this course is to introduce students to the basic structure of neural networks and learning rules, as well as to analyze their properties (using both the mathematical as well as the systems approach) in order to provide students with the ability to solve various problems in organizational systems.

Learning outcomes:

The acquired knowledge will enable students to model and manage organizational systems using neural networks and systems.

Course structure and content:

Basic elements and functioning of neural networks (NN). Perceptron, single and multi-layer linear network, types of neural networks. Application possibilities, limits, methods of implementation. Tuning and optimizing network performance. LMS algorithm, mean square error. Existence of minimum and maximum, method of steepest descent. Newton method. Conjugate gradient. Widrow-Hoff learning. ADALINE network. Backpropagation algorithm. Time delay neural networks. Improving convergence speed, variable learning rate. Levenberg-Marquardt algorithm. Adaptive heuristic criteria. Associative learning. Unsupervised Hebbian learning rule. Networks of simple recognition. Kohonen learning rule. Competing networks. Hamming network, self-organizing mapping, learning and improvement vector quantization. Grossberg networks. Basic non-linear model, two-layer competition network, learning rule, relationship with Kohonen rule. Theory of adaptive reasoning. Analysis of steady-state learning stability, ART algorithm. Stability of recurrent networks. Concepts of stability. Hopfield network. Probabilistic neural networks. Generalized regression neural networks. Adaptive neuro-fuzzy inference system (ANFIS). Support vector machine.

MATLAB, NeuroSolutions tutorials.

Literature/Readings:

1) S. Haykin, Neural Networks: A Comprehensive Foundation, MacMillan Publishing, 1994.

2) M. T. Hagan, H. B. Demuth, M. Beale, Neural Network Design, PWS Publishing, 1999.

3) J. C. Principe, N. R. Euliano, W. Curt Lefebvre, Neural and Adaptive Systems: Fundamentals through Simulations, Wiley, 1999.

4) B. Petrović, Teorija sistema, FON, 1998.

5) D. W. Patterson, Articial Neural Networks, Prentice Hall, 1995

The number of class hours per week	**Lectures:** 3	**Research study:** 4
Teaching methods: Lectures, mentoring.		
Evaluation/Grading (maximum 100 points) seminar (30%), written exam (30%), case study (40%)		

Course:

New Trends in Operations Research

Teacher:Vujošević B. Mirko,Čangalović M. Mirjana,Vujčić V. Vera,Mladenović M. Nenad,Martić M. Milan,Stanojević J. Milan,Savić I. Gordana,Makajić-Nikolić D. Dragana,Kuzmanović S. Marija

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

The aim of the course is to provide students opportunity to study the selected specific area of operations research in accordance with their interests and needs.

Learning outcomes:

Students are trained to understand and resolve the open issues in the field of operations research using modern approaches and available software.

Course structure and content:

The course is carried out on the principle of mentoring work with the selected teacher and covers methods such as data envelopment analysis, constraint programming, semidefinite programming, interior methods for convex and linear programming, integer programming, variable neighborhood search, multiple-criteria programming, Petri nets, Conjoint analysis; application of operations research in the fields of banking and finance, electronic commerce, telecommunications, military applications, civil engineering, aviation industry, etc.; with the use of modern software for operational research.

Literature/Readings:

6. Krčevinac S. i dr, O*peraciona istraživanja*, FON, Beograd, 2004.
7. Encyclopedia of Operations Research and Management Science By Saul Irving Gass, Carl M. Harris, Kluwer Academic, Publishers, 1996.
8. Operations Research and Management Science Handbook, editor A. Ravi Ravindran, Publisehed 2008, CRC Press, Taylor & Francis Group
9. Vujošević M., Metode optimizacije u inženjerskom menadžmentu, Akademija inženjerskih nauka Srbije i FON, Beograd, 2012
10. Ehrgott M., Multicriteria Optimization, Springer Berlin Heidelberg New York, 2005
11. Kuzmanovic Marija, Kvantitativne metode u marketingu: Primena Conjoint analize, Društvo operacionih istraživača, Beograd, 2006.
12. *** Management Science, A journal of INFORMS, USA
13. *** Operations Research, A journal of INFORMS, USA
14. *** European Journal of Operations Research
15. *** Yugoslav Journal of Operations Research

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods: Theoretical study is conducted as a block or mentoring, depending on the number of students.

Practical work is carried out through a case study.
Evaluation/Grading (maximum 100 points) Oral exam: 50 points Seminar: 50 points

Course:

Selected Topics in Operating Systems

Teacher:Simić B. Dejan

Course status: Elective

ECTS points: **10**

Prerequisites: none

Course objective:

Introduction to protection and security of modern operating systems, obtaining the knowledge necessary for the effective implementation of virtual machines, obtaining the knowledge of the advanced topics in the field of distributed systems, the study of operating systems for special purposes, understanding and application of the implementation of parallel processing within modern operating systems.

Learning outcomes:

Students are prepared for analysis and effective use of modern operating systems.

Course structure and content:

Protection and Security of Operating Systems. Protection Goals. Program threats, system threats, network threats. Cryptography as a security tool. Implementing Security Defenses. Security Classification in Systems. Applying *IPC* in Systems. Monitors. Types of virtual machines and their implementation. Virtualization and components of modern operating systems. Memory Management in *Linux*. Process Scheduling in *Linux* virtual machine. Distributed Operating Systems. Multiprocessor Scheduling. Communication protocols. Fault Tolerant Systems. Distributed File Systems. Multimedia Systems. Real-Time Systems. Examples of operating systems: operating systems that have contributed to today's operating systems (*MULTICS, IBM OS/360, Mach*), *Windows 7*, *Linux, Unix*. Queuing Models. Operating Systems on Mobile Devices. Analysis of selected professional and scientific papers.

Literature/Readings:

8. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "*Operating System Concepts*", John Wiley & Sons, 9 edition, 2013.
9. William Stallings, "*Operating Systems: Internals and Design Principles*", 7th Edition, Prentice Hall, 2011.
10. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, "*Distributed Systems: Concepts and Design*", 5th edition, Addison-Wesley, 2011.
11. Jerome H. Saltzer, M. Frans Kaashoek, "*Principles of Computer System Design: An Introduction*", Morgan Kaufmann, 2009.
12. Theodor Richardson, Charles Thies, "*Operating Systems: A Modern Introduction*", Mercury Learning & Information, 2013.
13. Selected professional and scientific papers

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Lectures. Consultation. Mentoring. Practical work. Solving specific cases. Case studies. Working on projects. Working in teams. Discussion. Methods for distance education. The collection and study of relevant literature with providing critical review of the resolution of specific problems. Creative workshops.
Evaluation/Grading (maximum 100 points) Analysis of the cases, models or specific practices /Homeworks/Seminar/Project. Oral exam.

Course:

Selected topics from security techniques in computer networks

Teacher:Simić B. Dejan

Course status: Elective

ECTS points: **10**

Prerequisites: none

Course objective:

Students should be able to identify the possible threats, attacks, and security measures that are relevant to Internet environment, and Web services, protection principles, techniques and mechanisms for the protection of computer networks, various methodological approaches in design and implementation.

Learning outcomes:

Students will become qualified to analyze and effectively implement protection techniques in computer networks.

Course structure and content:

Data and network security. Security threats and risks. Types of attacks. Methodology of protection. Models of protection. Basic mechanisms for network security. The use of cryptography - cryptography methods to protect the computer networks. Organizational and other noncryptographic security measures. Management of protection. Detecting incidents and response to incidents. *IP* security (*IPSec*). Network firewalls. Protection in virtual private networks (*VPN*). Systems for the detection and prevention of attacks. Operating system protection. Protection at the application level. Protection of databases. Email protection. Web protection. Electronic commerce and protection. Wireless network security. Analysis of selected scientific papers in the field of network security.

Literature/Readings:

14. William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson Education Limited, 2013.
15. Richard Bejtlich, "The Practice of Network Security Monitoring: Understanding Incident Detection and Response", No Starch Press, 2013.
16. Charles P. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", 5th Edition, Prentice Hall, Professional Technical Reference, 2011.
17. Charles P. Pfleeger, Shari Lawrence Pfleeger, "Analyzing Computer Security: A Threat/Vulnerability/Countermeasure Approach", 1st Edition, Prentice Hall, 2011.
18. William Stallings, "Network Security Essentials: Applications and Standards", 5th Edition, Pearson Education Limited, 2013.
19. J. Michael Stewart, "Network Security, Firewalls, and VPNs", Second Edition, Jones & Bartlett Learning, 2014.
20. Selected professional and scientific papers

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Lectures. Consultation. Mentoring. Practical work. Solving specific cases. Case studies. Working on projects.

Working in teams. Discussion. Methods for distance education. The collection and study of relevant literature with providing critical review of the resolution of specific problems. Creative workshops.
Evaluation/Grading (maximum 100 points) Analysis of the cases, models or specific practices /Homework/Seminar/Project. Oral exam.

Course:

Decision making – selected chapters

Teacher:Suknović M. Milija,Delibašić V. Boris

Course status: Mandatory

ECTS points: 10

Prerequisites: none

Course objective:

Introduction to modern disciplines and methods for decision making. All disciplines and methods are chosen to maximize usefulness in various fields of study, and allow students to utilize them in their own research and for further publishing in scientific journals.

Learning outcomes:

Students have surveyed the decision making field of study, and they have acquired enough skill and knowledge to be able to independently continue the research of decision making in their own domain of interest.

Course structure and content:

01: Introduction to decision making. 02: Decision making with certainty and risk. 03: Decision analysis. 04: Decision analysis with sampling. 05: Risk analysis. 06: Decision tree and sequential decision making. 07: Utility theory. 08: Multi-attribute utility. 09: Fuzzy systems. 10: Rough set theory. 11: Multi-criteria decision making. 12: Multi-criteria analysis. 13: Group decision making. 14: Interpolative Boolean algebra in decision making. 15: Patterns and decision making.

Literature/Readings:

1. Čupić M., Suknović M., Decision making – formal approach, FON, Belgrade, 2008 (in serbian).
2. M. G. Myriam Hunink, Paul P. Glasziou, Joanna E. Siegel, Jane C. Weeks, Joseph S. Pliskin, Arthur S. Elstein, Milton C. Weinstein (2001) Decision Making in Health and Medicine: Integrating Evidence and Values, Cambridge University Press, ISBN-10: 0521770297, ISBN-13: 978-052177029

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods: Classic lecture accompanied by the analysis of scientific papers.

Evaluation/Grading (maximum 100 points)

Presentation of scientific papers from M21 category: 20 points

Written exam: 40 points

Research proposal: 40 points

Course:

Optimal control

Teacher:Gajić R. Zoran,Petrović J. Bratislav

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

The aim of this course is to provide students with the necessary theoretical concepts and methods for optimal control. The students are enabled to apply these methods in solving practical problems of organizational system management.

Learning outcomes:

The acquired knowledge of the concepts of optimal control will enable students to apply appropriate approach for modeling and solving real business problems in organization systems.

Course structure and content:

Optimal control, modelling and optimality criteria. Calculus of variations, Hamilton–Jacobi equation, Riccati Equation. Principle of optimality, Bellman equation. Pontryagin's maximum principle. Dynamic programming and the maximum principle. Linear quadratic programming, Singular control. Stochastic optimal control. Numerical methods for finding optimal control and trajectories.

Literature/Readings:

1) M. I. Zelikin, Control theory and optimization I: Homogeneous Spaces and the Riccati Equation in the Calculus of Variations, Springer, 2000.

2) D. E. Kirk, Optimal Control Theory - An Introduction, Dover Publications, 2006.

3) Y. Grigorenko, Optimal Control and Forecasting of Complex Dynamical Systems, World Scientific Publishing, 2006.

4) S. P. Sethi, G. L. Thompson, Optimal Control Theory - Applications to Management Science and Economics – second edition, Springer, 2006.

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods: Lectures, Reaserch project, Mentoring

Evaluation/Grading (maximum 100 points)

Course:

Organization of IS&T function and change management

Teacher:Čudanov J. Mladen,Marković D. Vidan

Course: Organization of IS&T function and change management

Teacher: Čudanov, J, Mladen, Marković D. Vidan

Course status: Elective

ECTS points: 6

Prerequisites: -

Course objective

Course objective is to introduce students to different models of organizing IS&T function, organizational change and change in a way of business process work, which start as a consequence of implementation of information systems, as well as to get necessary knowledge and skills of change management for IS&T function itself, which are caused by technology development and evolution in approach of information function support.

Learning outcomes

To get skills and knowledge and master techniques necessary for successful change management in the information system life cycle and solving the change resistance. Knowing particular changes in information systems life cycle, as well as knowledge on needed actions to optimize gains and minimize problems which emerge in organization during life cycle of information systems.

Course structure and content

Theoretical instruction:

Place and role of information systems nd technology in organization. Authority and accountability of manager of information systems and technologies function. Definition of organizational change. Typology of organizational change. Organizational transformation. Reengineering of business process. Adizes method of organizational transformation. Lewin's method of organizational change. Koter's approach to leading change. Organizational change resistance. Phases of implenetation of information system. Particularities of ERP implementation. Changes in organization during information systems application.

Practical instruction:

Strategic stance of top management toward the function of information systems and technologies. Position of manager of information systems and technologies function in top management. Recognition and classification of organizational change. Influence of integrated information systems on business process change. Changes in organizational coordination during information systems implementation. Changes in organizational specialization during information systems implementation. Changes in organizational centralization during information systems implementation. Alignment of business process and information systems. Methods of re-engineering implementation.

Literature/Readings

1. Spagnoletti, P: *Organizational Change and Information Systems*. Springer, 2013
2. Čudanov, M (2011) *Organizaciona i strateška primena IKTa*, Beograd, Srbija: Zadužbina Andrejević.
3. Koter, DŽ: *Vođenje promene*. Beograd, Srbija: Želnid, 2000
4. Dulanović, Ž., Jaško, O: *Organizaciona struktura i promene*, Beograd, Srbija: Fakultet organizacionih nauka, 2007
5. Wallace, Thomas F., and Michael H. Kremzar. *ERP: making it happen: the implementers' guide to success with enterprise resource planning*. Wiley, 2002.
6. Keen, P. G. *Information systems and organizational change. Communications of the ACM*, 24(1), 24-33, 1981.

The number of class hours per week				**Other classes:**
Lectures: 2	**Labs:** 2	**Workshops:**	**Research study:**	

Teaching methods

Monological method, demonstrative method, case study, learning through mutual work on practical problem solution, independent research and problem solving on the background of given problems.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	5	Written exam	20
Mid-term paper	**65**	Project presentation	10

Course:

Organizational networks and alliances

Teacher:Jaško O. Ondrej,Čudanov J. Mladen

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

The course objective is to acquainted students with the concept of organizational networks and strategic alliances, which occur in a specific form, and to examine the implementation of the concept of organizational networks and virtual enterprises.

Learning outcomes:

To master the concepts that determine organizational networks and strategic alliances, methods and techniques used in their modeling and design, as well as to specify the information and organizational conditions of their existence and functioning.

Course structure and content:

Preliminaries - group of companies, types of grouping. The concept and characteristics of organizational networks. The metric of organizational network. Strategic alliances - concept and basic features. Types of strategic alliances. The characteristics of business strategic alliances. Stages of formation of strategic alliances. The organizational aspects of strategic alliances. Risks of strategic alliances. Information Alliance as a network of enterprises or virtual corporation.

Practical teaching: Exercises, Other forms of teaching, Research study

Overview of the development of strategic alliances. Analysis and comparison of different forms of organizational networks. Information Alliance and the performance of organization. Information alliances and firm size. The strategic role of information systems in organization. Examples of bad practice in the application of ICT in the organization. Specifics of managing organizational networks and alliances.

Literature/Readings:

1. Popović N, Jaško O, Prokić S (2009) Menadžment interorganizacionih odnosa – *autsorsing, strateške alijanse, merdžeri i akvizicije*. Beograd, Srbija: Institut za ekonomske nauke.
2. Čudanov, M (2011) Organizaciona i strateška primena IKTa, Beograd, Srbija: Zadužbina Andrejević.
3. Wratschko, K. (2009). Strategic orientation and alliance portfolio configuration. Springer.
4. Hendrikse, G. (Ed.). (2008). Strategy and governance of networks: cooperatives, franchising, and strategic alliance. Springer.
5. Gibbs R, Humphries A. (2009). Strategic Alliances and Marketing Partnerships: gaining competitive advantage through collaboration and partnering. Kogan Page Publishers.
6. Future organizational design – the scope for the IT based enterprise, Groth, Lars: Wiley&Sons, New York 1999.
7. Corning Incorporated- a network of alliances, Harvard Business School case study, ECCH, 1993.

The number of class hours per week	**Lectures:**	**Research study:**

	3	4

Teaching methods:

Monological method, demonstrative method, case study, learning through mutual work on practical problem solution, independent research and problem solving on the background of given problems.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	15	**Oral exam**	45
Term paper/papers	40		

Course:

Knowledge discovery in databases

Teacher:Suknović M. Milija,Delibašić V. Boris

Course status: elective

ECTS points: 10

Prerequisites: -

Course objective:

Students should learn to discover non-trivial, implicite, unknown and potentialy usefull patterns from big data. This course is intended to serve as an introduction for learning techniques that are neccesary to support this process of knowledge discovery in databases. Course is structured in order to enable wide possibilities for introducing students with this area of research and application, as well as investigation of new research direction, through solving practical problems.

Learning outcomes:

Students should be qualified for using and improving existing solutions as well as to implement their own solutions for knowledge discovery in databases. At the end of the course students should gain the knowledge that enables good review of research challenges of this research area.

Course structure and content

Theoretical instruction:

1. Review of tasks and techniques of knowledge discovery in databases (KDD) 2. Exploratory data analysis 1 (numerical, categorical and graph data, data cleansing, handling missing values, transformation of data) 3. Exploratory data analysis 2 (high dimensional data, reduction, visualization 4. Modeling (classification, regression, clustering, sequence analysis, outlier analysis 5. Spatial KDD; 6. Temporal and sequence KDD; 7.Social network analysis; 8. Text mining; 9. Web mining; 10. Bayesian networks; 11. Conditional random fields; 12. Bayesian conditional random fields.

Practical instruction:

Students are obligatory to to do a research proposal with the emphesize on theoretical or applicational aspects.

Literature/readings

1. Tan P.N., Steinbach M. and Kumar V.(2006) Introduction to Data Mining, Addison-Wesley, ISBN 0-321-32136-7.

<table>
<tr><td colspan="3">2. Han J., Kamber M. and Pei J. (2012) Data Mining: Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publishers, ISBN 978-0-12-381479-1.
3. Delibašić B, Suknović M, Jovanović M (2009) Machine learning algorithms for data mining (in Serbian), Faculty of organizational sciences, Belgrade, Serbia</td></tr>
<tr><td>The number of class hours per week</td><td>Lectures: 3</td><td>Research study: 4</td></tr>
<tr><td colspan="3">Teaching methods

Practical classes, laboratory work in computer lab</td></tr>
<tr><td colspan="3">Evaluation/Gratings (maximum 100 points)

Presentation of scientific paper – 30 points

Oral exam – 30 points

Research proposal – 40 points</td></tr>
</table>

Course:

E-business intelligence

Teacher:Bogdanović M. Zorica,Milutinović M. Veljko,Stefanović D. Nenad,Vukmirović V. Dragan

Course status: Elective

ECTS points: 10

Prerequisites: -

Course objective:

The aim of this course is to enable students to conduct independent scientific research and solve actual research problems in the field of knowledge discovery in e-business. Specifically, the concepts of knowledge discovery in big data are studied.

Learning outcomes:

The students will be able apply methods and techniques of e-business intelligence and discover knowledge in big data.

Course structure and content:

E-business intelligence methodology. Review and analysis of the most important references. Architecture of business intelligence systems. Data warehouse. ETL processes. Non-relational databases. Big data storages. Apache Hadoop. Apache Hive. Methods and algorithms for discovering knowledge in data. Reporting systems. OLAP. Key performance indicators. Queries over big data. Cloudera tools. Types of applications and tools for e-business intelligence. The use of the concepts of business intelligence and knowledge discovery for solving problems in e-commerce, e-marketing, e-health, mobile business and other areas of e-business. Social networks analysis. Analysis of unstructured data. Analysis of multimedia data. Summary of results of current scientific research projects in the field of application of e-business intelligence.

Literature/Readings:

23. E-resoruces from moodle.elab.fon.bg.ac.rs
24. M.Minelli, M.Chambers,A.Dhiraj, *Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses*, Wiley, 2013.
25. HC.Chen, RHL.Chiang, VC.Storey, *Business Intelligence and Analytics: From Big Data to Big Impact*, MIS Quarterly, Vol.36, No.4, 2012.
26. N.Stefanović, D.Stefanović, B.Radenković, *Integrated Supply Chain Intelligence through Collaborative Planning*, Analytics and Monitoring in Iraj Mahdavi, Shima Mohebbi, Namjae Cho (Eds.) Electronic Supply Network Coordination in Intelligent and Dynamic Environments Modeling and Implementation (43-92) DOI: 10.4018/978-1-60566-808-6.ch003
27. N.Stefanovic, B.Radenkovic, D.Stefanovic, *Designing OLAP Multidimensional Systems For Supply Chain Management*, International Journal of Pure and Applied Mathematics, IJPAM, ISSN 1311-8080, 2007.

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Lectures. Discussions. Case studies. Lab sessions. Independent research work.

Evaluation/Grading (maximum 100 points)

- Homework - **20 points**
- Written exam - **20 points**
- Seminar paper/project - **30 points**
- Publishing research results in conference proceedings or a scientific journal - **30 points**

Course:

Business intelligence - selected chapters

Teacher:Suknović M. Milija,Delibašić V. Boris

Course status: Elective

ECTS points: 10

Prerequisites: -

Course objective:

Students should learn to methods and disciplines of Business intelligence and to be able to work on scientific research in this area

Learning outcomes:

Students should be familiar with state-of-the-art and should be able to start the research in this area.

Course structure and content

01: Introduction to Business intelligence 02: Data warehousing 03: Data mining 04: Group decision support systems 05: Artificial neural networks 06: Case based reasoning 07:White box (component based) algorithms 08: Business intelligence research 09: Evaluation measures for classification models. 10: Evaluation measures for clustering models 11: Ensemble algorithms 12: Meta-learning

Literature/readings

1. TURBAN, E., ARONSON, EJ., LIANG, TP. & SHARDA, R., Decision Support and Business Intelligence Systems (8th Edition), 2007.
2. Suknović M, Delibašić V (2010) Business intelligence and decision support systems (in Serbian), Faculty of Organizational Sciences, Belgrade, Serbia.

The number of class hours per week	**Lectures**: 3	Research study: 4

Teaching methods

Practical classes, laboratory work in computer lab

Evaluation/Gratings (maximum 100 points)

Presentation of scientific paper – 20 points

Oral exam – 40 points

Research proposal – 40 points

Course:

Requirements Engineering

Teacher:Jovanović M. Jelena,Tomić B. Bojan

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective:

To develop an understanding of the main concepts, processes and techniques of Requirements Engineering (RE).

To develop knowledge of different approaches and techniques for the specification, validation and maintenance of software requirements, as well as an understanding of advantages and disadvantages of different approaches and techniques.

To gain an insight into some of the research challenges in the field of RE, and be ready to start one's independent research work in one or more of the chosen sub-fields of RE.

Learning outcomes:

Students will develop an understanding of the main RE concepts, processes and techniques. They will acquire knowledge of different approaches and techniques for the specification, validation and maintenance of software requirements. Finally, they will gain an insight into some of the research challenges in the field of RE, and will be ready to start their independent research work in this field.

Course structure and content:

Software requirements: the introduction.

The process of requiremens gathering: process model; process management; the quality of the process.

Requirements collection: sources of soft. requirements; gathering and organization of requirements; techniques for requirements gathering.

Requirements analysis: the boundaries of a software system; interaction with the environment; classification of requirements; conceptual modeling.

Requirements specficiation: different forms of requirements specification.

Requirements validation: requirements testing and evaluation; creation of prototypes; model validation.

Requirements management.

Requirements measuring. Metrics.

<table>
<tr><td colspan="3">Literature/Readings:

- K. E. Wiegers, J. Beatty. Software Requirements 3, the 3rd Edition. Microsoft Press, 2013.
- Papers published in the journal Requirements Engineering, Springer, URL: http://link.springer.com/journal/766
- Papers published in the Proceedings of the IEEE International Requirements Engineering Conference (http://requirements-engineering.org/)</td></tr>
<tr><td>The number of class hours per week</td><td>Lectures: 3</td><td>Research study: 4</td></tr>
<tr><td colspan="3">Teaching methods: Lectures or mentoring work, depending on the number of students</td></tr>
<tr><td colspan="3">Evaluation/Grading (maximum 100 points)

Individual practical project / research study</td></tr>
</table>

Course:

Applied Mathematical Analysis

Teacher:Mihić R. Olivera

Course status: Elective

ECTS points: 10

Prerequisites: -

Course objective

Students' introduction with the techniques of solving partial differential equations, Fourier transform and integral equations in order to master the techniques that allows modeling and analysis of real problems (organizational systems and economics).

Learning outcomes

Students training for the application of partial differential equations, Fourier transform and integral equations in the analysis of economic and organizational phenomena.

Course content

Theoretical instruction:

1. Vector Spaces.

2. Lebesgue measure.

3. Metric spaces and Banach fixed point theorem.

4. Banach spaces.

5. Hilbert spaces.

6 – 7. Distribution.

8 – 9. Fourier transform and Sobolev spaces, application.

10. Differential and integral calculations in Banach spaces.

11 – 12. Partial differential equations and their applications.

13 – 14. Integral equations and their applications.

Practical instruction: teaching through examples.

Homework presentation

Literature/Readings

1. Rudin W, *Real and complex Analysis*, McGrow Hill, New York, 1970.

<table>
<tr><td colspan="3">
2. D.H. Griffel, Applied Functional Analysis, ISBN: 0486422585, 1985.
3. Miklavcic M, Applied Functional Analysis and Partial Differential Equations, World Scientific Publishing Company, 1998.
4. K. Sydsaeter, P. Hammond, A. Seirstad, A. Strom, Further Mathematics for Economic Analysis, Prentice Hall, 2005.
</td></tr>
<tr><td>The number of class hours per week</td><td>Lectures: 3</td><td>Research study: 4</td></tr>
<tr><td colspan="3">Teaching methods

Mentoring. Seminar paper preparing</td></tr>
<tr><td colspan="3">Evaluation/Grading (maximum 100 points)

Homework:40 Oral exam:60</td></tr>
</table>

Course:

Applied Numerical Analysis

Teacher:Lazović P. Rade

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective:

Introduction to numerical methods in mathematical analysis and their applications

Learning outcomes:

Students will be able to understand numerical and apply numerical methods in mathematical analysis, as well as use some of specialized numerical software.

Course structure and content:

Solving nonlinear equations. Bisection method. Newton's method. Muler's method. Fixed- point iteration method. Applications of nonlinear equations. Systems of nonlinear equatiuons. Iterative method. Newton's method. Applications of systems of nonlinear equations. Vector space R^n. Vector and matrix norms. Convergence in R^n. Iterative methods for solving systems of nonlinear equations. Fixed-point method. Method Jacobi. Gauss-Saidel method. Applications of systems of linear equations. Approximation of functions. Interpolating polynomials. Spline interpolation. Least squares approximations. Fourier's approximations. Applications of approximations. Numerical integration. Basic quadrature rules. Composite quadrature rules. Gaussian quadrature. Orthonormal polynomials and numerical integration. Applications of numerical integration.

Literature/Readings:

1. C. Gerald, P. Wheatley, *Applied Numerical Analysis*, California Polytechnic State University, 2004.

2. A. Quarteroni, R. Sacco, F. Salery, *Numerical Mathematics*, Springer, 2007

3. D. Faires, R. Burden, *Numerical Methods*, Thomson, 2003

4. A. Gilat, *Uvod u MATLAB sa primerima*, Mikro knjiga, Beograd, 2005

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Ex-cathedra teaching, laboratory classes, team work
Evaluation/Grading (maximum 100 points) Written exam: 50 Oral exam: 50

Course:

Programming interactive systems

Teacher:Minović V. Miroslav,Francisco José García-Peñalvo,Milovanović M. Miloš

Course status: Elective

ECTS points: 10

Uslov: none

Course objective:

Deepening of previously acquired knowledge and skills in the area of programming interactive systems. Enabling students to critically evaluate available approaches and techniques for developing highly interactive user interface, with emphasis on developing systems that use natural user interfaces (voice, finger movements, arms, body, head, eyes).

Learning outcomes:

Students will deepen their previously acquired knowledge and skills in the field of interaction between the user and system for analysis, development, implementation and evaluation of interactive systems using natural user interfaces.

Course structure and content:

Theoretical study.

Introduction. What are interactive systems. User experience and interactive design process. Interaction conceptual model. Cognitive aspects. Social interaction. Emotional interaction. Interfaces. Requirements collection. Design. Prototype development. Construction and evaluation. Introduction to natural user interfaces (NUI). Space and social NUI. New technologies for interaction. Motion analysis. Development of motion based interfaces. Introduction to voice processing. Voice based systems development process. Speech processing. Voice XML.

Research work.

Research work is done in Laboratory for multimedia communication. The work includes methodology for designing interactive systems and natural user interfaces. Student is required to explore a given problem, present the problem state in the form of seminar paper and practically implement the given task in the field of interactive systems.

Literature/Readings:

1. *Yvonne Rogers, Helen Sharp, Jenny Preece, Interaction Design: Beyond Human - Computer Interaction, Wiley, 2011*
2. *Daniel Widgor, Dennis Wixton, Brave NUI World: Designing Natural User Interfaces for Touch and Gesture, Morgan Kaufmann, 2011*
3. *James R. Lewis, Practical Speech User Interface Design, CRC Press, 2010*
4. *Sean Kean, Jonathan Hall, Phoenix Perry, Meet the Kinect: An Introduction to Programming Natural User Interfaces, 2011*
5. *Rada Mihalcea, Dragomir Radev, Graph-based Natural Language Processing and Information Retrieval, Cambridge University Press, 2011*

The number of class hours per week	**Lectures:**	**Research study:**

		4

Teaching methods:

Classes are held in the form of lectures or in the form of individual consultations based on teaching units. The research part involves collecting and studying the relevant literature with researcher's own critical review in the form of seminar paper suitable for publication. Pracitical part includes example implementation of natural user interface usage for communication between human and a computer.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Project	**25**	Oral exam - assignments and theory combined	**50**
Seminar paper	**25**		

Course:

Design of Aggregated Data Systems

Teacher:Jovanović V. Vladan

Course status: elective for study group Information Systems

ECTS points: 10 points

Prerequisites: none

Course objective:

This course will gain knowledge about all aspects in data warehouse design (Data Warehouse, Data Mart etc.)

Learning outcomes:

Students will evaluate and then choose appropriate methodologies, processes and standards for information systems design and integration, and will also be capable to design data warehouse and to evaluate success of these systems.

Course structure and content:

Aspects of design, integration and exploitation of data warehouse. Dimensional modeling, materialized views, using SQL options for searching aggregate data, integrating models of transactional systems and data warehouse, designing system for loading data warehouse from existing transactional information systems. Integration on complex organization level, meta-model standardization and generic design of data warehouse and data mart.

Literature/Readings:

1. Kimbal R., *The Data Warehouse Lifecycle Toolkit*, 2ed John Wiley 2008.
2. Adamson C., Mastering Data Warehouse Aggregates, John Wiley 2006.
3. Inmon R., *The Data Warehouse Design*, John Wiley 2005.
4. Kimbal R., *The Data Warehouse ETL Toolkit*, 2ed John Wiley 2004.
5. Imhof C., *Mastering Data Warehouse Design*, John Wiley 2003.
6. Kimbal R., Ross M., *The Data Warehouse Toolkit*, 2ed John Wiley 2002.

The number of class hours per week	**Lectures: 3**	**Research study: 4**

Teaching methods: Lectures and labs.		
Evaluation/Grading (maximum 100 points)		

Pre-exam requirements	**Points**	**Final exam**	**Points**
Seminar presentation	**50**	Oral exam	**50**

Course:

Software design - selected chapters

Teacher:Vlajić S. Siniša

Course status: Election

ECTS points: 10

Prerequisites: none

Course objective: Introduction to the key issues and techniques of software design. Mastering the notation, strategies and methods of software design.

Learning outcomes: Successful use of various techniques, strategies and methods of software design.

Course structure and content:

Basics of the software design: The role of the software design. The general software concepts. Context, process and techniques of software design. Key issues of software design. Competitiveness. Processing events. The distribution of the components. Processing errors. Exceptions. Interaction and presentation. Persistence. Software Structure and Architecture: Aspects, structures, and styles of architecture. Design patterns. Families of programs and frameworks. Quality analysis and evaluation of software design: the software quality attributes. Analysis of software quality. Techniques and evaluation of the measurement. Notation of the software design: Models of structure. Models of behavior. Strategies and methods of software design: Top-down and bottom-up strategies. Abstraction. Heuristics. Models. Iterative-incremental approach. Function-oriented methods, object-oriented methods, methods based on the components and methods based on data structures.

Literature/Readings:

1. Ivar Jacobson, Grady Booch, James Rumbaugh: ***The Unified Software Development Process***, Rational Software Corporation, Addison-Wesley, 1999.

2. Craig Larman: ***Applying UML and Patterns***, Prentice Hall, New Jersy, 1998.

3. Rational Software Corporation: ***Unified Modeling Language (UML)***, www.rational.com

4. Erich Gamma, Richard Helm, Ralph Johnson, JohnVlissides: ***Design patterns***, Addison : Wesley, 18th Printing, September 1999.

5. D. Budgen, ***Software Design***, second ed., Addison-Wesley, 2004.

The number of class hours per week	**Lectures:** 3	**Research study: 4**

Teaching methods: Lectures and laboratory exercises.

Evaluation/Grading (maximum 100 points)

Individual work and oral defense of the study example.

Course:

Information Systems Development

Teacher:Marjanović M. Zoran,Aničić M. Nenad,Babarogić S. Slađan

Course status: mandatory for study group Information Systems

ECTS points: 10 points

Prerequisites: none

Course objective:

This course will provide knowledge about all phases in information system development. Students will evaluate and chose appropriate methodologies for system development, they will also figure out not just the importance of effective communication with users and user systems, but also basic aspects of team work.

Learning outcomes:

Students will be capable to apply in practice modern methodological approaches in information systems development.

Course structure and content:

Life cycle of information system development (planning, analysis, logical design, physical design, implementation, functioning and maintaining). Methods and techniques for specification user requirements and their organization (questionnaires, interviews, document analysis, monitoring the existing state). JAD (Joint Application Design) and other group approaches. Aspects of development team management. Feasibility study and risk analysis. Comparative analysis of methodological approaches in IS analysis and design. Nonfunctional aspects of IS development.

Literature/Readings:

1. Larman C., Applying UML and Patterns-An Introduction to Object-Oriented Analysis and Design and Iterative Development, 3rd ed., Prentice Hall, 2004.
2. Hoffer J., George J., Valacich J., Modern Systems Analysis and Design, Edition Prentice Hall, Upper Saddle River, Nj. 2005.
3. Jacobson I., Booch G., Rumbaugh J., The Unified Software Development Process, Rational Software Corporation, Addison-Wesley, Reading, MA 1999.
4. Booch G., Rambaugh J., Jacobson I., The Unified Modeling Language: User Guide, Addison –Weseley 1999.

<table>
<tr><td colspan="4">5. Rambaugh J., Jacobson I., Booch G., The Unified Modeling Language: Reference Manual, Addison – Weseley 1999.</td></tr>
<tr><td>The number of class hours per week</td><td colspan="2">Lectures: 3</td><td>Research study: 4</td></tr>
<tr><td colspan="4">Teaching methods: Lectures and labs.</td></tr>
<tr><td colspan="4">Evaluation/Grading (maximum 100 points)</td></tr>
<tr><td>Pre-exam requirements</td><td>Points</td><td>Final exam</td><td>Points</td></tr>
<tr><td>Seminar presentation</td><td>50</td><td>Oral exam</td><td>50</td></tr>
</table>

Course:

Availability, load balancing and virtualization

Teacher:Starčević B. Dušan,Minović V. Miroslav,Milovanović M. Miloš,Francisco José García-Peñalvo

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Deepening previously acquired knowledge and skills in computer networks in the field of system availability by using actual approaches such as load balancing and virtualization. Enabling students to critically evaluate and apply available approaches and techniques in highly available system's design and implementation.

Learning outcomes:

Students will deepen their previously acquired knowledge and skills in the field of system availability by using actual approaches such as load balancing and virtualization.

Course structure and content:

Theoretical study.

Introduction. Highly reliable systems design basics. Calculating the probability of system failure. Basics of load balancing. Creating server farms. Methods of load distribution. Sessions state check and maintenance. Network models. DNS balancing. Load balancing firewalls. Load Balancing cache memory. Further development of load balancing techniques. Introduction to system virtualization. Supervisors. Virtual machines. Management of virtual machines. Fundamentals of cloud computing. Basic mechanisms and architectures for cloud computing. Working with cloud computing.

Research work.

Research work is done in Laboratory for multimedia communication. The work includes design methodology for highly available IT systems. Student is required to explore a given problem, present the problem state in the form of seminar paper and practically implement the given task in the field of highly available systems.

Literature/Readings:

1. Zachary Taylor, Subramanyam Ranganathan, Designing High Availability Systems: DFSS and Classical Reliability Techniques with Practical Real Life Examples, Wiley-IEEE Press, 2013
2. Matthew Portnoy, Virtualization Essentials, Sybex, 2012
3. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 2013
4. Chandra Kopparapu, Load Balancing Servers, Firewalls, and Caches, Wiley, 2002

The number of class hours per week	Lectures: 3	Research study: 4

Metode izvođenja nastave

Classes are held in the form of lectures or in the form of individual consultations based on teaching units. The research part involves collecting and studying the relevant literature with researcher's own critical review in the form

of seminar paper suitable for publication. Pracitical part includes implementation of highly available system example by using one of available techniques.			
Evaluation/Grading (maximum 100 points)			
Pre-exam requirements	**Points**	**Final exam**	**Points**
Seminar work	**40**	Oral exam - theory and assignments combination	**40**
Work prepared for publication	**20**		

Course:

Computer simulation and virtual reality-selected chapters

Teacher:Radenković LJ. Božidar,Despotović-Zrakić S. Marijana,Marković M. Aleksandar

Course status: Elective

ECTS points: 10

Prerequisites: -

Course objective:

The aim of this course is to gain knowledge in advanced topics in the field of computer simulation and virtual reality, and apply this knowledge in scientific research.

Learning outcomes:

The students will be able to solve problems of real systems by applying simulation models. Students are able to select, use and develop simulation tools for realization of simulation models and models of virtual reality.

Course structure and content:

The methodology of scientific research in the field of modelling, simulation and virtual reality. Simulation tools and facilities. Simulation of continuous systems. Discrete event simulation. Intelligent systems in simulation. Simulation software: CSMP, Simulink and GPSS. Virtual reality. The medium of virtual reality. Models of environments. 2D and 3D modelling Computer animation. Computer visualization. The application in science, education, business and other fields. Design and implementation of 2D and 3D models in software packages (AutoCAD, Blender, Maya, 3DStudioMax). Designing virtual environments and virtual worlds using X3D technologies and Blender environment. Modelling games. Game-based simulation. Simulation and Game Development on social networks. Review and analysis of the most significant references and research projects in the field of computer simulation and virtual reality.

Literature/Readings:

28. E-resources from moodle.elab.fon.bg.ac.rs
1. B. Radenković, M. Stanojević, A. Marković, *Računarska simulacija*, Fakultet organizacionih nauka, Saobraćajni fakultet, 2009.
2. J. Banks, J.S. Carson II, B. L. Nelson, D. M. Nicol, *Discrete-Event System Simulation (Fifth Edition)*, Pearson Education, Inc. 2010. ISBN: 978-0136062127
3. A. Zikic, B. Radenkovic, *An application of GPSS/FON in teaching simulation*, International journal of applied engineering education, 247-253, Great Britain, 1993.
4. A.M. Zikic and B. Lj. Radenkovic, *The New Approach to Teaching Discrete Event System Simulation*, International Journal of Engineering Education, Volume 12, Number 6, 1997.
5. D.L.Galli, *Distributed Operating Systems*, Concepts & Practice, Prentice Hall 2000.
6. M.F.Shiratuddin, K.Kitchens, D.Fletcher, *Virtual Architecture: Modeling and Creation of Real-Time 3D Interactive Worlds*, 2008, Lulu Press, USA.
7. X3D International Standard, *Information technology — Computer graphics and image processing — Extensible 3D (X3D)* ISO/IEC 19775-1:201, 2013.
8. L. Ahearn, *3D Game Environments*, Elsevier, Inc. 2008. ISBN: 978-0-240-80895-6.
9. M.Despotović-Zrakić, D.Barać, Z.Bogdanović, B.Jovanić, B.Radenković, *Web-based Environment for Learning Discrete Event Simulation*, Journal of Universal Computer Science, ISSN 0948-695x, Online Edition ISSN 0948-6968, vol. 18, no. 10 (2012), pp. 1259-1278
29. M.Despotović-Zrakić, D.Barać, Z.Bogdanović, B.Jovanić, B.Radenković, *Integration of web based*

environment for learning discrete simulation in e-learning system, Simulation Modelling Practice and Theory, Vol.27, pp.17-30, DOI: 10.1016/j.simpat.2012.04.008, ISSN 1569-190X.		
The number of class hours per week	**Lectures:** 3	**Research study:** 4
Teaching methods: Lectures. Discussions. Case studies. Lab sessions. Independent research work.		
Evaluation/Grading (maximum 100 points) • Homework - **20 points** • Written exam - **20 points** • Seminar paper/project - **30 points** • Publishing research results in conference proceedings or a scientific journal - **30 points**		

Course:

Computer networks - selected chapters

Teacher:Starčević B. Dušan,Minović V. Miroslav,Milovanović M. Miloš

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Deepening previously acquired knowledge and skills in computer networks in the field of Enterprise computing. Enabling students to critically evaluate and apply available approaches and techniques of enterprise computing.

Learning outcomes:

Students will deepen their previously acquired knowledge and skills in the field of data exchange between computer systems, with emphasis on managing needs in enterprise computing. Acquired knowledge and skills will enable quality design and implementation of enterprise computer systems.

Course structure and content:

Theoretical study.

1. Introduction to enterprise computing. Centralized systems. Client-server computing. Distributed computer systems and Internet. 2. Component environment. OMG CORBA. J2EE. 3. Service oriented architecture and Web services. WSDL, SOAP, XML, BPEL.4. REST architecture and Restful Web services. Improvment of Restful Web services and standard Web services. 5. *Cloud Computing*. Solution examples. Possibilities and challenges analysis 6. *Enterprise* social networks. Social networks in enterprise systems. Internal and external social networks.

*Research work***.**

Practical teaching is done in Laboratory for multimedia communication. The work includes practical implementation of chosen computer networks technologies in laboratory conditions. Student is required to explore a given problem, present the problem state in the form of seminar paper and practically implement the given task in the field of computer networks. Seminar paper should be in the form suitable for scientific conference or journal publication.

Literature/Readings:

1. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 2013
2. D. Barry, Web Services, Service-Oriented Architectures, and Cloud Computing, Second Edition, Morgan Kaufmann, 2013
3. Thomas Erl, Service-Oriented Architecture (SOA): Concepts, Technology, and Design, Prentice Hall, 2005
4. J. F. Kurose, K.W. Ross, Computer Networking, 6th ed., Pearson Education, 2012
5. A. S. Tanenbaum, Computer Networks, 5th ed., Prentice Hall, 2010
6. D. Comer, Computer Networks and Internets, 5th ed., Prentice Hall, 2008
7. L. L. Peterson, B. S. Davie, Computer Networks, 5th ed., Morgan Kaufmann, 2011

The number of class hours per week	Lectures: 3	Research study: 4

Teaching methods:

Classes are held in the form of lectures or in the form of individual consultations based on teaching units. The research part involves collecting and studying the relevant literature with researcher's own critical review in the form of seminar paper suitable for publication. Pracitical part includes example implementation

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Seminar work	**40**	Oral exam	**40**
Work prepared for publication	**20**		

Course:

Cyber Psychology

Teacher:Mihailović M. Dobrivoje

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective: Course objective is to enable students to engage in independent scientific and research work in the field of cyber psychology.

Learning outcomes: Students are able to individually analyze current problems, apply previously and newly gained knowledge, and to conceptualize and implement research in the field of cyber psychology.

Course structure and content:

Introduction to psychological problems of Internet use; characteristics of Internet communication; work in Internet environment; new quality of interpersonal relations. Characteristics of human perception on Internet, self-representation on Internet and virtual identities; phenomena of Internet addictions; review of research results. Psychological characteristics of cyber space; limitations of sense experiences, anonymity, texting, digitalism, changed perception, disembodiment, flexibility of identities, social equality. Internet communities: singularity and factors affecting group formations on Internet.

Literature/Readings:

6. Golčevski, N., Milovanović, G., Global Citizens, Empirical Study of Internet Users in Serbia 2003., Center for Studing Information Technologies, Boš, Belgrade, 2004.
7. Negropont, N., Being Digital, Klio, Belgrade, 1998.
8. Jons, S., Virtual Culture, Identity and Communication in cyber society, XX century, Belgrade, 2001.

The *number of class hours* per *week*	**Lectures:** 3	**Research study:** 4

Teaching methods: Solving real cases studies. Writing a project. Teamwork. Debates.

Evaluation/Grading (maximum 100 points)

Class discussions, analysis of case studies, models and practices, project papers, tests

Course:

Quality System - selected chapters

Teacher:Filipović V. Jovan,Pejović B. Gordana

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

To introduce the concepts in the field of quality system and to, with a genuine understanding of the systemic-process approach, facilitate to the students understanding and mastering with existing and designing new models of quality systems and quality management systems.
To position the quality management system as the framework of the management systems integration process.
To help the students to develop abilities to apply the acquired knowledge in a real environment.

Learning outcomes:

Ability to students with a completely understanding of the concepts, apply and modify existing models of quality systems in a real environment and to, in accordance with the expressed requirements, including the integration of management systems and design of new systems.

Course structure and content:

Concepts and terminology of Quality System

Systemic-process approach

Models of quality system

Linkage of quality management and business strategy

Integrated Management Systems

The place and role of the Quality Management System in an Integrated Management System

Quality Management System as a complex adaptive system

The application of the Quality System in a real environment.

Literature/Readings:

Filipović, J. i Đurić, M., Quality Management System, 2010, FON, Beograd

Filipović, J, Krsmanović, M. i Horvat, A., Management and Quality (in the press process), FON, Beograd

Hoyle, David, Quality Management Essentials, 2007, Elsevier Limited, UK.

Handbook for the Integrated Use of Management System Standards, 2008, ISO.

The number of class hours per	**Lectures: 3**	**Research study: 4**

week		
Teaching methods: Lectures Exercises Presentation, discussion and seminar papers		
Evaluation/Grading (maximum 100 points) Test: 30 points Seminar: 30 points Final exam: 40 points		

Course: **Environmental Management System**		
Teacher:Filipović V. Jovan,Petrović B. Nataša		
Course status: Elective		
ECTS points: 10		
Prerequisites: none		
Course objective: To introduce the concepts in the field of environmental management system and to, with a genuine understanding of the systemic-process approach, facilitate to the students understanding and mastering with existing and designing new models. To position the environmental management system in the framework of the integration management systems. To help the students to develop abilities to apply the acquired knowledge in a real environment.		
Learning outcomes: Ability to students with a completely understanding of the concepts, apply and modify existing models of environmental management systems in a real environment and to, in accordance with the expressed requirements, including the integration of management systems and design of new systems.		
Course structure and content: Concepts and terminology of Environmental Management System Systemic-process approach Models of Environmental Management System Linkage of Environmental Management System and business strategy Integrated Management Systems The place and role of the Environmental Management System in an Integrated Management System The application of the Environmental Management System in a real environment.		
Literature/Readings: Filipović, J., Stokić, D., Đurić, M. i Ruso, J., Environmental Management System and sustainable Development (in the press process) FON, Beograd. Petrović, N. Environmental management, FON, Beograd. Stephen Tinsley and Ilona Pillai, 2008, Environmental Management Systems: Understanding Organizational Drivers and Barriers		
The number of class hours per	**Lectures: 3**	**Research study: 4**

week		
Teaching methods: Lectures Exercises Presentation, discussion and seminar papers		
Evaluation/Grading (maximum 100 points) Test: 30 points Seminar: 30 points Final exam: 40 points		

Course:

Business Process Management Systems

Teacher:Nešković N. Siniša,Babarogić S. Slađan

Course status: elective for study group Information Systems

ECTS points: 10

Prerequisites: none

Course objective:

To study and explore methods, techniques, standards and tools used in modeling and automation of business process.

Learning outcomes:

Students will be enabled in solving practical problems to successfully apply methods, standards, techniques and tools used in modeling and automation of business process.

Course structure and content:

The notion and definition of business processes (BP). Methods, techniques and tools for BP modeling. Standards in BP modeling. Automatisation of BP. Shortcomings of classical information systems. Types of BP management systems. Document based (DMS) and activity based (WfMS) systems. Overview of current standards reacted to business process management systems. Metamodels of WfMS and DMS systems. Comparative analyses of commercial DMS and WfMS systems. Application of BP management systems. Selected case studies.

Literature/Readings:

1. Mathias Weske, Business Process Management: Concepts, Languages, Architecture, Second edition, Springer-Verlag, 2012, ISBN: 978-3642286155
2. Van der Aalst W., Van Hee K., Workflow Management: Models, Methods, and Systems, The MIT Press 2004, ISBN: 978-0262720465
3. Havey M., Essential Business Process Modelling, O Reilly Media, 2005, ISBN: 978-0596008437

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Teaching is in the form of combination of lecturing and mentoring per teaching units. Research part done by students consists of collecting and studying relevant literature with own critical review given in a seminar paper.

Evaluation/Grading (maximum 100 points)

Seminar paper	**50**	**Oral exam**	**50**

Course:

Information Systems Security

Teacher:Simić B. Dejan,Jovanović V. Vladan

Course status: Elective

ECTS points: **10**

Prerequisites: none

Course objective:

The objective of the course is to transfer knowledge to students on all aspects of information systems security. Students will conduct the evaluation and selection of appropriate methodologies, processes and standards to protect the system, and be able to evaluate the effectiveness of existing protection systems and to design new systems to protect information systems.

Learning outcomes:

Students are prepared for the evaluation and implementation of an effective system for protection of information systems.

Course structure and content:

Aspects of information systems security. Methodological approaches to assessment and evaluation of established protection systems in business information systems. Assessment methodologies for security level, evaluation of system security, classification, and design of security system. The role of standards in establishment and assessment of the process of information system security. Testing aspects of the protection of computer applications and effectiveness of protection of entire system. Electronic and other protective measures as well as their integration into a complete security system. The study of general requests and / or cases / examples, including:

a) Information Systems Security Management System (ISSM based on ISO 27001:2006),

b) Organizational guidelines for protection (according to the code of practice based on ISO 27002)

c) System Security Plan (derived from NIST 800-18 and best practices of complex organizations).

Literature/Readings:

1. David Kim, Michael G. Solomon, "*Fundamentals of Information Systems Security*", Jones & Bartlett Learning, 2012.

2. C. Shou, D.Shoemaker, "*Information Assurance for the Enterprise*", Mc Graw-Hill, 2007

3. G. Milles et all., "*Security Assessment*", Syngress 2005,

4. William Stallings, "*Network Security Essentials: Applications and Standards*", 5th Edition, Pearson Education Limited, 2013.

5. *Security Standards and Guidelines* from the NIST Series 800

6. Thomas R. Peltier, "*Information Security Policies, Procedures, and Standards: Guidelines for Effective*

Information Security Management", CRC Press, 2013. 7. Selected professional and scientific papers		
The number of class hours per week	**Lectures:** 3	**Research study:** 4
Teaching methods: Lectures. Consultation. Mentoring. Practical work. Solving specific cases. Case studies. Working on projects. Working in teams. Discussion. Methods for distance education. The collection and study of relevant literature with providing critical review of the resolution of specific problems. Creative workshops.		
Evaluation/Grading (maximum 100 points) Analysis of the cases, models or specific practices /Homework/Seminar/Project. Oral exam.		

Course:

Discrete event systems

Teacher:Petrović J. Bratislav

Course status: Compulsory

ECTS points: 10

Prerequisites: none

Course objective: The course objective is to enable students to enhance their knowledge in the field of discrete event system theory and to apply it for modelling and control of organizational systems.

Learning outcomes: The acquired knowledge of the concepts of discrete event system theory will enable students to appropriately model and control organizational systems using ICT.

Course structure and content:

Miscellaneous examples of discrete event in organizational systems: planning, production, finance, communication networks. Semi-rings and dioids, linear systems in (max,+) and (min,+) algebra. Lattice properties of dioids. Path algebra and graph theory. Matrix equations on complete dioids. Concept, properties and subclasses of Petri nets. Deterministic, stochastic, fuzzy and hierarchical Petri nets. Structural and dynamical properties, reachability. Linear description of event graphs. Dynamic equations of counters and daters, ARMA models, state equations. Input-output description by sup-convolution. Dioids of dater, delay and shift operators. γ - and δ - transform. Asymptotic and spectral properties of (max,+) matrices. Eigenvalues and eigenvectors. Periodicity, cyclicity, cycle time. Discrete Event Systems (DES) and automata. State-based control of DES. Supervisory control of timed DES. Software packages for numerical and symbolic calculations: Matlab, Mathematica and SciLab.

Literature/Readings:

1) F. L. Baccelli, G. Cohen, G. J. Olsder, J.-P. Quadrat, Synchronization and Linearity: An Algebra for Discrete Event Systems, Wiley, 1993.

2) C. G. Cassandras, S. Lafortune, Introduction to Discrete Event Systems, Springer-Verlag, 2007.

3) B. J. Petrović, Introduction to Discrete Event Systems, FOS, 2002.

4) W.M. Wonham, Notes on Control of Discrete-Event Systems, Department of Electrical and Computer Engineerings University of Toronto, 2002.

5) D. Duffie, Dynamic Asset Pricing Theory - third edition, Princeton University Press, 2001.

6) L. Lovasz, J. Pelikan, K. Vesztergombi, Discrete mathematics: elementary and beyond, Springer, 2003.

The *number of class hours* per *week*	**Lectures:**	**Research study:**
	3	4

Teaching methods: Lectures, Reaserch project, Mentoring

Evaluation/Grading (maximum 100 points)
Seminar paper (30%), written exam (30%), project presentation (40%)

Course:

Software architectures

Teacher:Nešković N. Siniša

Course status: elective for study group Information Systems

ECTS points: 10

Prerequisites: none

Course objective:

To attain practical knowledge and skills in the area of software architectures needed in realization of complex distributed systems.

Learning outcomes:

Students will be enabled to critically analyze different advanced software architectures, select and apply one which is appropriate for realization of complex IS.

Course structure and content:

Definition of software architecture and basic concepts. Abstractions, structure and communication of components, non-functional requirements, views, patterns. Software quality attributes. Overview of middlewares (distributed objects, message based systems, subscribe models, application servers, service orchestration). Issues with classical software architectures. Examples. Software production lines. Aspect oriented architectures. Model driven architectures. Service oriented architectures. Semantic web. Software agents. Adaptive architectures. Software architecture development process. Documenting software architecture.

Literature/Readings:

1. Ian Gorton, Essential Software Architecture, second edition, Springer, 2011, ISBN: 978-3642191756
2. John Reekie, Rohan McAdam, A Software Architecture Primer, Angophora Press 2006, ISBN: 978-0646458410
3. Len Bass, Paul Clements, Rick Kazman, Software Architecture in Practice, third edition, Addison-Wesley Professional, 2012, ISBN: 978-0321815736

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Teaching is in the form of combination of lecturing and mentoring per teaching units. Research part done by students consists of collecting and studying relevant literature with own critical review given in a seminar paper.

Evaluation/Grading (maximum 100 points)

Seminar paper	**50**	**Oral exam**	**50**

Course:

Software process and maintenance - selected chapters

Teacher:Vlajić S. Siniša

Course status: Election

ECTS points: 10

Prerequisites: none

Course objective: Getting to know the models of software life cycle. Mastering the models and methods of assessment processes. Understanding the techniques of maintenance.

Learning outcomes: Successful use of various models and methods of the software life cycle and maintenance techniques.

Course structure and content:

Process implementation and change: Infrastructure and Management software process. Process models. Implementation, changes, and practical considerations. Definition of Process: Model and Software Life Cycle Processes. Adaptation and process automation. Evaluation process: Models and methods of evaluation process. Measurement processes and products: Measuring process. Measuring Software Product. The quality of the measured results. Models of the software product. Techniques for the measurement process. Fundamentals of Software Maintenance: Definitions and terminology. The nature of software maintenance. The need for maintenance. Price maintenance. The evolution of software. Categories of maintenance. The key issues of software maintenance: technical issues. Maintenance management. Evaluation of maintenance costs. Measures of software maintenance. Maintenance process: Process Description. Maintenance activities. Maintenance techniques: Understanding programs, reengineering. Reverse engineering.

Literature/Readings:

1. Object Management Group: Software Process Engineering Metamodel Specification, 2002.

2. B. McFeeley, IDEAL: A User's Guide for Software Process Improvement, Software Engineering, Institute CMU/SEI-96-HB-001, 1996,

3. S.L. Pfleeger, Software Engineering: Theory and Practice, second ed., Prentice Hall, 2001.

4. R.S. Pressman, Software Engineering: A Practitioner's Approach, sixth ed., McGraw-Hill, 2004.

5. K.H. Bennett and V.T.Rajlich, Software Maintenance and Evolution: A Roadmap, The Future of Software Engineering, A. Finklestein, ed., ACM Press, 2000.

6. K.H. Bennett, "Software Maintenance: A Tutorial in software Engineering, M. Dorfman and R. Thayer, eds., IEEE Computer Society Press, 2000.

The number of class hours per week	**Lectures:** 3	**Research study: 4**

Teaching methods: Lectures and laboratory exercises.

Evaluation/Grading (maximum 100 points)

Individual work and oral defense of the study example.

Course:

Spreadsheet engineering

Teacher:Lečić-Cvetković M. Danica

Course: Spreadsheet engineering

Teachers: Lečić-Cvetković M. Danica

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Introduction and application of software engineering principles into design of spreadsheet application. Analyzing of engineering questions initiated by spreadsheet usage, which are not considered in software engineering.

Learning outcomes:

productivity improvement of spreadsheet programming; decreasing frequency and severity of spreadsheet errors; improvement of spreadsheet maintenance; etc.

Course structure and content:

Spreadsheet engineering principles; Spreadsheets for quick changes in strategic important models; Spreadsheets for research modeling; Spreadsheet applications for small data bases; Spreadsheet engineering best practice; Spreadsheets as enterprise tools; Spreadsheet errors reduction and limitations; Spreadsheet development control; Spreadsheet application designing; Spreadsheet debagging and development process; Software engineering approach for spreadsheet applications development; Spreadsheets errors editing; Computer programming psychology; End-user programming;

Literature/Readings:

1. Powell S., Baker K., *The Art of Modeling with Spreadsheets*, Wiley and Sons, 2004
2. Kimmel P., Green J., Bullen S., Bovey R., Rosenberg R., Paterson B., *Excel 2003 VBA*, Programers Reference, Wiley, 2004.
3. Pfleeger S., *Software Engineering Theory and Practise*, Prentice Hall, 2001
4. Published papers, *European Spreadsheet Risks Interest Group*, 2000-2012, http://www.eusprig.org

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods: Lectures, labs, mentoring, research study

Evaluation/Grading (maximum 100 points)

Course:

Standardization – chosen chapters

Teacher:Mijatović S. Ivana

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective: Acquiring of advanced knowledge about standardization on the levels of understanding, application of the acquired knowledge as well as analysis, synthesis and evaluation.

Learning outcomes:

Active participant will be able to: understand importance, purposes and benefits of standardization; understand and adequately interpret development of standards in discipline of interest and understand and contribute to researches related to specific aspects of standardization.

Course structure and content:

Lectures:

Different interpretation of terminology in standardization. Classification of standards and standardization. Classification of standards in accordance to the problems they solve. Importance, purposes and benefits of standardization. Role of standards in the global market. Relationships between standards and markets Standardization and scientific and industrial research. State of art in standardization researches – business approach. Comparative analysis of the models for standard development – pro and contra. Dynamics and quality of standards. Research of the standards performance on market based on *Technology Acceptance Model* (TAM). Technological, economic and social implication of standardization. Empirical evidence of relationships between standardization and technological change. Standardization and international trade. Standardization and innovation.

Research study:

Research study in areas: impact of the standards usage on the business performance, an overview of the recent trends in standardization research, perception of standardization, development of models for standards' quality assessment. Considerations of others areas of research are welcomed.

Literature/Readings:

1. Blind, K. (2004). The Economic of Standards – Theory, Evidence, Policy. Edward Elgar Publishing Limited.

2. de Vries H., Standardization – A Business Approach to the Role of National Standardization Organizations, Kluwer Academic Publishers, 1999, ISBN 0-7923-8638-8.

3. Hesser W., Feilzer A., de Vries H., Standardization in Companies and Markets, Helmut Schmidt University Hamburg, 2010., ISBN 9783940385 4. Murphy, C. N., Yates, J.A., The International Organization for Standardization (ISO): global governance through voluntary consensus, Taylor & Francis, 2009. ISBN 0-203-88434-5 5. Prasad R., Future trends and Challenges for ICT standardization, River Publishers, 2010.

The number of class hours per week	**Lectures:** 3	**Research study:4**
Teaching methods: Interactive lectures, workshops and case studies		

Evaluation/Grading (maximum 100 points)

Research study	40	Final exam	40
Research paper	20		

Course:

Standardization in information systems and technologies – chosen chapters

Teacher:Filipović V. Jovan,Mijatović S. Ivana,Marjanović M. Zoran

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective: Acquiring of knowledge about standardization in information systems and technologies on the levels of understanding, application of the acquired knowledge as well as analysis, synthesis and evaluation.

Learning outcomes:

Active participant will be able to: understand importance, purposes and benefits of ICT standardization; understand roles and complex relationships among organizations for standardization in ICT sector; understand and contribute to researches related to broad aspects of ICT standardization.

Course structure and content:

Lectures

Standardization and standards - basics. Development and importance of ICT standardization on global market; Classification of ICT standards and standardization. Formal ICT standardization. Consortia based ICT standardization. Sectoral ICT standardization. Organizations for standardization in ICT sector (ITU, ISO, IEC, CEN, CENELEC, ETSI, TIA, TTC, W3C, WWRF, IEEE, OASIS, OMG, IETF, OSI...) and cooperation among them; Relationships between standards and markets; Competing standards and standards battles in area of ICT. Dynamics and quality of ICT standards; Specific principles of ICT standardization. Paradox of RAND/FRAND principles; Interoperability and compatibility. Compatibility and interface ICT standards; Standards related to ITC services; ITIL concept. Relationships between ITIL concept and QMS in accordance to ISO 9001; Family of standards ISO/IEC 20000; ISO/IEC 20000 Certification; Relationships between ITIL concept and ISO/IEC 20000; Capability Maturity Model Integration (CMMI); IT Mark.

Research study

Case study: Development of ICT standardization. Standardization Workshop: Classifications of standards. Case Study: ICT standards and market. Standardization workshop: Standards development. Case study: Standards battle. Case study: Consortia based standardization. Standard development in formal organizations for standardization. Ad hoc de facto standardization. Work shop: ITIL concept, Workshop: ISO /IEC 20000. Workshop: CMMI. Workshop: IT mark.

Literature/Readings:

1. Filipović J., Jovanović B., *Kvalitet i informacione tehnologije - Priručnik za vežbe*, Fakultet organizacionih nauka, Beograd, 2014.
2. Mijatović I., *Standardizacija*, Fakultet organizacionih nauka, 2014.
3. Jakobs K., *Information Communication Technology Standardization for Business Sectors: Integrating Supply and Demand Factors*, IGI Global, 2009.
4. Ahern, Dennis; Jim Armstrong, Aaron Clouse, Jack Ferguson, Will Hayes, Kenneth Nidiffer, *CMMI SCAMPI Distilled: Appraisals for Process Improvement*. Addison-Wesley Professional, 2005.

The number of class hours per week	**Lectures:** 3	**Research study: 4**

Teaching methods: Interactive lectures, workshops, case studies,

Evaluation/Grading (maximum 100 points)

Class activities	5	Written exam	20
Midterm exams	20	Verbal exam	35
Seminar papers	20		

Course:

Statistics in management

Teacher:Bulajić V. Milica,Radojičić A. Zoran,Vukmirović V. Dragan,Jeremić M. Veljko

Course status: Compulsory, Elective

ECTS points:10

Prerequisites: none

Course objective:

This course gives a review of statistical methods and models, which are used as a useful tool in the decision making process in different areas of management. The special attention is paid to methods used in scientific research of PhD students.

Learning outcomes:

The content of this subject prepares students for modelling and solving practical management problems with the application of methods of statistical analysis.

Course structure and content:

Data acquisition, The sample and sample planning. Classification of methods and models. Automatic control and correction of errors. Creating a questionnaire. Logical design of questionnaire. The hypothesis testing. The use of standard statistical applications. Multivariate statistical analysis, models. MANOVA. ANCOVA. Models of repeated measurements. Methods of data transformation. The software support to statistical research. Forecasting, classification and analysis of risk. ROC curves. Solving practical problems. Formalisation and presentation of the results of statistical research in scientific papers. Methodology of scientific research in technical sciences. Case studies.

Literature/Readings:

Metcalfe A.V., *Statistics in Management Sciences*, Arnold, Oxford University Press, New York, 2000.

Keller G., *Statistics for Management and Economics, Abbreviated Edition*, 9th Eddition, South-Western, New York, 2012.

Ramsdent F., *The Essentials of Management Ratios*, Gower Publishing, Ltd., UK, 1998.

Neter J., Wasserman W., Whitmore G.A, *Applied Statistics (3rd edition)*, Allyn and Bacon, USA, 1993.

Cargill M., O'Connor P., *Writing Scientific Research Articles – Strategy and Steps*, Wiley BlackWell, 2009.

Walpole R., Myers R., Myers S., Ye K., *Probability and Statistics for Engineers and Scientists*, 8th Edition, Pearson Prentice Hall, New Jersey, USA, 2007.

The number of class hours per week	**Lectures:** 3	**Research study:4**

Teaching methods: Depending on the number of students, teaching method is classical and mentoring, or only

mentoring. The student project, carried out in consultation with the teacher, is required.
Evaluation/Grading (maximum 100 points) **Project:** 70 points **Oral exam:** 30 points

Course:

Stochastic Models for Computer Science

Teacher:Đorić S. Dragan,Lazović P. Rade

Course status:**:** Elective of the study program Information Systems and Quantitative Managementt, Study Group Operational Research

ECTS points: **10**

Prerequisites: Completed master studies

Course objective:

Introduction to the basic probabilistic and statistical methods and models, s well as random processes used in computer science. Making a connection between theory (mathematical models), the experiment (simulation) and solving practical problems.

Learning outcomes:

Training students for the application of stochastic models to real engineering problems of informatics and computer science.

Course structure and content:

Theoretical study:

Review of basic concepts and facts of probability. Discrete distributions. Important continuous distributions. Determination of the distribution of the sum, difference, product and quotient of random variables. Asymmetric distributions. Simulation of random variables with a given distribution. Introduction to random processes, stationarity, ergodicity. Gaussian and Markov processes. Poisson arrivals process. Wiener process. Birth and death processes. Sampling size, statistics, and their distribution. Statistical hypothesis testing. Checking the adequacy of the selected distribution. Single-channel queues. Multi-channel queues.

Research study:

The implementation of all methods in a programming language R, simulation of random variables and processes, evaluation of parameters of stochastic model and the adequacy of the obtained models. Practical work on concrete examples. Seminars or homeworks.

Literature/Readings:

1. S.M. Ross, Introduction to Probability Models, Academic Press, 1997.
2. M. Lefebvre, Applied Stochastic Processes, Springer, 2007.
3. P. Dalgaard, Introductory Statistics with R, Springer, 2002.
4. S. Asmussen, P. Glynn, Stochastic Simulation, Springer, 2007.
5. D. Đorić, V. Jevremović, J. Mališić, E. Nikolič-Đorić, Atlas of Distributions, Faculty of Civil Engineering, Belgrade, 2007.

6. S. Krčevinac, M. Čangalović, V. Kovačević-Vujčić, M. Martič, M. Vujošević, Operations Research, FON, Belgrade, 201		
The number of class hours per week	**Lectures:** 3	**Research study:** 4
Teaching methods: Lectures and presentations on computer.		
Evaluation/Grading (maximum 100 points) seminars/homeworks:50 Oral examination:50		

Course:

Stochastic processes and systems

Teacher:Radojičić A. Zoran,Filipović Ž. Vojislav

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

The aim of this course is to provide students with the necessary theoretical concepts and methods in stochastic processes. The students are enabled to apply these methods in solving practical problems.

Learning outcomes:

The acquired knowledge of the concepts of stochastic processes will enable students to apply appropriate approach for modeling and control of organizational systems.

Course structure and content:

Probability model with infinite number of possible outcomes. Kolmogorov's Axioms. Algebra and sigma algebra. Lebesgue integration. Mathematical expectation. Conditional mathematical expectation. Gaussian processes. Wiener process. A geometric Brownian motion. Processes and orthogonal polynomials. Markov processes with discrete state space. State space graph. State classification. Markov chains. Stationary stochastic processes. Correlation function. Spectral representation of stationary processes. Linear transformation of stationary processes. Ergodicity. Vector stochastic process. Martingale. The convergence of sequences of random variables. The convergence of stochastic recursive procedures with probability 1. The central limit theorem. Stochastic differential equation. Solving tochastic differential equation. Ito calculus. Stratonovich integrals. Stochastic polynomial expansion (AR, ARMA, ARIMA models). Time series prediction. The theorems of arbitrage. The Black–Scholes equation.

Literature/Readings:

1) D. P. Bertsekas, J. N. Tsitsiklis, Introduction to Probability, Athena Scientific, 2002.

2) G. F. Lawier, Introduction to Stochastic Processes – second edition, Chapman and Hall, 2006.

3) I. I. Gikhman, A. V. Skorokhod, S. Kotz, The Theory of Stochastic Processes II, Springer, 2004.

4) S. M. Ross, An Introduction to Mathematical Finance – Options and Other Topics, Cambridge University Press, 1999.

5) A. N. Shiryaev, Essentials of Stochastic Finance: Facts, Models, Theory, World Scientific Publishing, 1999.

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods: Lectures, Reaserch project, Mentoring

Evaluation/Grading (maximum 100 points)

Seminar paper (30%), written exam (30%), project presentation (40%)

Course:

Stochastic and Fuzzy Programming

Teacher:Vujošević B. Mirko,Makajić-Nikolić D. Dragana,Stanojević J. Milan

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Examination of the phenomena of uncertainty and their impact on solving the problem of optimal planning. The aim is to provide the students with knowledge of approaches to modeling and solving optimization problems under uncertainty.

Learning outcomes:

The acquired knowledge will qualify the students to apply stochastic programming and fuzzy programming to solving of different real-life problems under uncertainty.

Course structure and content:

Uncertainty, imprecision and vagueness in the optimization tasks. Approaches based on probability theory. Fuzzy approaches to the uncertainty treatment. Other possible approaches to the modelling of uncertainty. The general formulation of the stochastic programming problem. Optimization of the expected value. Robust optimization. Scenario analysis. Models with probabilistic constraints. Risk modelling. Stochastic linear programming (SLP). Stochastic mixed integer programming. Stochastic dynamic programming. The use of Monte Carlo methods for solving problems of stochastic programming. Approaches for comparing (ranking) fuzzy numbers. Fuzzy optimization. Fuzzy linear programming. Applications in finance. Portfolio optimization models. Application in the supply chain. Software and tools for solving the optimization problem under uncertainty.

Literature/Readings:

1. P. Kall, S. W. Wallace, *Stochastic Programming*, John Wiley & Sons, 1994
2. A. J. King, S. W. Wallace, *Modeling with stochastic programming*, Springer, 2010.
3. M. Vujošević, *Metode optimizacije u inženjerskom menadžmentu*, AINS, Beograd, 2012.
4. M. Vujošević, *Operaciona istraživanja- odabrana poglavlja*, FON, Beograd, 1999.
5. G. J. Klir, B. Yuan, *Fuzzy sets and fuzzy logic – theory and applications*, Prentice Hall, 1995.
6. D. Petrović-Đorđević, N. Cakić, *Stohastički modeli finansijskih tržišta,* Akademska misao, Beograd, 2010. Young_jou Lai, Ching-Lai Hwang, *Fuzzy multiple objective decision making - methods and applications*, Springer, 1996.

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods Theoretical instructions are performed as block classes and/or by mentor work (depending on the number of students). Students have to work project.

Evaluation/Grading (maximum 100 points)
Oral exam: 30; Project 60; Project presentation 10

Course:

Strategic innovation

Teacher:Stošić A. Biljana

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Acquisition of knowledge in the field of strategic innovation management for competitiveness enhancement through innovative business models and new product, service, process, technology, organization, marketing development.

Learning outcomes:

Ability to manage all stages of the strategic innovation process and strategic innovation portfolio; strategic innovation management and development from organizational level to national economy.

Course structure and content:

Theoretical study: Innovation theory. Innovation and change. Strategic innovation as a basis for development and competitiveness. Innovation capacity. Innovation as management and engineering process. Systematic approach to innovation process – elements that determine innovation in the system. Innovation "pillars" – complexity and system thinking. Strategic innovation management from new business idea to development and new product, service, process, technology, organizational, marketing implementation. Strategic business innovation model. Innovative organization. Innovation strategy and innovation value chain. Strategic management of innovation projects. Risk management and roles network in strategic innovation management. Idea management (creativity, design and idea generation, sources of ideas, evaluation and selection). Growth model through innovation. Innovation process models. National innovation systems and innovation infrastructure. Measuring innovation. Innovation performance and innovation indicators. EU innovation policy and strategy. Strategic innovation and intellectual property.

Practical study: Supporting methods in managing strategic innovation processes. Analysis and application of strategic ideation methods - generating new ideas, prediction, evaluation and selection of innovation projects. Case studies from the field.

Literature/Readings:

Required:

Stošić, B., Innovation Management - Innovation Projects, Models and Methods, Faculty of Organizational Sciences, Belgrade, 2013.

Stošić, B., Innovation in Technology, Faculty of Organizational Sciences, Belgrade, 1997.

Optional:

Liyanage, S., et al. Serendipitous and Strategic Innovation: A Systems Approach to Managing Science-based Innovation, Greenwood Publishing Group, 2006.

Le Masson, P., Weil, B., Hatchuel, A. Strategic Management of Innovation and Design, Cambridge University Press, 2010.

Trott, P., Innovation Management and New Product Development, Prentice Hall, 2005.

Chesbrough, H., Open Business Models: How to Thrive in the New Innovation Landscape, Harvard Business School Press, 2006.

The *number of class hours* per *week*	**Lectures**: 3	**Research study**: 4

Teaching methods

Power Point presentation, research activities through overview and analyses of selected case studies.

Evaluation/Grading (maximum 100 points)

Class Discussion and Exercises	10 points
Practical exercise	10 points
Tests	30 points
Written assignments	20 points
Oral examination	30 points

Course:

Strategic Project Management

Teacher:Petrović Č. Dejan,Mihić M. Marko,Obradović LJ. Vladimir

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

Understanding the concept of strategic project management and its role in modern business. One of objectives is to familiarize students with the theoretical frameworks and developments concerning the integration of project management and business strategies of the organizations. Students should be introduced to methods and concepts of research and analysis as well as to approaches to defining and implementing strategic project management.

Learning outcomes:

Students will gain theoretical and practical knowledge about the state of the art approaches for creating efficient and effective strategic management, based on integration of business strategy and essential projects. This approach will enable organizations to achieve competitive advantages. Students will develop skills needed in order to perform: critical analysis in the process of project selection, project implementation, monitoring and evaluation of projects and compliance with the organization's strategy. Students will be educated for independent scientific researches and conducting researches in the area of integration of business strategies and projectsimperative to organizations. Students will be able to conduct expertise concerning the implementation approaches of strategic project management. Students will also be in position to develop their own approaches and concepts of implementation, and to improve practical implementationof models, methods and techniques of strategic project management.

Course structure and content:

Theoretical study:

The concept of Strategic Management. Models of strategic management. Contemporary approaches (Strategic Management issues;Institutional approach to strategy; Strategic mapping;Resource-oriented approach to strategy). Unsuccessful implementation as a problem of strategic management. The improved model of strategic management. Integration of strategic and project management. Defining mission, vision, goals and strategies of a project. Project planning. The life cycle of the project. The project strategy. Organization and provision of personnel for the project unit and the project team. The critical factors of success. Role of project manager. Management of the project team. Risk Management. Control and evaluation of the project. Strategic and project leadership.

Practical classes:

Corporate Strategy. The strategy at the business unit. The international strategy. Strategies for entrepreneurial ventures, public sector and non-profit organizations. Strategic decisions making process. The strategic focus of the projects. Methods and techniques of planning, monitoring, control and evaluation of strategies. Strategic tools for the management of programs and projects. Project portfolio methods. Strategic map. Balanced scorecard. Performance measurement. Models project maturity.

Literature/Readings:

1. Schmidt T: Strategis Project Management Made Simple – Practical Tools for Leaders and Teams, John Wiley

<table>
<tr><td colspan="3">and Sons, 2009
2. Shenhar J. A, Milošević D, Dvir D, Thamhain H, Linking Project Management to Business Strategy, Project Management Institute, Newtown Square, PA, USA, 2007
3. Morris, P.W.G, Jamieson, H. A. Translating corporate strategy into project strategy, Project Management Institute, Newtown Square, PA, USA, 2004.
4. Coulter M: Strategic Management, Fourth Edition, Data status, 2009th

5. Dess G, Lumpkin, G, Eisner A: Strategic Management, Third Edition, Data status, 2007

6. Kerzner H.: Project Management: A Systems Approach to Planning, Scheduling and Controlling, 10th edition, John Wiley & Sons, Inc., 2009

7. Milošević D, Martinelli R, Waddell J: Program Management for Improved Business Results", John Wiley & Sons, New York, 2007</td></tr>
<tr><td>The number of class hours per week</td><td>Lectures: 3</td><td>Research study:4</td></tr>
<tr><td colspan="3">Teaching methods:

Lectures, exercises, tutorials and independent research student's work on writing a seminar paper.</td></tr>
<tr><td colspan="3">Evaluation/Grading (maximum 100 points)

Activity during the lectures: 10

Essay: 40

Written exam: 50</td></tr>
</table>

Course:

Game theory

Teacher:Gajić R. Zoran

Course status: Elective

ECTS points: 10

Prerequisites: Optimal Control

Course objective:

The aim of this course is to provide students with the necessary theoretical concepts and methods in game theory. The students are enabled to apply these methods in solving practical problems with special attention to problems in economics, finance, political sciences, biology and computer science.

Learning outcomes:

The acquired knowledge of the concepts of game theory will enable students to apply appropriate approach for modeling and solving real business problems in organization systems.

Course structure and content:

Modelling and optimality criteria. Calculus of variations, the principle of optimality and the maximum principle. The basic elements of non-cooperative and simultaneous games (players, strategy, representation of games). Random selection strategy. Strategic dominance. Example: The prisoners' dilemma. The best response. Nash equilibrium and its implications. Simultaneous games with imperfect information. Bayesian equilibrium. The possibility of errors. Dynamic games (continuous and discrete time): Stackelberg, Nash and Pareto strategy. Sequential rationality and backward induction. Negotiations. Believes and perfect Bayesian equilibrium. Auction theory. Monopoly and oligopoly in game theory. Repeated Interactions. Axelrod's Tournament. Asymmetric information and negative selection. Signaling quality.

Literature/Readings:

1) A. Mas-Colell, M. D. Whinston, J. R. Green, Microeconomic Theory, Oxford University Press, 1995.

2) D. Fudenberg, J. Tirole, Game Theory, MIT Press, 1991.

3) M. J. Osborne, A. Rubinstein, A Course in Game Theory, MIT Press, 1994.

4) D. Fudenberg, J. Tirole, Handbook of discrete and combinatorial mathematics, CRC Press, 1999.

5) R. Branzei, D. Dimitrov, S. Tijs, Models in cooperative game theory: crisp, fuzzy, and multi-choice games, Springer, 2005.

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods: Lectures, Reaserch project, Mentoring

Evaluation/Grading (maximum 100 points)

Seminar paper (30%), written exam (30%), project presentation (40%)

Course:

Game theory and Industrial Organization

Teacher:Kuzmanović S. Marija,Jednak J. Sandra

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

To enable students both to explore the operations of the companies and industries in a dynamic environment and to understand relations between companies within the industry and between industries. Students apply the basic principles of game theory and microeconomics to understand the market structure, corporate management and economic performance of the industry. At the same time, students develop knowledge related to pricing and production within the different market structures, as well as knowledge related to market entry and exit barriers. Students improve the ability of their own thinking on the strategic behavior of companies within the industry.

Learning outcomes:

Students will be provided with the tools to improve their abilities for strategic and analytical thinking and application of contemporary methods (advanced concepts of game theory) in the modeling and analysis of market structure and understanding of business behavior of companies, depending on the specific market structure.

Course structure and content:

P1. Introduction**:** The concept of industrial organization. Why is studying. Basic schools of thought and methodologies.

P2-P3. Basic concept of non-cooperative games: Terminology. Normal form games (simultaneous games). Equilibrium. Dominant strategy equilibrium. Nash equilibrium. Extensive form games (sequential games). Subgame and Subgame perfec equilibrium. Games with repetition.

P4-P5. Market structure and organization: Perfect competition and monopoly. Markets of homogeneous and differentiated products. Oligopoly models: Courno, Bertrand and Stackelberg. The location model. Hotelling game. A linear approach to the problem of the location model. Sequential entry in a linear city. The existence of equilibrium in a linear city. Concentration, Mergers, and barriers to entry.

P6. Technology and market structure: Research and development. Race in innovation and race equilibrium. Cooperation and lack of cooperation in R & D. Economics of compatibility and standards.

P7-P10. Strategic behavior of oligopolies: Advertising (informative, incentive and predatory advertising. Advertising level that maximizes profit). Quality-Durability-Warranty (Trade off between innovation and durability. Market of lemons (Ackerlof model). Games of quality signaling. Guarantees in terms of symmetric and asymmetric information. Pricing.

P11 – P12. The role of information: Monitoring (Principal-agent problem. Providing economic incentives under uncertainty. Principal-agent problem in terms of asymmetric information. Optimal level of effort. Economic mechanism in terms of equal distribution. Efficient economic allocation mechanisms). Management (Payments and

incentives for managers. Two-stage games. Collusion between owners. Regulation of firms in terms of the unknown costs). Compensation-regulation, price dispersion and search theory.

P13-P15: Some applications - selected industries: Economics of restaurants, air transportation, branch fisheries, public roads and traffic congestion. Other application.

Literature/Readings:

1. Shy, Oz, Industrijska organizacija – Teorija i primene, Ekonomski fakultet, Beograd, 2005. (prevod udžbenika Industrial organization:Theory and Application, Cambridge, MA:The MIT Press, 2001)

2. Kuzmanović, M. Model nekooperativnog strateškog ponašanja oligopola baziran na teoriji igara i conjoint analizi, Doktorska disertacija. Fakultet organizacionih nauka, Beograd, decembar 2011.

3. Church J., & Ware R. Industrial Organization. A Strategic Approach. Irwin, McGraw Hill, 2000.

4. Tirole, J., The Theory of Industrial organization, Cambridge, MA: The MIT Press, 1992.

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Lectures accompanied by appropriate presentations and multimedia content. Exercises based on realistic and illustrative examples. Creative workshops based on interactive work with students through analysis of case studies, experimental games and simulations.

Evaluation/Grading (maximum 100 points)

Project: 50 points

Final exam: 50 points

Course:

Theory of Combinatorial Algorithms

Teacher:Čangalović M. Mirjana,Mladenović M. Nenad,Vujčić V. Vera

Course status: Elective

ECTS points:10

Prerequisites: none

Course objective:

Introduction to basic combinatorial structures, graph theory terms and combinatorial optimization problems. Analysis of the existing algorithms for dealing with combinatorial structures (generating, searching, sorting) and for solving the most important combinatorial optimization problems (shortest path problem, travelling salesman problem).

Learning outcomes:

Students will learn the most important combinatorial algorithms and be trained for creating algorithms for solving the combinatorial problems.

Course structure and content:

Lectures:

Computational complexity of the algorithm. Basic combinatorial structures (finite sets, lists, combinations, permutations).Computer presentation and manipulation with combinatorial structures.

Algorithms for generating combinatorial structures, sorting and searching. Algorithms for generating all combinations and permutations. Algorithms for generating all number and set partitions.

Basic graph theory terms (graphs, hypergraphs, path, clique). The most important graph problems. Computer presentation of graphs. Algorithms for determination of the shortest distances and paths.

Algorithms for all spanning trees generation. Algorithms for maximum clique determination.

Eulerian and Hamiltonian Graphs. Algorithms for solving the Travelling salesman problem.

Network flows. Algorithms for solving the maximum network flow problem. Combinatorial design. Algorithms for Steiner triple systems constructing. Other combinatorial problems and their solving using combinatorial algorithms.

Research work:

The implementation of the acquired theoretical knowledge on specific combinatorial problems. Seminar.

Literature/Readings:

1. Jiri Fiala, Jan Kratochvil, Mirka Miller, *Combinatorial Algorithms*, Springer, 2009.

<table>
<tr><td colspan="3">2. Donald E. Knuth, The Art of Computer Programming, Volume 4, Addison-Wesley, 2005.

3. Donald Kreher, Douglas Stinson, Combinatorial Algorithms: Generation, Enumeration and Search, CRC Press, 1998.

4. Edward M. Reingold, Jurg Nievergelt, Narsingh Deo, Combinatorial Algorithms, Prentice-Hall, 1977.

5. Dennis Stanton, Dennis White, Constructive Combinatorics, Springer-Verlag, 1986.

6. Nicos Christofides, Graph Theory - an Algorithmic Approach, Academic Press, 1975.

7. D. Cvetković, M. Čangalović, Đ. Dugošija, V. Kovačević-Vujčić, S. Simić, J. Vuleta, Kombinatorna optimizacija, Dopis, 1996.

8. M. Vujošević, Metode optimizacije u inženjerskom menadžmentu, ANIS – FON, Beograd, 2012.</td></tr>
<tr><td>The number of class hours per week 7</td><td>Lectures: 3</td><td>Research study: 4</td></tr>
<tr><td colspan="3">Teaching methods:

Mentoring. Writing a seminar paper.</td></tr>
<tr><td colspan="3">Evaluation/Grading (maximum 100 points)

Seminar:50 Oral exam:50</td></tr>
</table>

Course:

System theory – selected topics

Teacher:Petrović J. Bratislav

Course status: Compulsory

ECTS points: 10

Prerequisites: none

Course objective: The course objective is to enable students to enhance their knowledge in some specific topic in the field of system theory and to apply it for modelling and control of organizational systems.

Learning outcomes: The acquired knowledge of the concepts of system theory will enable students to appropriately model and control organizational systems using ICT.

Course structure and content:

Systems, models and notion of state. Dynamics of discrete time and continuous time systems. Vector spaces, metric spaces. Deterministic and non-deterministic systems. Systems and choice of state. Linearization and linear models. Reachability and controllability of discrete time systems.

Inner product spaces and adjoint mapping. Observability of discrete time systems. Behaviour of time varying continuous time systems: systems of differential equations, input-output descriptions, equivalent systems and realizations. Distributions, Dirac and Heaviside functions. Time invariant linear systems: matrix exponential, diagonalisation, Jordan's canonical form, transform methods, signal flows graphs. Controllability, observability and reachability of continuous time systems. Stability theory: Stability of system state, input-output stability, Lyapunov's stability. Control and management of systems and feedback. Observers and controllers. Control of multiple-input, multiple-output (MIMO) systems. Introduction to optimal control. Software packages for numerical and symbolic calculations: Matlab, Mathematica and SciLab.

Literature/Readings:

1) B.J. Petrović, System theory (in Serbian) FOS, Beograd, 1998

2) E. Sontag, Mathematical Control Theory, Springer, 1998.

3) Y. Takahara, M. Mesarovic, Organization structure: cybernetics systems foundation, Springer, 2003.

The *number of class hours* per *week*	**Lectures:** 3	**Research study:** 4

Teaching methods: Lectures, Reaserch project, Mentoring

Evaluation/Grading (maximum 100 points)

Seminar paper (30%), written exam (30%), project presentation (40%)

Course:

Software Testing - selected topics

Teacher:Đurić O. Dragan,Lazarević D. Saša,Ševarac V. Zoran

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective:

Understanding and mastering software testing principles, methods and tools.

Learning outcomes:

Students' ability to use contemporary tools and methods of testing in practical and research-oriented projects.

Course structure and content:

Theoretical instruction

Software testing basics and terminology. Key software testing issues. Connections with other software development activities. Testing levels. The subject of testing. The goals (qualification, installation, alpha and beta testing, testing correctness, reliability, evaluation, regression testing, performance testing…). Techniques of testing. Techniques based on tester's experience, program specifications, program code, program errors, program use. Combining techniques. Testing metrics. Program evaluation. Testing evaluation. The process of testing. Testing process management. Test documentation. Testing patterns. Testing activities.

Practical instruction: labs, research study, other instruction

Demonstration of specific application of techniques and methods of software engineering. Practical project.

Literature/Readings:

1, K. Beck Test-Driven Development by Example Addison-Wesley 2002

2, P.C. Jorgensen Software Testing: A Craftsman's Approach CRC Press 2004

The *number of class hours* per *week*	**Lectures:** 3	**Research study:** 4

Teaching methods: Classical teaching or mentoring, depending on the number of registered students.

Evaluation/Grading (maximum 100 points)
Individual practical project / seminar

Course:

Data management technologies

Teacher:Simić B. Dejan,Jovanović V. Vladan

Course status: Elective

ECTS points: **10**

Prerequisites: none

Course objective:

Introduction to the technology of data management, obtaining the knowledge necessary for the effective management, the use of new technology, designing systems which require high data availability and ensure data protection.

Learning outcomes:

Students are prepared to analyze and evaluate data storage technology, as well as to design systems which require data protection and high availability.

Course structure and content:

Data storage technology. Disk technology. *SCSI* technology. *SAN* (*Storage Area Network*) technology. Components of *SAN*. *NAS* (*Network Attached Storage*) technology. Components of *NAS*. Models of memory for data storage. Distributed file systems. General Parallel File System. *Google* File System (*GFS*). *Megastore* organization. Virtualization. Data management. *RAID* technology. High availability of data. Failure analysis. Fault tolerance. Archiving and backup. Business Continuity. Performance Management. Disaster Recovery. Protection and data security. Operating system security. Virtual machine security. Virtualization security. Security attacks. Security services. Security mechanisms. Standards for data encryption. Analysis of selected professional and scientific papers.

Literature/Readings:

21. Dan C. Marinescu, "*Cloud Computing Theory and Practice*", Elsevier Inc., 2013.
22. Zaigham Mahmood, Richard Hill, "*Cloud Computing for Enterprise Architectures*", Springer Verlag London, 2011.
23. G. Somasundaram, Alok Shrivastava, "*Information Storage and Management: Storing, Managing, and Protecting Digital Information*", Wiley Publishing, Inc., 2009.
24. Richard Barker, Paul Massiglia, "*Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs*", Wiley India Pvt. Limited, 2008.
25. William Stallings, "*Cryptography and Network Security: Principles and Practice*", 6th edition, Prentice Hall, 2013.
26. Selected professional and scientific papers

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods:

Lectures. Consultation. Mentoring. Practical work. Solving specific cases. Case studies. Working on projects. Working in teams. Discussion. Methods for distance education. The collection and study of relevant literature with

providing critical review of the resolution of specific problems. Creative workshops.
Evaluation/Grading (maximum 100 points) Analysis of the cases, models or specific practices /Homeworks/Seminar/Project. Oral exam.

Course:

Supply Chain Management - Selected Topics

Teacher:Vujošević B. Mirko,Makajić-Nikolić D. Dragana

Course status: Optional

ECTS points: 10

Prerequisites: none

Course objective:

Introduce students with the strategic importance of supply chains in the modern economy, the main factors and the performances of supply chains, and analytical methods and techniques that are necessary for effective supply chain management.

Learning outcomes:

Understanding modern manufacturing and business phenomena in supply chains, the ability of the modeling and analysis process in supply chains, addressing specific problems, optimization decision-making in supply chains.

Course structure and content:

Introduction to Supply Chain Management. The strategic importance of supply chains in the modern economy. Factors and the performances of supply chains. Analytical methods and techniques that are necessary for effective management of supply chains. Forecasting demand. Physical Planning. Planning of supply and demand. Management of economies of scale - cycle inventory. Managing uncertainty - safety supplies. Determining the optimal level of product availability. Transport. Decisions on locations - network design. Information technology. Coordination in the supply chain. E-business in supply chain. Financial factors that influence the decisions of the supply chain. Software support in supply chain management. Case studies

.

Literature/Readings:

1. S. Chopra, P. Meindl, *Supply chain management – Strategy, planning, and operation*, Prentice Hall, Uppere Saddle River, 2001
2. *Handbook Of Quantitative Supply Chain Management - Modeling in the E-Business Era*, (D. Simchi-Levi, S. David Wu and Zuo-Jun (Max) Shen, Editors, Springer, 2004
3. S. Voss, D.L. Woodruff, *Introduction to computational optimization models for production planning in a supply chain*, Springer Verlag, Berlin 2003
4. M. Vujošević, M. Stanojević, N. Mladenović, *Metode optimizacije – mrežni, lokacijski i višekriterijumski modeli*, DOPIS, Beograd, 1996
5. R. Petrović, A. Šenborn, M. Vujošević, *Hierarchical spare parts inventory*, Elesevier orth Holland, New York, 1986.

The number of class hours per week	**Lectures:** 3	**Research study: 4**

Teaching methods: Depending on the number of students, classes are taught classical and mentoring. Students have

to create a project which is being implemented in consultation with mentor.
Evaluation/Grading (maximum 100 points) Oral examine: 50 Project: 50

Course:

Data Management

Teacher:Marjanović M. Zoran,Aničić M. Nenad,Babarogić S. Slađan

Course status: mandatory for study group Information Systems

ECTS points: 10 points

Prerequisites: none

Course objective:

This course will provide knowledge about management of data as one of the basic resources of organization. Students will examine components of enterprise system data architecture, data configuration and their organization and methods for searching information.

Learning outcomes:

Students will be capable to optimal organize and configure data and to apply methods for optimization and improving performance of database management systems when solving problems in practice.

Course structure and content:

Data management. Characteristics and architecture of database management system. Methods and techniques for design, development and maintaining big databases and data warehouses. Data integrity and transaction management. Comparison between normalized and unnormalized data structures. Comparative analysis of different data models. Components of enterprise system data architecture. Data administration and administration of database management system. Approaches in database implementation. Aspects of optimization, reliability and database management system performance improvement.

Literature/Readings:

1. Date, C.J., An Introduction to Database Systems, Addison-Wesley 2000.
2. Ramakrishan R., Gehrke J., Database Management Systems, McGraw Hill 1999.
3. Elmasri, R.A., Navathe B.S., Fundamentals of Database Systems, Addison-Wesley 2000.
4. Garcia-Molina, H., Ullman J., Widom J., Database Systems - The Complete Book, Prentice Hall 2002.
5. Lazarević B., Marjanović Z., Aničić N., Babarogić S., Baze podataka, FON, Beograd 2010.

The number of class hours per week	**Lectures: 3**	**Research study: 4**	
Teaching methods: Lectures and labs.			
Evaluation/Grading (maximum 100 points)			
Pre-exam requirements	**Points**	**Final exam**	**Points**
Seminar presentation	**50**	Oral exam	**50**

Course:

Business Process Management

Teacher:Radović M. Milić,Slović D. Dragoslav

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective: Training students to apply the process approach, to design business system process model, to create a foundation for process management, process management.

Learning outcomes: By studying the course, students acquire the knowledge and skills to design and establish a system for process management.

Course structure and content:

Business processes and process approach. Process engineering. Design process model. Identifying priority, critical and key processes in the business system. Reviewing, improving and reengineering business processes. Methods and techniques for managing key processes. Creating a basis for process management. Translation objectives of the business system to the process (performance) indicators. Definition of responsibilities for process management. Software support for process management. Process management and integrated software solutions.

Literature/Readings:

1. Harmon, P., "Business process change: a guide for business managers and BPM and six sigma professionals", Second Edition, Elsevier/Morgan Kaufmann Publishers, 2007.
2. Jeston, J., Nelis, J., "Business process management: practical guidelines to successful implementations", Second Edition, Butterworth-Heinemann, 2008.
3. Jeston, J., Nelis, J., "Management by process: a roadmap to sustainable business process management", Butterworth-Heinemann, 2008.
4. Radović, M., Tomašević, I., Stojanović, D., Simeunović, B., " Inženjering procesa ", I edition, FON, Belgrade, 2012.
5. Von Brocke, J., Rosemann, M.: Handbook on Business Process Management I – Introduction, Methods and Information Systems, Springer, Berlin, 2010.
6. Von Brocke, J., Rosemann, M.: Handbook on Business Process Management II – Strategic Alignment, Governance, People and Culture, Springer, Berlin, 2010.
7. Weske, M., "Business Process Management: Concepts, Languages, Architectures", Springer, 2007.

The number of class hours per week	**Lectures:** 3	**Research study:4**

Teaching methods:

Lectures and preparation case study - project "Process management in a particular business system"

Evaluation/Grading (maximum 100 points)

Autonomus preparation and oral presentation of the case study - 50 points

Checking the other theoretical and practical knowledge of the subject - 50 points

Course:

Production and Service Management – selected chapters

Teacher:Lečić-Cvetković M. Danica

Course: Production and Service Management – selected chapters

Teacher: Lecic-Cvetkovic M. Danica

Course status: Elective

ECTS points: 10

Prerequisites: none

Course objective:

The course objective is to capacitate postgraduate students to gain additional knowledge of management of manufacturing/production and services, to evaluate further application of actual information systems and Internet technologies in management of production systems or services, to understand usage of ERP software tools for production and service systems and to be ready for independent researches in field of production and service management.

Learning outcomes:

The course outcome is PhD students' capacity to apply certain knowledge about: 1) actual theoretical and practical solutions for related problems in production and service management; 2) usage of actual software tools and 3) independent approach for further theoretical and practical methods in the filed f production and service management.

Course structure and content:

Theoretical instruction:

Demand forecasting and demand-supply balancing. Production management approach (Make to Stock , Make to Order, Assemble to Order, Engineer to Order, Available to Promise and Capable to Promise). Master Production Scheduling as central part of Manufacturing Planning and Control System. Advance approach to MRP (Material Requirements Planning) and advance DRP (Distribution Requirements Planning) in production/service company. Inventory management from manufacturer perspective: Vendor Managed Inventory and Co-Managed Inventory. Process of SIOP (Sales, Inventory and Operations Planning). Production and service management based on KPIs (Key Performance Indicators). Application of information and Internet technology in production and service management, e-manufacturing and e-service management. ERP and selected softwares for production/service management: MS Dynamic NAV, SAP, SAP BUSINESS ONE, PANTHEON, AUTOMOD, ARIS, EASE, BAAN, ORACLE- ERP. Meta-management and relevant tools.

***Research work*:**

Students will make research on defined problem, collecting relevant data, preparing, analysis and create potential solutions: research results will be presented in relevant Journals and/or relevant Conferences of specific research interests.

Literature/Readings:

1. Halevi G. (2001), *Handbook of Production Management Methods*, Butterworth-Heinemann, Linacre House, Jordan Hill, Oxford, Reed Educational and Professional Publishing Ltd.
2. Kumar S. A., Suresh N. (2008), *Production and Operations Management*, New Age International Ltd.
3. *Timings R., Wilkinson S. (2004),* E-manufacture, *Prentice Hall, Edinburg.*
4. *Todorovic J., Lecic-Cvetkovic D.*, Production management *(in Serbian), FON, Belgrade, 2005*.
5. *Lecic-Cvetkovic D.*, Software for production management – *SAP, Navision, Baan, Oracle, Pantheon, etc (in Serbian), in electronic form, available on: www.om.fon.rs, Belgrade, 2011*.
6. *Omerbegovic-Bijelovic J.*, Metamanagement and quality management *(monography in Serbian), Zaduzbino Andrejevic, Belgrade, 1998.*
7. *Zikmund W., Babin B., Carr J., Griffin M.(2010),* Business Research Methods, *South-Western College Pub, International edition.*

The number of class hours per week: 3+4				**Other classes:**
Lectures: 3	**Labs:**	**Workshops:**	**Research study:** 4	

Teaching methods

Lectures, practical work, labs (software), small groups, creative sessions, team projects, guests speakers, e-data exchange, case and research study.

Evaluation/Grading (maximum 100 points)

Pre-exam requirements	**Points**	**Final exam**	**Points**
Participation in class	10	Oral exam	40
Practical instructions/project/essay	50		

Course:

Software project management – selected topics

Teacher:Devedžić B. Vladan,Lazarević D. Saša

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective:

Introduction to models and techniques of software project management. Understanding and mastering the process of software project management in everyday's software development process.

Learning outcomes:

Student's capability to understand software project management at four levels: individual, team, company/enterprise and virtual environments. Practical experience in applying the process of software project management.

Course structure and content:

Traditional software processes
Agile software processes
Software metrics
Individual management of software development
Managing software development in a team
Relationship between software project management and other areas of software engineering
Validation, testing and performance measurement in a software process
Tools for managing software development projects

Literature/Readings:

- M.K. Chemuturi and T.M. Cagley Jr., Mastering Software Project Management: Best Practices, Tools and Techniques, J. Ross Publishing, 2010.
- R.K. Wysocki, Effective Project Management: Traditional, Agile, Extreme (6th edition), Wiley, 2011.
- Project Management Institute, Software Extension to the PMBOK Guide, 2013.

The *number of class hours* per *week*	**Lectures:** 3	**Research study:** 4

Teaching methods: Classical teaching or mentoring, depending on the number of registered students.

Evaluation/Grading (maximum 100 points)

Individual practical project / seminar

Course:

Fuzzy logic and systems - selected topics

Teacher:Radojević Dragan

Course status: Compulsory

ECTS points: 10

Prerequisites: none

Course objective:

The course objective is to enable each student to enhance quantitative scientific reasoning about problems related to modeling of uncertainty, imprecision and incompleteness and its application to real world business problems in organizational systems.

Learning outcomes:

The acquired knowledge of the concepts of fuzzy theory will enable students to apply appropriate approach for modeling and solving real business problems in organization systems. Students are also enabled to build complex control systems on the basis of fuzzy logic and its consistent generalization based on interpolative Boolean algebra.

Course structure and content:

The course is organized in the form of traditional mentoring for the selected research topics but not limited to:

Consistent generalization of Boolean logic based on interpolative Boolean algebra, Control theory - fuzzy approach, Uncertainty theory - fuzzy approach, Fuzzy modeling, Approximate reasoning, Fuzzy pattern recognition, Fuzzy clustering, Fuzzy decision making and modeling consensus, Neuro-fuzzy systems, Fuzzy time series, Fuzzy search and databases, Fuzzy statistics.

Literature/Readings:

1) J. Kacprzyk, Multistage Fuzzy Control : A Model-Based Approach to Fuzzy Control and Decision Making, Wiley, 1994.

2) R. R. Yager, D. Filev, Essential of Fuzzy Modelling and Control, Wiley, 1994.

3) G. J. Klir, B. Yuan, Fuzzy Sets and Fuzzy Logic – Theory and Applications, Prentice Hall, 1995.

4) J. Lai, C.-L. Hwang, Fuzzy multiple objective decision making: Methods and applications, Springer, 1996.

5) D. Radojević, [0,1]-valued logic: A natural generalization of Boolean logic, Yugoslavian Journal of Operational Research - YUJOR, 2000.

6) D. Radojević, Interpolative Relation base for Graduation and/or Fuzziness, In: Forging New Frontiers: Fuzzy Pioneers II Studies in Fuzziness and Soft Computing, Springer-Verlag, 2007.

7) D. Radojević, Real Sets as Consistent Boolean Generalization of Classical Sets, In: From Natural Language to Soft Computing: New Paradigms in Artificial Intelligence, Editing House of Romanian Academy, 2008.

The number of class hours per	**Lectures:**	**Research study:**

week	3	4
Teaching methods: Lectures, Reaserch project, Mentoring		
Evaluation/Grading (maximum 100 points) Seminar paper (30%), written exam (30%), project presentation (40%)		

Course:

Financial Management – selected chapters

Teacher:Žarkić-Joksimović A. Nevenka,Benković S. Slađana

Course status: elective

ECTS points: 10

Prerequisites: none

Course objective:

The aim of the course is theoretical and practical understanding of the advanced principles, methods, techniques and procedures of financial management in business systems. Particular emphasis is on applying financial and investment strategies in real economic environment.

Learning outcomes:

Improvement of theoretical and practical knowledge in the field of financial management and consequent improvements in appropriate decision-making on investments and financing in business systems.

Course structure and content:

Theoretical part

Financial functions in the company. The aims and objectives of financial management. Financial markets and participants in the financial markets. Institutional and economic environment and the financial operations of the company. Investment policy. Financing policy. Dividend policy. Financial Planning. Analysis of financial statements. The management of working capital. Liquidity management. Valuation of the company. Mergers and acquisitions. International Financial Management.

Exploratory part

Research part includes practical application of methods, techniques, procedures and instruments of financial management. The student is required to examine specific issues in the field of financial management and to present its proposals for a solution in the form of a seminar paper.

Literature/Readings:

[1] Žarkić Joksimović N, Benković S, Milosavljević M: *Finansijski menadžment*, FON, Beograd, 2013.
[2] Copeland T. Weston J: *Financial Theory and Corporate Policy* [fourth edition], Pearson Education, 2004.
[3] Mishkin F. Eakins S: *Financial Markets and Institutions* [fifth edition], Pearson International Education, 2009.
[4] Coppeland T. Koller T. Murrin J: *Valuation – Measuring and Managing the Value of Companies*, Wiley Finance, 2000.
[5] Bekaert G. Hodrick R: *International Financial Management*, Prentice Hall, 2009.
[6] Hopper T. Northcott D. Scapens R: *Issues in Management Accounting*, Prentice Hall, 2007.

The number of class hours per week	**Lectures:** 3	**Research study:** 4

Teaching methods: Lecturing and mentoring. Students are actively involved in the educational process through interactive discussion, practical work, homework, case studies and workshops.

Evaluation/Grading (maximum 100 points)

Course: Research proposal
Teacher: All teachers involved in the study program
Course status: Mandatory
ECTS points: 30
Prerequisites: /
Course objective The main objective is to prepare students for independent research work on his doctoral dissertation, and the case study can be viewed as the first phase of doctoral thesis. With the help of mentors, students will be prepared that, with the conquest necessary scientific research methods and instruments, and with the application during the study gained extensive and deep scientific-professional and professional application of knowledge, on the eve of a specific current problem, set a plan and expose its resolution. Defence accession, the student acquires 30 ECTS.
Learning outcomes The outcome of the course the student is qualified for independent research work in the electoral area. Who is able to find an available and accessible scientific literature that analyzes and to prepare a comparative review of existing approaches and solutions. Student is able to set its own criteria for critical evaluation of existing solutions and that in this sense the eve of the advantages and disadvantages of such solutions. Is capable on the basis of the previous analysis on the eve of a current problem for the studied scientific field it believes may be over independent research to provide significant scientific contributions. Student is able to describe the form of the expected scientific contributions, exposed to initial hypotheses and the expected scientific results. Also, is able to specify the basic research methods that will be used in solving the problem and to explain their choice, indicating the research plan with the planned implementation schedule, indicating the outline of the content of work as presenting the research results and the literature indicate that you will use in the study.
Course structure and content After passing all exams and gaining 90 ECTS, the student chooses a mentor and with the active support of SIR conducted in the laboratory or research centre of the Faculty. Student explores the problem which is the subject of his interest. The specific content of the work depends on the chosen electoral areas. Access work on doctoral studies should be structured so that the student demonstrate extensive knowledge and deep understanding of the problem in the part of the study area that is studied in doctoral studies, so it will spread based on a comprehensive literature review of the identified problems in a given scientific field, as well as known ways of solving these problems; provide their own critical review of the presentation described the problems and solutions; identify the actual problem, or problems in the scientific field that would conduct independent research and the goals you would like to accomplish these studies; exposed form of the expected scientific contribution (new model, new equipment, new approach, ...); exposed initial hypotheses and the expected scientific results, indicate the basic research methods that will be used in solving the problem and to explain their choice; specify the research plan (research phase, the use of research methods in individual aspects of research) with the proposed implementation schedule, indicating the outline of the content of work as presenting the research results (at least to the level of the sections in the chapters, preferably up to the third level of the hierarchy), indicating the literature that will be used in the study.
Literature/Readings
Number of classes:

Lectures: 2	Research study:18

Teaching methods

Rules on doctoral studies of the Faculty contains detailed application process, workflow and defense of the access operation. After consultation with the prospective mentor candidate submits a wider research topic Chamber of the faculty. Larger evaluates and determines the suitability of topics mentor. Once approved topic, a student in the laboratory or research center explores the theme with the help of mentors, where is mandatory to use the literature indicated that his mentor. Periodically in consultation with the supervisor checks the student's progress and if necessary further directs. Student if necessary perform certain measurements, tests or statistical data. Access work is defended before a panel that determines the evening after reports of mentors that work zabršen. Defended the access operation is a requirement for applying for a doctoral dissertation.

Evaluation/Grading (maximum 100 points)

Research proposal (50 points)

Defense research proposal (50 points)

Course: Final exam	
Teacher: All teachers involved in the study program	
Course status: Mandatory	
ECTS points: 60	
Prerequisites: /	
Course objective Doctoral dissertation should be an original and independent scientific work, which contributes to the development of scientific thought, and that the methodology of treatment and the degree of contribution to science is suitable for determining a candidate's ability to act as an independent researcher in the selected field of science.	
Learning outcomes The student is qualified for independent scientific research in order to solve the problem. Student is able to find an available and accessible scientific literature that analyzes and to prepare a comparative review of existing approaches and solutions. Student is able to set its own criteria for critical evaluation of existing solutions and that in this sense the eve of the advantages and disadvantages of such solutions. Student is able to identify and formally put the problem in the domain of the attached. Student is able to describe the shape of the expected scientific contributions, exposed to initial hypotheses and the expected scientific results. Capable of using different research methods in solving the problem, to explain their choice, set research plan and determine the implementation schedule.	
Course structure and content Student explores the problem which is the subject of his interest, addresses the results obtained during the research and presents them in a format suitable for publication. The specific content of the doctoral thesis depends on depends on the considered problem, research methods, processing of results and ways of interpretation and presentation of findings.	
Literature/Readings	
Number of classes:	Research paper: 20
Teaching methods	
Evaluation/Grading (maximum 100 points) Working on thesis: 50 points Thesis defense: 50 points	