COURSE CATALOG

Information for incoming students
applying for 2022/23 at FOI UNIZG

\ Foreword \ Guidelines \List of Courses

Faculty of Organization and Informatics
University of Zagreb

FOREWORD

Exchange students (coming via Erasmus+ programme, bilateral cooperation and freemovers) should choose courses from the list below containing **all courses** at the **Faculty of Organization and Informatics (FOI), University of Zagreb (UNIZG)** that are taught in English. Aside courses, students can enroll in one or more **short intensive programmes (workshops)**.

Exchange students who can prove that they have a sufficient knowledge of the Croatian language can be allowed to take courses that are taught and examined in Croatian.

This list can still undergo changes until the start of the semester, but it can be used as a guideline for putting together an acceptable **Learning Agreement (LA)** for Erasmus+ and other applicants. The Learning Agreement can still be changed upon arrival.

Students who would like to write a **final thesis**, need to find a lecturer at our Faculty who accepts to be their mentor before the application deadline. Please contact us for more information on this possibility.

Most of the short intensive programmes (workshops) will be organized in summer (second) semester. Students can enroll in one or more workshops (maximum 3).

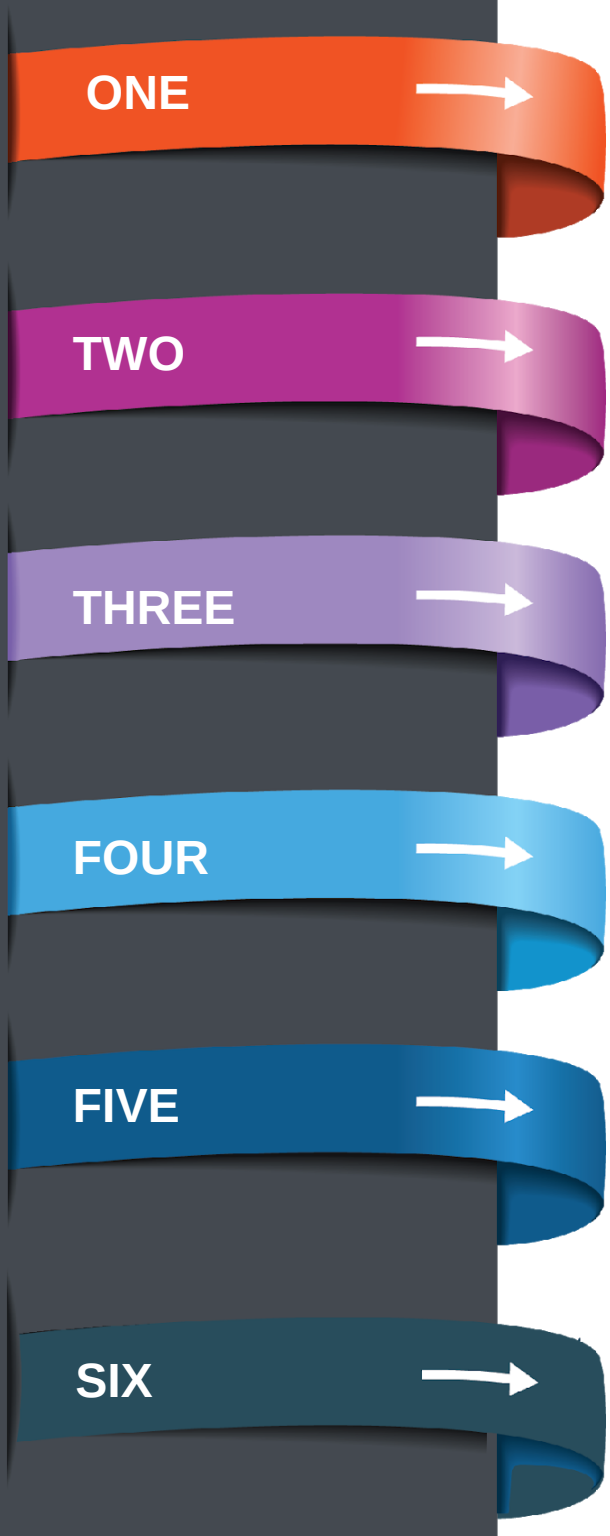
While in Croatia, you might want to learn the basics of the Croatian language, or get acquainted with Croatian history, geography, natural and cultural heritage. If interested, you can enroll in our 10-hour interactive workshop called **Croatian language and culture workshop**.

CONTACT

For more information about the courses and workshops please contact:

- **FOI ECTS coordinator** (academic advisor) – Asst. Prof. Martina Tomičić Furjan, Ph.D., ects.coordinator@foi.unizg.hr
- **FOI International Relations Office**, international@foi.unizg.hr

GUIDLINES



We advise exchange students to take around 30 ECTS credits per semester.

The courses are selected by bachelor and master programme, informatics or economics study programme, but exchange students can take courses from the different study programmes and study level.

Always check the prerequisites of each course (by clicking on the course description), to see whether you have enough previous knowledge to follow the course successfully.

For more information about the course (content, prerequisites, evaluation etc.), please click on the course description or search the course on FOI website.

If you miss some information about the course or a workshop that you would like to take, please contact FOI ECTS coordinator (academic advisor).

Most of the courses are offered as blended learning courses. Therefore, students can use LMS to study some of the course materials.

LIST OF COURSES

Course title: ANALYSIS OF BUSINESS DECISIONS

Lecturers	Nikola Kadoić Nina Begičević Ređep
Language of instruction [Croatian / English]	Croatian and English
Study level [Bachelor / Master]	Master
Study programme	Economics of entrepreneurship
Semester [Summer / Winter]	Winter
ECTS [number]	6
Goal	To train students to analyze business decisions in conditions of security, uncertainty and risk, and to apply methods and tools that are characteristic of the analysis of business decisions. The student is expected to acquire sufficient knowledge to be able to recognize and apply a certain method and tool for analyzing decision-making problems and give a proposal for a business decision in a real situation, given the available information.
General and specific learning outcomes	/
Content	1. Introduction to methods for decision making 2. Return on investment analysis 3. Forecasting methods 4. Basic methods for decision-making under uncertainty and risks 5. Decision-making tree 6. Bayes theorem 7. Risk matrix 8. Sensitivity analysis 9. Introduction to multi-criteria decision-making methods 10. Analytic hierarchy process 11. Analytic network process 12. Electra 13. Topsis 14. Decision support systems
Exercises	Exercises are implemented in MS Excel and follow the lectures. See Content.
Realization and examination	Tests, project, homework, different activities at class.

Related courses	-
Literature	LMS Moodle

Course title: ECONOMICS FOR ENTREPRENEURS

Lecturers	Vladimir Kovšca Zrinka Lacković Vincek Ivana Dvorski Lacković
Language of instruction [Croatian / English]	English
Study level [Bachelor / Master]	Master
Study programme	Economics of Entrepreneurship
Semester [Summer / Winter]	Winter
ECTS [number]	6
Goal	Main aim of this course is to help students develop economical way of thinking and reasoning and to provide them with basic knowledge of economics and economics of business systems. Within this basic goal, this theme is systematically elaborated in relation to the basic unit of economy – the firm – starting with the firm's establishment, through its inclusion in the economic system and its interactions within this system, to its functioning and business evaluation.
General and specific learning outcomes	1. Analyse and evaluate business performance and suggest business system improvements. 2. Identify and understand relevant factors that affect the business operation of an organization and individuals, and apply basic methods and concepts of business planning, management and accounting. 3. Keep track of professional literature in Croatian and a foreign language, prepare and independently deliver presentations in Croatian and a foreign language to professional and general public, and critically evaluate a presented professional topic.
Content	1. Introduction to economics. Classification of economics on microeconomics and macroeconomics. Connection and conditioning of economics as theoretical science with practical problems. Monetary and fiscal policy. Gross domestic product. (2 hours) 2. Basic concepts of price modelling. Demand and supply. Price elasticity of demand. Market structure and price. Perfect competition. Monopoly. Oligopoly. Price policy. Determining price based on costs. Determining price based on demand. Target costs and prices. (2 hours) 3. Definition of company. Role of company in development of economic and social development of society. Foundation of a company and regulatory

framework. Models of companies. Types of business activities. Criteria for company division. Structure of companies in Croatia. (2 hours)

4. BASIC AIMS OF COMPANIES' ACTIVITIES. Traditional company theory. Behavioural company theory. Agency theory. Theory of transaction costs. Evolution theory. (2 hours)
5. Business result and financial reporting. Basic financial reports (balance sheet, profit and loss account, cash flow statement). Determining company performance. Financial indicators (rentability, investment, debt, liquidity, stability). New measures of business performance. Measures oriented on managing company value. (2 hours)
6. Principles of rational business activity. Analysis of production and productivity. Productivity as a measure and criteria. Analysis of economic and technical features of production. Measures for improving production and productivity. Profitability analysis. Analysis of income and outcome. Measures for improving cost effectiveness. Production rentability. Measures for improving business result. Interaction of company performance indicators. (2 hours)
7. Basic costs concepts. Difference: costs, expenditure. Division of costs. Natural sorts of costs. Costs according to dynamics. Fixed costs. Variable costs. Decreasing, increasing and constant returns. Critical points in costs behaviour. Costs remanence. Costs reagibility. Costs in long term. Economies of scale. The learning curve. Contemporary costs concepts. (2 hours)
8. Separating costs on fixed and variable costs – basis for business decisions and costs forecasting. Methods of costs separation. The variator method. The interpolation method. The regression line method. Costs estimation. Contribution analysis (business decisions based on marginal costs). (2 hours)
9. The break-even point. Graphical representation of break-even point. Determining target profit. The safety rate. Influence of changes in prices of factors, quantity and fixed costs on break-even point. Empirical application of the break-even point. Operational lever. (2 hours)
10. Calculations. Types of calculations in business decision making. Direct and indirect costs. Calculations in trade, Calculations in project cost management. Calculations of product price. Functional system of cost accounting. Methods of calculations in functional costs accounting. Division and additional calculations. (2 hours)
11. Activity Based Costing (ABC method). Rationale for ABC method in costs management. Identification of activities. Association of costs and activities. Determining factors of dissipation. Problems in ABC system introduction. Comparison of functional and ABC system of cost management. (2 hours)
12. Types of plans. General plan. Sales plan. Production plan. Direct costs plan. General production costs plan. General management and sales plan. Soled products plan. Planned report on cash flow. Planned profit and loss account. Planned balance sheet. (2 hours)
13. Internal and external conditions in business policy making. Analysis of technological, social, demographical, economic and political factors. Development policy. Expansion. Diversification. Integration. Conversion. Contraction. (2 hours)

	14. **Economic laws in business activities.** The law of minimum and maximum. Law of optimum. Law of increasing returns and mass production. Law of decreasing returns. Substitution law. Transport costs and location law. (2 hours) 15. **Basic concepts of market economy.** Marketing as business philosophy. Marketing management. Segmentation, targeting market and positioning products. Marketing mix. Product, price, place, promotion. (2 hours)
Exercises	Exercises are highly practical and follow the theoretical part of Syllabus. Each exercise term is dedicated to solving practical calculative assignments and applying theoretical concepts on business examples.
Realization and examination	The course is taught in English through Lectures and Exercises. Students are obliged to make a presentation on the topic related to the course. There are regular calculative assignments that students are obliged to solve. Two exams are solved through semester. Final grade is the product of all the above activities.
Related courses	Managerial economics
Literature	1. Dvorski, S., Kovšca, V., Lacković Vincek, Z.: Ekonomija za poduzetnike - uvod u poslovnu ekonomiju, TIVA - Tiskara, Varaždin, 2018. 2. Dominick, S.: Managerial Economics in a Global Economy, Oxford University Press, 8th Revised edition, 2015. 3. Moodle materials

Course title: ORGANIZATIONAL BEHAVIOR

Lecturers	Asst. Prof. Ivan Malbašić, Ph.D., Nikolina Posarić, M. Econ.
Language of instruction:	Croatian and English
Study level	Master
Study programme	Economics of Entrepreneurship
Semester	Winter
ECTS	6
Goals	• Apply the skills of organizational behavior • Understand the contents and characteristics of organizational values • Understand the importance of motivation in the organization • Perceive connections between the elements of organizational behaviorand performance of the organization • Valorize the role of individuals and groups in the organization • Valorize the importance and steps of organizational changes and managestress • Evaluate work performance and implement reward systems • Identify and apply the skills of organizational behavior for the successfulfunctioning of enterprises
Content	1. What is organizational behavior (OB)? The role of organizational behavior in management. Defining organizational behavior. Disciplines that contribute to the organizational behavior field. Challenges and opportunities for organizational behavior. Developing an organizational behavior model. 2. Organizational behavior in a global context The world as a global village. Multinational corporations. Examples of cooperation between countries. Assessment of differences between countries. Culture research concepts. 3. Organizational values What are these values (in general)? The importance of values. Historical aspect of organizational values. Defining organizational values. Types of organizational values. Balanced organizational values. Functions of organizational values. The impact of organizational values on organizational effectiveness.

	4. Foundations of individual behavior Individual differences and organizational behavior. Biographical characteristics. Abilities. Personality. Perception. Opinions. Feelings and moods. Learning. 5. Importance and understanding of motivation Defining motivation. Early theories of motivation. Contemporary theories of motivation. Integrating contemporary theories of motivation. The importance of motivation: implications for managers. 6. Designing jobs that motivate Motivation: from concepts to applications. The Job Characteristics Model. Alternative work arrangements (flextime, job sharing, telecommuting). Determining employee performance. Employee involvement and participation. Creating a purpose-driven organization. 7. Group dynamics in organizational behavior Defining and classifying groups. Why do people join groups? Stages of group development. Group properties (roles, norms, status, size and dynamics, cohesiveness, diversity). Group decision making. 8. Performance evaluation and reward systems What is performance? Purposes of performance evaluation. What do we evaluate? Who should do the evaluation? Methods of performance evaluations. Improving performance evaluations. Providing performance feedback. Using rewards to motivate employees. 9. Conflicts in the organization A definition of conflict. Transitions in conflict thought. Differentiating functional from dysfunctional conflicts. The conflict process—Stage I: Potential Opposition or Incompatibility, Stage II: Cognition and Personalization, Stage III: Intentions, Stage IV: Behavior, Stage V: Outcomes. Conflict and group effectiveness. 10. Organizational change and stress management Forces for change. Approaches to managing organizational change. Resistance to change. Creating a culture for change. Stress at work. Consequences of stress at work. Managing stress. 11. Organizational culture What is organizational culture? Do organizations have uniform cultures? What do cultures do?—The functions of organizational culture. Creating and sustaining culture. How employees learn culture? Influencing an organizational culture—an

	ethical culture, a positive culture, a spiritual culture. 12. Group and teamwork Why have teams become so popular? Differences between groups and teams. Types of teams. Creating effective teams. Turning individuals into team players. When are teams the right solution? 13. Power and politics in the organization Power and leadership. Bases of power. Dependence: the key to power. Power tactics. How power affects people? Politics: power in action. Causes and consequences of political behavior.
Seminars	Students should actively participate in seminar classes, positively solve two colloquies during the semester, exhibit solutions to particular problems in classes, and actively participate in the task project on the specific topic of identification and problem solving in given organizations in practice.
Preconditions	-
Realization and examination	Classes: Lectures and seminars Exam: Written and oral exam and seminars
Related courses:	1. California State University Channel Islands—Course: ORGANIZATIONAL BEHAVIOR 2. The London School of Economics and Political Science—Course: ORGANISATIONAL BEHAVIOUR 3. Faculty of Economics and Business, University of Zagreb—Course ORGANIZATIONAL BEHAVIOR
Literature	Basic: 1. BOOK—Robbins, S. P., Judge, T. A. (2018). Organizational Behavior, 18th Edition, Pearson. 2. LECTURE MATERIALS—available on FOI e-learning system. Additional: Any other book on organizational behavior & management
Online sources:	1. Organizational Behavior Division at the Academy of Management (http://obweb.org/hom) 2. European Academy of Management (https://euram.academy) 3. International Society for the Study of Work & Organizational Values (https://www.isswov.net)

Course title: SMALL AND MEDIUM ENTERPRISE IN THE EU

Lecturers	Full Prof. Ksenija Vuković, Ph.D., Tamara Šmaguc, Ph.D., Ivana Fojs, M. Econ.
Language of instruction:	Croatian and English
Schedule:	60 teaching hours - 4 hours per week (2 hours lectures + 2 hour seminar)
Study level	Master
Study programme	Economics of Entrepreneurship
Semester	Summer
ECTS	5
Goal	The aim of the course is to enable students to critically analyse local, regional and national SME policy in more integrated EU environment.
Content	1. Introduction Introducing the course content and agree on the way of work. Economic fundamentals of the EU. Strategic orientation and common economic policy measures. Development and importance of SMEs for the EU economy. Introduction to the principles, conception and implementation of EU policy related to the development and support of the EU SME sector. (2 hours) 2. Economy as a set of different sizes enterprises. Enterprise size distribution in economic theory. Conventional-technological approach to enterprise size. Implications of transactional cost theory on the enterprise size distribution. Imperfect competition and size of the enterprises – theory approach on developed EU industrial organization switch. Dynamic models and enterprise sizes. (2 hours) 3. Growth of SMEs. Fast growing enterprises. Growth traps and sustaining growth problem. Obstacles to the growth of small enterprises. SMEs growth in the EU. (2 hours) 4. Productivity of SMEs. The importance of the business innovation and internationalization for the enterprise and economy. The relation between productivity, innovation and internationalization of SMEs. (2 hours) 5. SMEs in different individual EU countries. Distribution of enterprises, employees and market shares in EU countries. Enterprise size distribution by industries. The position of small enterprises in the Croatian economy. Distribution of employees, market shares and profits. Small enterprises distribution by activities in the Croatian economy. (2 hours) 6. Position of medium-sized enterprises in the Croatian economy. Distribution of employees, market shares and profits. Distribution of medium-sized enterprises by activities. EU support policy for SME sector: incentives for the development and competitiveness of the SME sector. European Charter for small

	enterprises: ten basic principles for implementing entrepreneurship incentives at EU and member state level. Green paper on entrepreneurship. (2 hours) 7. EU support strategy for creating entrepreneurial culture and entrepreneurial mindset. The role of educational institutions in shaping the entrepreneurial mindset. EU strategy to encourage individuals to become entrepreneurs. Reducing the stigma of failure. Supporting business transfer. Social security for small business owners. (2 hours) 8. EU Strategy on supporting women and national minorities in entrepreneurship and the participation of small businesses in national market and creation of innovative clusters. Facilitating access to EU funding sources for SMEs. (2 hours) 9. Entrepreneurship in selected areas of entrepreneurship: rural entrepreneurship, entrepreneurship in agriculture, youth entrepreneurship, family entrepreneurship and crafts, ICT entrepreneurship. Encouragement policies for selected areas of entrepreneurship. 10. A strategy to help EU SMEs utilize the opportunities provided by the EU single market and promote the promotion of knowledge and skills in SMEs as well as other forms of innovation. The business environment and market mechanisms failures. (2 hours) 11. A strategy for creating a public administration that responds to needs of SMEs. Examples of good practice in EU SME support policy. Social entrepreneurship in the EU. (2 hours) 12. Entrepreneurial indicators. Structural indicators of entrepreneurial population. Entrepreneurial performance. Determinants of entrepreneurship. Micro and macro determinants of entrepreneurship. Determinants on the supply side. Determinants on the demand side. (2 hours) 13. Entrepreneurship in Croatia. Entrepreneurship indicators in Croatia: results of the GEM (Global Entrepreneurship Monitor) survey. Examples of good practice in fostering entrepreneurship. Enterprises with growth potential. Attributes of people who initiate entrepreneurial ventures in Croatia. Motives for starting your own business in Croatia. (2 hours) 14. The importance of entrepreneurship in Croatia from the employment point of view. Unemployed people and self-employment opportunities. Distribution of entrepreneurial capacities by regions of the Republic of Croatia. Croatia's entrepreneurial activity in terms of international and European perspective. Insufficient export orientation. (2 hours)

	15. SME incentive programs in Croatia. Objectives and implementation. Strengthening competitiveness. Improving the quality of entrepreneurial infrastructure. Even regional development. Reducing administrative barriers. Creating an entrepreneurial climate. Helping SMEs in Croatia find cooperate opportunities and prepare to enter the EU market. (2 hours)
Realization and examination	Classes: Lectures and seminars Exam: Written and oral exam and seminars
Literature	Basic: Družić, G. Croatian economic development and the EU (Gospodarski razvoj Hrvatske i EU), Školska knjiga, Croatian Academy of Sciences and Arts, Zagreb, 2009. Kandžija, V., Gospodarski sustav Europske unije, Ekonomski fakultet Rijeka, Rijeka, 2011. Additional: European Commission, Think small first, A small business act, 2008 Select Committee on the European Union: The Commission's Green Paper: Entrepreneurship in Europe, with Evidence, published by Authority of the House of Lords, London – the Stationery Office limited, 2003 Europska komisija: Europska povelja o malom gospodarstvu (European Charter for Small Enterprises) Singer, S., What Makes Croatia an Entrepreneurial Country, Results of GEM Croatia Research, Zagreb, 2006. Mcdonald, F., Dearden, S., European Economic Integration, 4. Izdanje, 2004. Kovačević, Z., Restrukturiranje hrvatskih poduzeća, Politička kultura, Zagreb, 2001. Kandžija, V. Gospodarski sustav Europske unije, Ekonomski fakultet Sveučilišta u Rijeci, Rijeka, 2003.

Course title: INSTITUTIONAL INVESTORS

Lecturers	Full Prof. Marina Klačmer Čalopa, Ph.D. Ivana Đunđek Kokotec, Ph.D.
Language of instruction [Croatian / English]	Croatian and English
Study level [Bachelor / Master]	Master
Study program	Economics of Entrepreneurship
Semester [Summer / Winter]	Summer
ECTS [number]	5
Goal	This course aims to acquaint students with the characteristics, operations, and reasons for the expansion of institutional investors (investment funds, pension funds, insurance companies). Each group of institutional investors has its specifics, which students will get to know through the teaching material. Through a theoretical and practical approach (guest lecturers from each financial sector), students acquire fundamental knowledge and get acquainted with the techniques used in the business and management of institutional investors. Knowing the business of institutional investors is extremely important for future entrepreneurs and managers because it simplifies the process of transferring financial resources.
General and specific learning outcomes	<u>Learning outcomes / Level of the Study program</u> 1. Identify and analyze the characteristics of institutional investors and their role in small, medium, and large companies. 2. Explain the role of institutional investors in implementing the practice of corporate governance and their importance for the development of small, medium, and large companies. 3. Apply knowledge of the financial market and financial indicators to manage institutional investors and their portfolios successfully. <u>Learning outcomes / Level of the Course</u> 1. Understand and critically discuss the role of institutional investors in the financial market. 2. Explain the interaction between institutional investors and businesses. 3. Identify and critically evaluate the risk in alternative sources of investment. 4. Discuss advantages and investments limitation in a specific form of the institutional investor.

	5. Analyze and evaluate the institutional investor's return on investment in a particular form. 6. Apply investment methods and techniques with the aim of best allocating financial resources. 7. Present the acquired knowledge and results of the analyses of institutional investors to entrepreneurs and managers and experts from individual, specific financial sectors.
Content	1. Institutional investors (2h) – Introduction to the course – goals and purpose of the course, literature, and students' obligations. Conceptual definition of institutional investors. Market trends. Classification of institutional investors and their characteristics. Comparative analysis of institutional investors in the Republic of Croatia and other post-transition countries. 2. Financial intermediation (2h) – banco-centric vs. market-centric financial systems. The need for financial intermediation. Transfer of financial resources from surplus to the deficit sector. Financial intermediation and its role. Classification of the financial intermediaries - depository institutions (banks), contractual savings institutions (pension funds, insurance companies), investment intermediaries (investment companies, investment funds). The economic function of financial intermediaries. 3. Institutional investors management (2h) – Financial system analysis. Structure of financial institutions. Alternative investment forms. Classification of investors into individual and institutional investors. Principal-agent problem, in terms of the agency theory in the context of institutional investors. Foreign institutional investors and their impact on the ownership structure of the small, medium, and large companies. 4. Investment funds (4h) – definition of the investment fund. Development of investment funds globally and in the Republic of Croatia and their perspectives for the future. Privatization of investment funds and their successors. Changes in the legal regulations of investment funds activities in the Republic of Croatia. Institutions of supervision of investment funds in the Republic of Croatia (The Croatian Financial Services Supervisory Agency (Hanfa); Zagreb stock Exchange (closed-end type of funds). The role of deposit bank. Classification of funds – open and closed types of investment funds. Essential characteristics of each type of investment fund. Investment fund management companies and their organization (UCITS, AIF). Fund managers and their roles. Advantages and disadvantages of investing in investment funds. Investment strategy. Investment fund asset structure. Calculation of net asset value (NAV) of the investment funds. 5. Classification of investment funds (2h) – comparative analysis of open-end (equity, mixed, bond, and money market funds) and closed-end investment funds in the Republic of Croatia and the world. Investment fund analysis in transition and post-transition counties. Differences in the legal framework for managing the institutional investors in the Republic of Croatia and worldwide. Investment strategies in the particular type of fund

and allocation of fund assets. Investment funds costs and fees. Investment fund selection from the aspect of the investors. (small investor or institution investor).

6. Real estate funds and venture capital funds (2h) – REIT. Analysis of REIT funds in the world and the Republic of Croatia. REIT investment structure. Interaction between business and venture capital funds. Venture capital. Venture capital is a driving force of economic development. Creating preconditions for the inclusion of venture capital. Venture capital funds in the Republic of Croatia. The legal framework of REIT and venture capital funds.

7. Hedge and index funds (2h) – introduction to modern investment instruments with portfolio diversification – options, futures. Hedge funds investment goals and strategies—analysis of the hedge funds in the US and EU. Prerequisites need to develop hedge funds in the Republic of Croatia – development of the capital market and its infrastructure. Index funds investment goals and strategies. ETFs. Analysis of index funds in the world and the Republic of Croatia.

8. Pension reform (2h) – development of the pension system through history. Pension reform in the Republic of Croatian and the world. Comparative analysis of pension reform in the Republic of Croatian and other post-transition countries. Social security. Institutions in the Republic of Croatia are responsible for implementing pension reform and the pension system (Central Registry of Insured Persons (REGOS)). Pension insurance companies. Legislation on pension reform and the pension system in the Republic of Croatia.

9. Pension funds (2h) – definition of pension funds. Classification of pension funds – mandatory and voluntary pension funds. Investment principles. Pension fund investment rules. Pension funds investment strategies. Membership in the pension fund. Analysis of pension funds in the Republic of Croatia according to the three-pillar pension system – pension form a second and third pillar. State of capitalized pension insurance. Pension fund supervision (The Croatian Financial Services Supervisory Agency (Hanfa)).

10. Insurance companies (4h) – definition of insurance companies. Development of the insurance companies in the Republic of Croatia and the world. Comparative analysis of the insurance and its companies in the Republic of Croatia and other post-transitional counties. Purpose and types of insurance. Development of new insurance products and services. The insurance market in the US and EU. Insurance legislation in the Republic of Croatia. Insurance company's supervision (The Croatian Financial Services Supervisory Agency (Hanfa)). The importance of insurance companies in the financial sector. Profitability of insurance companies. Financial risks in the business of insurance companies. Insurance company’s investment strategies. Changes in the business of the insurance companies.

	11. Investment banking (2h) – basics and history of investment baking. Definition of investment banking. Bank as an institutional investor. Analysis of the investment banks in the world. Investment banking operation – Initial privet offering (IPO). Crises caused by investment banking activities – subprime mortgage crisis. Organization of banks in the Republic of Croatia – the existence of investment banks. Practice and activities of investment departments in the Croatian banks. 12. Investment portfolio management (2h) – analysis of portfolio management theories – Markowitz Model, Capital Asset Valuation Model (CAPM), Arbitration Valuation Theory (APT), Post-modern Portfolio Management Theory – assumption and its elements. Macroeconomic impact on the investment portfolio structure. 13. Guest lecturers from practice (2h) - Analysis of examples from practice.
Exercises	Regular class attendance and active teaching, preparation of seminars and individual assignments, group work (team), participation in the work through the e-learning system (downloading assignments, storing seminar papers and individual assignments, etc.). As part of the exercises, students will be required to prepare a project task. They will have to analyze the observed financial sector, study the cost-effectiveness of establishing and managing the observed institutional investor, and propose investment policies and strategies and institutional investor development strategies.
Realization and examination	Regular monitoring of students at lectures and seminars, estimates of their seminar works and critical papers, testing thought the semester (2 colloquiums). The system for e-learning will be used to monitor the efficacy of students' work. The final evaluation of the teaching process and teachers will be done at the end of the semester. Students will be able to comment on the content, teaching methods, and literature for this course. Teachers will use the evaluation forms for improving their teaching process. The Universities' student survey will be used.
Related courses	Financial Institutional and Markets Corporate Finance Personal Finance Corporate Governance
Literature	1. Kidwell, D.S.; Peterson R.L.; Blackwell D.W.; Whidbee, D.A.; Financial institutions, markets and money, John Wiley & Sons, Inc, England, 2003 2. Davis, D. P.; Steil, B.: Institutional Investors, Cambridge: MIT Press, 2001.

Course title: INTERNET MARKETING

Lecturers	Full Prof. Damir Dobrinić, Ph.D., Asst.Prof. Iva Gregurec, Ph.D.
Language of instruction [Croatian / English]	English
Study level [Bachelor / Master]	Master
Study programme	Economics of Entrepreneurship
Semester [Summer / Winter]	4th
ECTS [number]	4
Goal	The Internet is becoming a very significant promotional sales medium with several specific advantages expressed through low costs and the ability to engage in interactive communication with consumers. Basically, these are significant advantages over other forms of communication, which result in its greater use in all areas of social and economic activity. The purpose of the course is to enable students to upgrade their existing marketing knowledge by getting acquainted with the trends in the field of internet marketing, as well as their specific characteristics of analyzing, planning and conducting marketing activities in online environment.
General and specific learning outcomes	1. Analyze the state, identify opportunities and define problems faced by organizations and individuals in implementing ICT, and formulate solutions with the use of ICT. 2. Understand relevant factors that affect the business operation of an organization and individuals, and apply basic methods and concepts of business planning, management and accounting. 3. Understand and apply ethical principles, legislative regulation and norms that are applied in the professional field of discipline. 4. Understand processes, methods and technologies for the management of IT services and resources, and provisioning and support of different ICT related services.
Content	1. INTRODUCTORY LECTURE (2 hours) - introducing students to the subject, curriculum, teaching methods and course requirements, brief reminder of the basic concepts of traditional marketing in order to introduce students to the course and its basics - recalling the elements of the marketing mix. The importance of segmentation, positioning and market research, and the basic environmental influences on the behavior of businesses in their work environment 2. INTERNET AS MARKETING MEDIA (2 hours) - conceptual definition of the internet, historical development of the internet, the main forces

shaping the age of the internet, internet services, internet technology development, Internet marketing determination, marketing strategy in the new digital age (e-business, e-commerce, e-marketing)

3. INTERNET MARKETING (2 hours) - definition of internet marketing, internet vs. electronic marketing, transactions in internet marketing, examples of business models in internet marketing, process of internet marketing, introduction to digital marketing strategy (features of digital marketing strategy, application of internet marketing, advantages and disadvantages of internet marketing), digital marketing communication (relationship between digital and traditional communications, types of digital communication)
4. MARKETING ENVIRONMENT OF INTERNET MARKETING (2 hours) - microenvironment - online market analysis, analysis of consumers and their behaviors, online consumer behavior, competitors, suppliers, intermediaries, market models, macro environment - the degree of change in the environment, social factors, legal and ethical factors, technological factors, acceptance of technological innovation, economic factors, political factors
5. BUSINESS MODELS ON THE INTERNET (2 hours) - e-commerce (auxiliary tools, purchase procedure, advantages and disadvantages, security and privacy of e-commerce, payment in e-commerce, contracting via internet), B2B trade, B2C trade, m-commerce, online store, online department stores, online auctions, online service models (e-learning, e-banking)
6. DEVELOPMENT OF INTERNET MARKETING STRATEGY (2 hours) - integrated internet marketing strategy, influences on strategy selection, parts of internet marketing strategy, generic strategic approach, presentation ie. situation analysis, strategic goals setting, strategy formulation (market and product strategy development, strategies business and revenue, targeting strategy - target segment selection, positioning and differentiation strategy, multi-channel distribution strategy, multi-channel communication strategy, online communication mix and budget, organizational capabilities), strategy implementation
7. RELATIONSHIP MARKETING USING THE INTERNET (2 hours) - concept of relationship marketing (benefits of relationship marketing, consumer value differentiation, consumer loyalty, satisfaction and loyalty relationship), CRM concept - customer relationship management (term, importance of CRM for the internet marketing), the concept of e-CRM - electronic customer relationship management, (term, specificity of e-CRM and its importance for internet marketing, e-CRM implementation approach)
8. DIGITAL MEDIA CAMPAIGN PLANNING (2 hours) - characteristics of digital media: goal setting and search for interactive marketing communication (terminology for measuring the effectiveness of digital campaigns), campaign insight (consumer insight), segmentation and targeting, offer, message and creative development , budgeting and selection of the digital media mix (level of investment in digital media techniques, selection of appropriate mix elements), integration into the overall media schedule and plan (planning and selection of major activities)

	9. INTERNET AND ELEMENTS OF MARKETING MIX (2 hours) - product (digital product, e-services, brand in internet marketing), price (price transparency on the internet, influences on pricing, impact of costs), promotion (only general - promotional mix) on the Internet), distribution (the Internet as a sales and distribution channel, major trends in online sales and distribution), people, process, physical evidence 10. MARKETING INTERNET COMMUNICATION I. (2 hours) - search engine optimization (SEO), online marketing communication, online advertising, ad network, affiliate programs, online sales promotion, online public relations, viral marketing, online partnerships (affiliate marketing), interactive advertising 11. MARKETING INTERNET COMMUNICATION II. (2 hours) - direct internet marketing, direct email, email production, SPAM, email marketing, offline vs. online marketing, offline promotional techniques (advantages and disadvantages of using offline communication to support internet marketing, public relations, direct marketing, word-of-mouth marketing) 12. MARKETING INTERNET COMMUNICATION III. (2 hours) - new trends (virtual communities, social networking - conceptual definition, types and purpose of social networks and mobile marketing - conceptual definition, wireless advertising models, measuring mobile marketing campaign results), new media activities, social media optimization, use of new trends for marketing purposes, especially advertising 13. INTERNET MARKETING OF THE FINAL CONSUMPTION MARKET (B2C) (2 hours) - consumer behavior models, characteristics that influence consumer behavior, consumer decision-making process, consumer attitude to online consumer behavior, internet acceptance, trends affecting consumer behavior, motives to use the internet, e-commerce marketers' point of view, implementation of e-commerce strategy 14. INTERNET MARKETING BUSINESS CONSUMPTION MARKETS (B2B) (2 hours) - business consumption markets (B2B market characteristics, business buyer behavior model), online business buying, environment and B2B online trading marketplace, B2B e-commerce sales points, online efficiency, analysis of factors that influence the adaptation of Internet technologies, B2B digital marketing strategies on the Internet 15. INTERNET MARKET RESEARCH (2 hours) - defining problems and setting research goals, determining data sources and types of research, compiling a survey questionnaire, methods and forms for data collection, sample and data collection, data analysis and interpretation of results, reporting
Exercises	During the semester students in teams of max 5 students will work in teams and analyze relevant case studies for each lecture topic. And that team will have to make an e-marketing plan for a new or innovative product or service and present it on seminars. The basic for e-marketing plan will be laboratory exercises where students will make analysis for creating that plan.

Realization and examination	Classes: Lectures, seminars and exercises Examination: case study analyses, making of e-marketing plan and its evaluation, written exam
Related courses	Introduction to marketing, Customer relationship management, Databased marketing
Literature	Basic: 1. Lecture materials 2. Chaffey, D. Ellis-Chadwich, F: Digital marketing: Strategy, Implementation and Practice, 7th edition, Pearson, 2019. 3. Chaffey, D.: Digital Business and E-Commerce Management: Strategy, Implementation and Practice, 6th edition, Pearson 2015. Additional: 4. Hanlon, A.: Digital marketing: Strategic planning & integration, 1st edition, Sage, 2019. 5. Charlesworth, A.: Digital marketing: A Pratical Approach, 3rd edition, Routledge, 2018.

Course title: MANAGERIAL COMMUNICATION AND LEADERSHIP

Lecturers	Full Professor Goran Bubaš, Ph.D., Associate Professor Ivan Malbašić, Ph.D., Assistant Antonela Čižmešija, M.Inf.
Language of instruction [Croatian / English]	Croatian and English
Study level [Bachelor / Master]	Master
Study programme	Graduate study program "Economics of Entrepreneurship"
Semester [Summer / Winter]	2st semester (Summer)
ECTS [number]	4
Goal	Improving the knowledge and skills related to communication between leaders and managers in business organizations, and in relation to other employees at different levels, groups and teams, as well as representatives of other business organizations. Getting acquainted with communication processes in organizations, as well as processes related to communication in small groups and teams, communication in motivation and leadership, in decision-making, as well as intercultural business communication.
General and specific learning outcomes	/

Content	1. Organizational communication processes (2+1) Areas of research of organizational communication. Theoretical models of communication in the organization. Information processes in the organization. Communication channels and networks in organizations. Formal and informal communication. Rumors. Communication climate. Communication aspects of organizational culture. 2. Communication between different levels in the organization (2+1) Interpersonal and group communication in the organization. Problems in communication between superiors and subordinates. Foundations of individual and group communication behavior in the organization. Communication styles of managers. 3. Group communication in the organization (2+1) Groups and processes of group communication in organizations. Group development in the organization. Individual and group goals. Communication in small groups. Cohesion and norms in the group. Conforming and deviant behavior in a group. Group collaboration. Conducting meetings of working groups and committees. 4. Communication and skills in leadership (2+1) Definitions of leadership and leadership. Communication competence of leaders. Communication processes and theoretical models of leadership. Taxonomies of managerial behaviors. Leadership traits and effectiveness. Competences of leaders and situational relevance of their abilities. The power and influence of a leader. Political behavior. Participatory leadership. 5. Contingency theories of leadership (2+1) Leadership continuum theory. Managerial grid theory. Fiedler's theory of leadership. Path-goal theory. Leadership substitution theory. Other contingency theories. 6. Charismatic and transformational leadership (2+1) Attribution theory of charismatic leadership. Transformational versus transactional management. 7. Teamwork and team leadership (2+1) Characteristics of communication in successful teams. Types of teams. Team development. Roles of team members related to tasks and communication. Trust in the team. Effective behavior of team leaders. 8. Communication in the application of group techniques for creative problem solving (4+2) Basics of group communication in creative problem solving. Group creative techniques: brainstorming, writing down thoughts, writing down ideas, nominal group techniques, applying individual techniques in a group. Techniques for choosing a creative solution in a group. Leadership and creative problem solving.

	9. Communication in decision-making processes (4+2) Types of decisions and factors influencing decision making. Communication in decision-making processes in a group. Group discussions. Personal factors and communication in decision errors. Advantages and disadvantages of groups in decision making. Groupthink and polarization of the group in decision making. Decision-making communication processes in large organizations. Roles and tasks of leaders in decision making. 10. Communication in employee motivation processes (2+1) The connection between communication and motivation. Basic theories of motivation and communication processes in the organization. Special motivational techniques. Ways of influencing communication to increase employee motivation. 11. Communication in political behavior in the organization (2+1) Status and status symbols in the organization. Impression management. Sources of power of individuals and groups in the organization. Coalitions, cliques, oligarchy and other forms of connecting individuals to interest groups in organizations. Intergroup conflict. Mediation in organizational conflicts. 12. Ethical leadership and intercultural communication (diversity) in the organization (4+2) Ethical dilemmas related to leadership. Creating an ethical climate in organizations. Perceptions of space, time, work, gender roles and hierarchy in different cultures. Explicit and implicit rules in intercultural communication. Dealing with differences. Factors of leader competence in intercultural communication.
Exercises	Seminars: While performing exercises at seminars the students will practice various skills and techniques in the field of managerial communication and leadership (creative problem solving in groups, teamwork, decision making, employee motivation, political behavior in organizations, intercultural communication, leadership etc.). The following teaching methods are used for seminars: focused discussion, case-study, self-assessment tests and questionnaires, check-lists for the improvement of personal communication behavior, analysis of video-recordings, role playing, written assignments, design of multimedia presentations, polls and interviews, e-portfolio, use of learning management system (Moodle).
Preconditions	None.

Realization and examination	Classes: lectures, seminars Examination: written and oral examination, work on seminars, midterm exams
Related courses	Advanced Leadership Communication, MIT Sloan School of Management, https://mitsloan.mit.edu/faculty/academic-groups/managerial-communication/courses Leading People, Haas School of Business at the University of California, Berkeley, https://mba.haas.berkeley.edu/academics/curriculum
Literature	1. Dubrin, A. J. (2014). Leadership: research findings, practice, and skills. Boston: Cengage Learning. 2. Lussier, R.N. (2015). Leadership: theory, application & skill development. Indianapolis: Wiley.

Course title: NEGOTIATING IN THE INTERNATIONAL CONTEXT

Lecturers	Assoc. Prof. Violeta Vidaček-Hainš, Ph.D., Antonela Čižmešija, M. Inf.
Language of instruction	Croatian and English
Schedule	- 3 teaching hours per week Per semester: - Lectures (30 teaching hours) - Seminars (15 teaching hours)
Study level	Master
program	Economics of Entrepreneurship
Semester	Summer
ECTS	4
Main goals	Familiarizing with the specific characteristic of the negotiation in the international context, negotiation techniques, and communication skills that leads to international agreements; Efficacy in applying negotiation techniques and communication skills in face-to-face interpersonal communication and computer-mediated communication. Working effectively in online virtual teams on real-life scenarios using information and communication and collaboration tools.
General and specific learning outcomes	1. Learning outcomes / Level of the Study program - Using the ethical principles, entrepreneur's skills, communication skills,s and negotiation skills in a business environment. - Solving the problems in communication in an international business environment 2. Learning outcomes / Level of the Course - Understanding the differences and initiating the motivation for understanding the differences between business partners from an international context - Analyze and estimate the efficacy of the negotiation process in an international context - Develop intercultural and cross-cultural competencies in the business surrounding - Decrease the possible communication apprehension in an international surroundings and improve the communication skills/competences - Understand and apply principles of effective teamwork and team members in virtual collaborations - Using effective negotiation skills in a specific international context - Objectively estimate and create effective international surroundings as well as assemble competent teams for the business negotiation process - Using techniques of effective facing problems and difficulties in communication and applying the techniques for their solving - Using ethical principles for negotiation in an international context - Adopt and upgrade a system of personal and organizational values for effective negotiation in an international context.

Content	1. Introduction – Business communication and negotiation in the international context (2 hours) – Familiarizing with the term international context, types of communication, and communication goals; Definition of international communication and negotiation, the specifics of business communication in an international context. 2. Researches in the field of business negotiation in an international context (2 hours) – Methodology and types of international research, cross-cultural, intercultural, and inter-cultural level; Collecting the data, interpretation of results, the characteristics of researches in international surrounding and possible limits in interpretations of results, examples of good practice. 3. Relations between culture dimensions and communication in cross-cultural sounding (2 hours) – Complexity, individualism, and collectivism, coherency, vertical and horizontal cultures, active and passive cultures; Interpersonal communication is different in different cultures, the link between the negotiation and diversity of interpersonal communication with business communication in an international context; Culture differences in perception, cognition, tolerance at diversities; using the technique of mind mapping; 4. Diversities of emotional expression in communication and negotiation in international context / among differculturesture (2 hours) – Link between expression of emotions and different interpretations, recognition and correct interpretation of emotions as well as elements of non-verbal communication, self-control, and correct emotional expression; Need for correct perception of diversities and tolerance at diversities. 5. Motivation for business negotiation in an international context (2 hours) – Differences in intrinsic and extrinsic motivation, professional competencies for negotiation in an international context; Communication skills and personality traits for effective negotiation in an international context; Encouragement of the communication-ba at onsedllaboration with focused at effective problem-solving. 6. International and cross-cultural business communication and negotiation (2 hours) – Preparation for negotiation in an international context, negotiation techniques; parties in business negotiations; representatives, parties, audience; working at communication skills development among the construct of communication competence and according to the specific demands the of the international surrounding; Roll play technique. 7. Process of negotiation in international surrounding between more partners (2 hours) – Building up negotiations teems – possibilities for communication problems and ways for effectively solving problems in common in the internnicationational surrounding, social skills, and teamwork in an international context, group processes, and group/team dynamic, definition of emotional intelligence and skills that are required in the process of international negotiation; Using MindManager tool for creating an effective business meeting. 8. Up-to-date negotiation's concept for European integration (2 hours) – Lobbying – definition of the term and characteristics of lobbying, the

	preparation process for lobbying, lobbyist's competencies, ways of professional and communication competencies developing, factors of motivation; The importance of preparation that is high quality and on write time, sustainability of negotiation's process; Examples of good practice / Case study; Assembly of European Regions, European Commission... 9. Lifelong learning and international surroundings (2 hours) – Lifelong learning and education for international communication and business negotiation in an international context – the role of higher education; Results of research conducted at the Faculty of Organization and Informatics and comparative studies conducted in European's and others Universities. 10. International exchange and mobility (2 hours) – International students exchange and mobility of working forces, advantages and disadvantages, the problem of brain drain; Results of research conducted at the Faculty of Organization and Informatics and comparative studies conducted in European and others Universities; Widening participation and tolerance at diversity caused by the invalidity, belonging to national, ethnic, gender, etc. underrepresented groups of students; the role and importance of assimilation process. 11. Reasons for possible difficulties and ways of solving the problems in the negotiation process in an international context (2hours) – Possible difficulties caused by cultural differences – definition and knowledge of the terms of ethnocentrism, stereotype, prejudice…; Possible difficulties at an interpersonal and personal level – predictors for stress and effective stress management, burn up syndrome, mobbing… Communication and education as effective ways for decreasing and overcoming those difficulties; The importance of modern information and communication technology. 12. Adaptation to differences in business communication and negotiation in an international context (2hours) – Decreasing the communication apprehension with business partners from different cultures; Process of acculturation – mechanisms of adaptation; The role of computer-mediated communication, advantages and using possibilities, possible disadvantages caused by lack of information and computer literacy as well as effective ways for solving those problems. 13. Characteristics of oral and writing communication in a foreign language (2 hours) – Active (speaking, writing) and passive (listening, reading) language skills – characteristics of communication in a foreign language; language barriers, communication with translators, and cord interpreters, types of writing business communication; Case study: application for an international project, writing documents and preparation for negotiation before signing the international contract; The importance of globalization process, and accessibility of information – examples of computer-mediated communication. 14. Possible failures in process of business negotiation in international surrounding (2hours) – need for up to date recognition of possibilities for conflicts/failures, adequate and effective response/communication, the

	inclusion of third parties in the process of business negotiation, international arbitrage, possible ways for effective conflict management, the importance of collaborative communication. 15. Ethic principles in negotiation and system of personal and organizational values in an international context (2hours) – international context, stimulating acquisition and development of personal values, the role of communication and education, accessibility of information, controlling and breaking inconvenient ways of communication and stimulating collaboration inside the business organizations and stimulating partnerships in an international context; Feedback to the course and final evaluation of the course.
Exercises	During the whole semester seminar exercises will introduce students to the practical aspects of the theoretical knowledge presented in the lectures. Seminar exercises will include tasks based upon virtual mobility and virtual team collaboration with international students.
Realization and exam	Teaching methods: Lectures (50%), seminars (30%), E-learning (10%) Examinations: Student presentations and seminar work and colloquium/exam, using the principles of collaborative learning and with the support of an E-learning system.
Quality control	Students will regularly and actively participate in the teaching process. By using the method of qualitative analysis, the estimates of communication skills and competencies for the international negotiation process will be done. During exercise/seminars, techniques of role play, small group discussion, mind mapping, etc. will be used. Writing skills and critical thinking will be estimated through paperwork (reports and colloquium). The E-learning system will be used as a support for the registration of student reports and teacher feedback. The E-learning system will support teamwork planning during the exercises at computers laboratories. At the end of the semester; students will provide feedback to teachers by using an anonymous student survey.
Literature	1. Brislin, R. (2008). Working with Cultural Differences: Dealing Effectively with Diversity in the Workplace, Praeger Publishers, Westpoint, CT, USA (p.p. 1-21) 2. Cohen, R. (2005). Negotiating Across Cultures: International Communication in an Interdependent World Paperback; United States Institut of Peace, Washington D.C. 3. Samovar, L.A., Porter, R.E:, McDaniel, E.R. (2010). Communication Between Cultures, Wadsworth Engage Learning, Boston, MA, USA (pp 22-47) 4. Beebe, S.A., Beebe, S.J., Redmond, M.V. (2005). Interpersonal Communication: Relating to Others. 4 th ed. Pearsons, Boston, USA. Chapter 4: Interpersonal Communication and Cultural Diversity: Adapting to Others (pp 88-119)

	5. Locker, K. & Keczmarek, S.K. (2009). Business Communication; Building critical Skills. 4 the edition. Higher Education, Boston, 2009. Module 3: Communicating Across Cultures (pp 39-61) 6. Cordell, A. (2019). The Negotiation Handbook; 2nd edition. Routledge, New York.

Course title: PROJECT CYCLE MANAGEMENT

Lecturers	Full Professor Blaženka Divjak, PhD Assistant Professor Katarina Pažur Aničić, PhD Barbi Svetec, mag. educ. philol. croat. et angl.
Language of instruction [Croatian / English]	English
Schedule	2 hours of lectures and 1 hour of seminars per week
Study level [Bachelor / Master]	Master
Study programme	Economics of Entrepreneurship
Semester [Summer / Winter]	Winter
ECTS [number]	4
Goal	To train students for a project-based approach to problems and situations in their professional interest areas in order to support innovation. The course involves the application of methods and tools of classical project management as well as the project cycle approach. Furthermore, students are trained to work in a team when developing a comprehensive project plan, which includes a timeline, organization of project work, a financial and marketing (dissemination) plan, as well as a risk management plan to ensure deliverables and reaching project goals. Finally, students are supported in project proposal planning based on criteria given by sponsors, and especially in preparation and management of projects funded within EU funding programs.
General and specific learning outcomes	
Content	1. Project definition. Approaches to project management. Project phases. Project cycle in innovative projects. 2. EU funds and programs, their characteristics, and opportunities for innovation funding. 3. Project planning and goal setting. From problem solving to a project idea. 4. Project planning using project management methods and tools. 5. Methods and tools for overall project time planning, scheduling and workflow. 6. Software tools for project management. 7. Project budgeting and estimation of overall project costs. 8. Development of a project dissemination and marketing plan.

	9. Risk identification, categorization and mitigation. Risk management plan. 10. Project team selection, role setting and work styles. 11. Project implementation, monitoring of progress. 12. Quality assurance of project results. 13. Project reporting and closing a project. 14. Preparation of a project proposal for EU funding based on evaluation criteria. Peer-evaluation of the quality of project application.
Exercises	During the semester, students work on practical tasks related to course topics for 10 weeks in teams of three. In the last five weeks, student teams prepare project proposals based on a specific call for proposals for EU funding. Finally, students present their projects and participate in project peer-evaluation using criteria in pre-defined rubrics.
Realization and examination	Essay on a topic of interest from the field of project management (individual work). Weekly tasks and teamwork related to course topics. Project proposal and evaluation.
Related courses	-
Literature	1. Projektni ciklusi u znanosti i razvoju. Ed. Divjak B. (2009). TIVA-FOI, Varaždin. 2. Online self-paced courses available at www.projekti.hr – open access Nokes, S.; Major, I.; Greenwood, A.; Allen, D.; Goodman M. (2003). The definitive guide to project management. Prentice Hall, London. 3. Kerzner H. (2003). Project management, A systems Approach to Planning, Scheduling and Controlling. John Wiley & Sons, Inc.

Course title: PROCESS PERFORMANCE MANAGEMENT

Lecturers	Assoc. Prof. Igor Pihir, Ph.D., Asst. Prof. Martina Tomičić Furjan, Full. Prof. Stjepan Vidačić, Ana Kutnjak, M. Econ.
Language of instruction [Croatian / English]	Croatian and English
Study level [Bachelor / Master]	Master
Study programme	Graduate study programme Economics of Entrepreneurship
Semester [Summer / Winter]	Winter
ECTS [number]	6
Goal	Contemporary organizations are constantly striving to achieve their goals and improve their business through the improvement of business processes. Business processes are therefore the focus of business people, IT professionals, practitioners, and scientists involved in the development of information systems with the aim of supporting and managing business processes and increasing their performance. Process performance management is a set of business excellence methods, supported by modern ICT, and includes a wide range of management activities and scientific methods known as business process improvement (BPI), business process reengineering (BPR), or business process modeling (BPM), and strategic planning and measurements such as Balanced Scorecard (BSC) and SWOT. The common features of all these methods are the analysis of business processes, analysis of organizational goals, and setting metrics for measuring and evaluating process performance, which monitors the achievement of not only operational but also strategic goals of the organization. While listening to this course, students will learn how to recognize business processes, which methods and norms are applied in business process modeling, and managing and measuring process and organizational performance. Students will be introduced to new technological trends of business process improvement, business models, and digital transformation of modern organizations. Theoretical insights will be applied to multiple case studies, and practical skills will be complemented by students using modern computer-aided performance measurement tools. The knowledge gained in this course will enable graduate students to work as business analysts, managers, strategic development planners of the organization, development experts, and consultants for business excellence and modern forms of business.

General and specific learning outcomes	/
Content	Part 1. Assoc. Prof. Igor Pihir 1. Organizational system and its business processes: Systematic, organizational and functional presentation of the company. Basic transformation process and connection of the company with the environment. Definition of business process. Primary and supporting business processes (Porter's value chain), Priorities of process informatization (McFarlan process matrix). The connection of business processes with data content. Data exchange between processes (input / output analysis) and exchange formats in information systems. (2 hours of lectures + 1 hour of seminars = process puzzle - Porter's value chain and McFarlan / input-output analysis of process sketches of their choice) 2. Business process management life cycle: Process recognition. Discovering knowledge of processes. Process analysis. Process redesign. Process implementation. Supervision and control of the process. IT tools for BPM. (2 hours of lectures + 1 hour of seminars = presentation of tools and examples of processes in tools - introduction to the example of processes that we consider through the course CASE STUDY) 3. Business process modeling and notations for BPMN business process modeling: Basic terms. Modeling methodologies. Modeling standards: BPMN 2.0, OMG UML, ARIS ePC, etc. BPMN - notation and standard for business process modeling. Analysis and evaluation of existing processes - examples of projects, examples of processes in sales, procurement, logistics, production and service activities. Examples of process support through information systems (ERP; CRM, application software, web store and systems for booking tickets, accommodation, etc.). (2 hours of lectures + 1 hour of seminars = presentation of process examples through several types of tools - process analysis / study of symbols of activity / event norms / switches on examples of discussions / workshops) 4. Basic concepts of process performance management and analysis of process models by simulation: Process performance management system. Measurement methodologies. Efficiency and effectiveness. Types of effects on the process: direct and indirect; qualitative and quantitative; short-term and long-term. Process simulation with analysis of duration, process time, resource consumption, process costs, etc. Selection of business processes for improvement using information and communication technology (McFarlan matrix, Porter chain). (2 sata predavanja + 1 sat seminara = demonstracija procesa kroz složeni primjer s cijelim postupkom analize) Part 2. Full. Prof. Stjepan Vidačić 5. Integration and automation of wholesale, retail and web sales systems: Wholesale as a system of centralized flow management. Retail as a subsystem of the wholesale system. Web sales as a subsystem of wholesale and retail systems. (2 hours of lectures with support for specific software solutions in use)

6. Integration of warehousing and goods subsystem:
Inventory warehouse management model (goods cards). Document warehousing process. The process of commodity conclusion of documents. (1 hour of lectures with a presentation of the support of specific software solutions in use)

7. Integration of the wholesale system and the private customs warehouse system:
Entry of goods into the customs warehouse system (customs receipt). Exit of goods from the customs warehouse (bookkeeping record). Entry of goods from a customs warehouse into a wholesale warehouse (link between customs receipt, accounting record and wholesale receipt). Customs warehouse inventory management model (goods card). (1 hour of lectures with a presentation of the support of specific software solutions in use)

8. System of terms of sale for wholesale customers:
Parameters of sales conditions. Generating contracts from terms of sale. Automate the application of sales conditions. (1 hour of lectures with a presentation of the support of specific software solutions in use)

9. Automation of the process of procurement and stock management:
Managing the status of the total, reserved and available quantities in the warehouse. Automated algorithm to generate the required quantities to replenish stock. Integration of documents (Order, Receipt, Delivery note). (1 hour of lectures with a presentation of the support of specific software solutions in use)

10. Automated rebate system management in wholesale.
Applied rebate system models. Automated algorithm of hierarchical control of rebate approval. Integrated documents in the context of automated rebate system management (Terms of sale for customers, Offer, Order, Delivery note). (1 hour of lectures with a presentation of the support of specific software solutions in use)

11. Automatic financial accounting and posting of documents:
Formal financial attributes. Formal rule systems for automatic accounting and financial posting of documents. Foundation as a bookkeeping concept and meta object of automated integration of data from business process documents and financial bookkeeping. (1 hour of lectures with a presentation of the support of specific software solutions in use)

12. Company in the context of eBusiness:
Account fiscalization. Algorithms for generating e-Forms on business (JOPPD, SEPA, OPZ-Stat, PD-IPO ...), Operationalization of eInvoice system. (2 hours of lectures with support for specific software solutions in use)

(+ 5 hours of seminars = demonstration of the process through a complex example with the whole analysis procedure performed by Igor Pihir, Ph.D.)

Part 3. Asst. Prof. Martina Tomičić Furjan

13. New technological trends of business process improvement and new business models:
Currently current business process improvement concepts. Concepts of digitalization of business processes. Business transformation concepts. Selection of technology to improve the selected business process. Business models. Definition of a business model. Elements of the business model.

Methodological frameworks for business model development. Business model analysis. Creating a business model to improve the selected business process. (2 hours of lectures + 1 hour of computer exercises = Digitrans.me platform)

14. Digital transformation:

Definition of digital transformation. Methodological frameworks of digital transformation. Drivers of digital transformation. Foundations for the implementation of digital transformation.
(2 hours of lectures + 1 hour of computer exercises = Digitrans.me platform)

15. Strategic planning, measurement of organizational performance and basic concepts of performance management at the strategic level:

The concept of strategy and strategic planning. An overview of modern methods of strategic planning. The concept of measuring organizational performance. An overview of modern methods of measuring organizational performance. Measuring the performance of processes and organizations with the use of ICT (ERP, CRM, etc.). Continuum of strategic management. Organizational mission. Mission development. Organizational vision. The relationship between vision and strategic goals. Syntax and semantics of strategic goals. Reasons for introducing performance measurement: continuous organization management and focused program evaluation. IT tools for measuring performance.
(2 hours of lectures + 1 hour of computer exercises = ADOscore)

16. Development of organizational performance measurement models and measuring instruments of the BSC model:

Basics of the Balanced Scorecard method (BSC). Development of a performance measurement management model according to the BSC method. Analysis of strategic goals. SWOT analysis as a source of strategies. Strategic implementation activities. Objectives of the activity. Strategic goal map. Relationship between goals and measures. The amount of the measure as an indicator of achieving the goal. Structure of the measuring instrument: designation of the measure, name of the measure, type of measure, method of measurement, limit values, coefficients of influence. Calculating the amount of measures. Strategic map of measures. Validation and verification of the BSC model.(2 hours of lectures + 1 hour of computer exercises = ADOscore)

17. Cascading goals and measures:

Decomposition of strategic goals. Strategic goal maps. Tactical target maps. Goals and organizational forms. Objective classification matrix. The process of cascading goals and measures. Chains of cause and effect of tactical goals and measures. (2 hours of lectures + 1 hour of computer exercises = ADOscore)

Assoc. Prof. Igor Pihir

18. Operational implementation of process performance management:

Recapitulation of the steps of creating and implementing a process performance management system. Introduction of the BSC model as an organization management system. Key roles in the implementation of process performance management. Verification and validation of process performance management systems. (2 hours of lectures + 1 hour of computer exercises)

Exercises	Students solve problems and discuss examples connected to particular lectures in real-life independents assignments combined together into the student team project. Every unit of lectures is accompanied by seminars, enabling the students to apply the acquired knowledge on practical examples and present their ideas through team projects.
Realization and examination	Preliminary exams. Additional activities are conducted within the class. Those activities will be evaluated. Class attendance. Student project. If not solved by up mentioned activities final exam in form of the written and oral exam.
Related courses	-
Literature	Basic: 1. Presentations and 2. other digital materials, available on the e-learning course system.Russell, R.S.; Taylor, B.W. (2008) Operations Management. Prentice Hall, Upper Saddle River, USA. 3. Brumec, J.; Brumec, S. (2016) Modeliranje poslovnih procesa. Zagreb: Koris d.o.o. 4. Vidačić, S., Pihir, I. (2019) Automatizirana poslovna pravila u funkciji upravljanja poslovnim sustavom (skripta u izradi). Additional: 5. Westerman, G., Bonnet, D., McAfee, A. (2014). Leading Digital – turning technology into business transformation. USA: Harvard business review press. 6. Osterwalder, A., Pigneur, Y., Bernarda, G., Smith, A. (2014). Value proposition design, Hoboken, New Yersey: John Wiley &Sons 7. Tomičić, M., Dobrović, Ž. (2006). Metode oblikovanja strateške mape ciljeva kod izgradnje BSC. Zbornik radova konferencije CASE 18, Opatija. 8. Dobrović, Ž., Tomičić, M., Vrček, N. (2008). Towards an effective government: Implementation of Balanced Scorecard in the public sector, Intellectual economics, No1 (39), p. 7-17. 9. Vidačić, S.: Some Models of the "VISTEL" Program Used to Support the Management of the Business Processes of a Trading Company, Proceedings of the 14th International Conference of Information and Intelligent Systems - IIS'2003, september 24-26, Varaždin, 2003, str. 263-272. 10. Vidačić, S.: The Use of Information System in the Management of Business Rules, Proceedings of the 16h International Conference of Information and Intelligent Systems - IIS'2005, september 21-23, Varaždin, 2005, str. 145-151. 11. Vidačić, S., Brumec, S.: Hybrid Model of the Mobile Information System in a Complex Warehouse System, Proceedings of the 19h International Conference of Information and Intelligent Systems - CECIIS'2008, september 24-26, Varaždin, 2008, str 333-339. 12. Pihir, I., Pihir N., Vidačić, S.: Improvement of warehouse operations through implementationof mobile barcode systems aimed at advancing

	sales process, Proceedings of the ITI 2011 33rd International Conference on Information Tehnology Interfaces, June 27-30, 2011, Cavtat/Dubrovnik, Croatia, str. 433-438. 13. Vidačić, S., Pihir, I.: Towards e-business in bookkeeping agencies: perceptions, problems and efficiency, Proceedings of the 26th International Conference of Information and Intelligent Systems - CECIIS'2015, september 23-25, Varaždin, 2015, pp. 135-141. 14. Vidačić, S., Tomičić-Pupek, K., Pihir, I.: The orcestration of web-based sales processes – a case study. Proceedings of the 11th International Scientific on Economic and Social Development – Bulding Resilient Society, Zagreb, Croatia, 17 – 18 december, 2015, pp. 336-341. 15. Vidačić, S.: Model i efekti slanja veleprodajnih računa emailom, 3rd International Scientific and Professional Conference (CRODMA 2018), Book of Papers, ISSN 2459-7953, Varaždin, 12.10.2018, pp. 159-167. 16. Vidačić, S.: Model i efekti online web izvještajnog sustava knjigovodstvenog servisa, 3rd International Scientific and Professional Conference (CRODMA 2018), Book of Papers, ISSN 2459-7953, Varaždin, 12.10.2018, str. 169-177. 17. Vidačić, S. (2008). Audio vizualne prezentacije aplikacije TRENIS. 18. Vidačić, S. (2008). Audio vizualne prezentacije aplikacije KISPLACE. 19. Vidačić. S. (2009). Audio vizualne prezentacije aplikacije FINKSQL.

Course title: CORPORATE GOVERNANCE

Lecturers	Assoc. Prof. Marina Klačmer Čalopa, Ph.D., Ivana Đunđek Kokotec, M. econ., Karolina Kokot, M. econ.
Language of instruction:	Croatian and English
Study level	Master
Study programme	Economics of Entrepreneurship
Semester	Winter
ECTS	5
Goal	The goal of course is to introduce students to the basic principles of corporate governance and ethics that apply in managing socially responsible private companies, financial institutions and state enterprises.
Content	After completing and passing the course students will be able to: • Understand the role of corporate governance in companies and a framework for socially responsible business society. • Explain the interaction of corporate governance from legal, organizational, financial and IT aspects of business society. • Analyze models of corporate governance according to the structure of government institutions. • Apply knowledge of financial statements and indicators with the aim to understand corporate reporting as a basis for achieving business success. • Demonstrate critical thinking and understanding of the advantages and disadvantages of different models of management remuneration. • Discuss the trade associations considering the implementation of best practice corporate governance. • Explain and critically evaluate the processes of corporate governance due to modern information-communication environment. 1. Corporate governance (2 hours) - Introduction to the subject - the goals and purpose of the course, books and obligations of students. Conceptual definition of corporate governance. Corporate governance and competition. Corporate governance in the function of strengthening the competitiveness of enterprises.

	Models of corporate governance: Single tier Board and Two-tier Board. Changes to the Corporation Acts. 2. Theoretical approaches to corporate governance (2 hours) – Agents theory and corporate governance. Definition and problems of the study. Basic assumptions and reasons for contractual relations. Asymmetry of information Agency cost. Equilibrium effects on the efficiency of the relationship. Other theoretical approaches to corporate governance - Stakeholder theory (categorization interests of stakeholder groups – Flower model), the stewardship theory. Basic assumptions of other theoretical approaches to corporate governance. 3. Corporate governance in Croatia (2 h) - Issues of corporate governance model in post privatization period. Croatian privatization model. Corporate governance and capital market development. Regulation and turnover in the capital market in Croatia. Institutional investors and their role in corporate governance. The quality of corporate governance in joint stock companies. 4. Experiences of other countries in corporate governance (2 hours) - Western experience with corporate governance (France, Germany, Netherlands etc.). The main features of the German corporate governance system. The main features of the Japanese corporate governance system. The main features of the Anglo-American corporate governance. Privatization and corporate governance - examples of transition countries (Slovenia, Hungary, Czech Republic ...). 5. Privatization and the new rulers (2 h) - Dominant effects of corporate governance in Croatia after the privatization. Characteristics of corporate governance in private companies. Social research in Croatia. Institutional owners and management business take over. Managerial ownership - a comparative analysis of Croatia and Slovenia. Managers - the company's ownership structure. The problems of corporate governance by the ownership structure of enterprises. Analysis of the data of the Central Depository and Clearing Agency (SKDD). 6. OECD Principles of Corporate Governance (2 h) - History of the OECD. Mission and vision of the OECD. The main objectives of the OECD. The structure of the organization. Statistics OECD. The role and requirements of the OECD by member states. The role and requirements of the OECD to Croatia. Development of OECD principles throughout history. The role of Britain in development. The importance and purpose of the OECD principles of corporate governance. Shareholder rights. Equal treatment of shareholders. The role of stakeholders in corporate

	governance. Disclosure and transparency. Responsibility of the Supervisory Board. Analysis of compliance of corporate governance with OECD principles. The index of corporate governance. 7. Code of Corporate Governance (2 h) – Law regulation of corporate governance - the Corporate Act, The Capital Market Law, the Law on Credit Institutions. National Code of Corporate Governance (ZSE and HANFA). Organizational and financial arrangement of the implementation of corporate governance. Association for the promotion of corporate governance in Croatia - CROMA, HUCNO. 8. Characteristics of corporate governance in state-owned enterprises (2 h) - OECD Guidelines and code for corporate governance in state enterprises. How to manage state-owned enterprises? State officials and their role in the supervisory boards of state enterprises. Monitoring the process of corporate governance in state enterprises. 9. Characteristics of corporate governance in financial institutions (2 h) - Corporate governance in banks. Corporate governance in investment funds. The role of CNB in the implementation of corporate governance. CNB documents on corporate governance in banks. Analysis of the implementation of the principles of CG in the financial institutions. 10. The role of the supervisory board of business enterprises (2 h) - Key dimensions of the work of the Supervisory Board. Choosing the members of the supervisory board and the differences depending on the model of corporate governance. Legal powers of the supervisory board. Subcommittees. Persistence of sub-committees in Croatia. The election of members of the Supervisory Board. Investor Relations. Shareholder rights in Croatian enterprises. Relations with the administration. Analysis of members of the supervisory board in Croatian companies. Key dimensions of the supervisory board action. 11. Salaries and remuneration of management models (2 h) - Mechanisms of corporate governance. Strategy management compensation. Reward management. Salary structure of supreme managers. Factors affecting the manager's salary. Remuneration of members of the supervisory board. Models and ethics of the salary. Short-term and long-term incentives. Bonuses. Equity options. Severance packages - Golden parachute. Pension programs and life insurance.

	Analysis of managerial salaries in the United States, Europe and countries in transition. 12. Social responsibility of companies and business performance (2 h) - Corporate Social Responsibility. Business justification for Corporate Social Responsibility. Initiatives related to promoting socially responsible business. Principles of corporate social responsibility. Corporate finance and control. Business Intelligence. Modern regulation of corporate reporting. Corporate reporting in the U.S., Europe and Croatia. Corporate reporting on the Internet. Committee on internal audit and oversight. 13. Rules and financing of employee stock ownership plans (2 h) - Development of employee stock ownership in the world. USA. Insurance funds. Formation of dividend policy. The basic rules of design: stock companies have all employed workers, the ordinary/ preference shares; there are no external members, quitting of the program. ESOP programs in Croatia. Employee participation in decision-making. Analysis of the companies that implemented employee stock. 14. Holding ratio (2 h) - Control of the company – different classes of shares, voting methods, majority against cumulative voting, nomination of candidates. Advantages and disadvantages of holding relationships. Protection of small shareholders - proportionality, pre-emption rights, the general regulations. Processing components of corporate governance. Processes related to strategic planning. 15. Corporate governance and previous research (2 h) - Analysis of the implementation of best corporate governance practice in Croatia. Reasons and results of introducing the principles of corporate governance.
Realization and examination	Classes: Lectures, seminars and laboratory exercises Exam: Written and oral exam and seminars
Literature	Basic: Tipurić, Darko i suradnici: Korporativno upravljanje, Sinergija, 2009

Course title: STRATEGY OF HUMAN RESOURCES MANAGEMENT

Lecturers	Full Prof. Marina Klačmer Čalopa, Full Prof. Violeta Vidaček-Hainš, Karolina Kokot, M.Econ.
Language of instruction	Croatian and English
Study level	Master
Study programme	Economics of Entrepreneurship
Semester	Winter
ECTS	4
Main goals	The goal of the course is acquisition of knowledge and developing the skills for human resources management at business organizations. The understanding of strategic importance of human resources management (HRM) and management of human resources in reaching the privileges in competitive business environment tried to be developed. The goal is to present contemporary methods and techniques from this area as well as basic theories and results of resources.
General and specific learning outcomes	<u>Learning outcomes / Level of the Study program</u> 1. Participation in creating effective strategies of HRM in contemporary business organizations in different cultural contexts 2. Identify and explain different approaches in HRM, depending on type of industry type of business organization 3. Research, collect and evaluate information form different scientific and professional sources to developing the new approaches in entrepreneurship and business in general. <u>Learning outcomes / Level of the Course</u> 1. Analyzing strategic opportunities and explained the factors in decision making process in HRM 2. Understanding the different concepts of strategic management in process of HRM 3. Acquisition the competences for understanding the importance of HRM 4. Reaching the skills and knowledge in HRM 5. Identifying and solving practical problems in developing the HRM 6. Suggesting methods for improving the related changes in HRM 7. Describing goals, processes and roll of HRM in business organization

Content	1. Human resources management (2 hours) – Introduction to the course goals and purpose of the course, literature and students obligations. Term definitions. Comparison with similar terms. Approach to the HRM in the history- Croatia and the world. The importance of HRM. The role of HRM. Reengineering functions of human resources management. Main process and functions in HRM. The environmental influence at HRM. 2. Strategic human resources management (SHRM) (2 hours) – Characteristics of SHRM. Developing and strategic aspects of resources management. Development of HRM in the context of Croatian entrepreneurs. Relationship between strategy and human resources. Human resources management plan. Goals and strategies of HRM. Activities of HRM. Strategic options in HRM. Management of human resources and company's lifecycle. 3. Company's perspective of HRM (2 hours) – Human resources management from the perspective of small, medium and large companies. Specifics of HRM in small and medium companies. Position of HRM's function. Institutionalization of function- the influence of organizational factors at HRM. Differences in management. HRM in manufacturing. Using information and communication technology in HRM. 4. Analyzing and business estimates (2 hours) – Methods of workplaces selections. Occupational psychology – goals, methods and applying in contemporary business organizations. Scheduling jobs and workplaces. Estimating conditions and demands for working places. Working places with specific demands and conditions. 5. Methods and techniques of professional selection (2 hours)- Methods and techniques of professional selection related to the working places. Process of attracting human resources. Prediction needs for human resources. Crops pyramid of human resources. General strategies for human resources acquisitions. Internal and external sources of finding human resources. Non conventional methods of professional selections. Methods of professional selections of managers. 6. Employees motivation and rewording (2 hours) – Follow up activities for employee's efficacy. Encouraging creativity at workplaces. Strategies of financial rewording system and other types of rewording. Compensation and HRM. Strategies and policies of compensation. Predictors and criteria in working performance. Relations between human resources and Trade Union in process of satisfaction employees needs. Manager's contracts. 7. Follow up process for employment's work quality (2 hours) – Evaluation's methods and techniques. Estimates of employ's work's results. Types of estimates scales. System of ranking. Methodological problems in using different techniques for estimates. Basic subjective mistakes in estimates. Factors of career development. Characteristics of employees that bosses (managers) demands. Discovering management's potentials.

	8. **Employees education (2 hours) –** Policies and types of education. Development of managers and career. Creating effective learning environment. Lifelong learning process. Methodic of learning and learning techniques. Opportunities for widening participation. Career developing. Balance between individual and organizational needs. Promotion. 9. **Stress and effective stress management (2 hours) –** Basic skills at stress management process. Understanding the stressors. Stress and working environment. Decreasing the level of stress. Management of personal and professional life. Fluctuation and absence. Factors of work's tire. Burn up syndrome. 10. **Management of business relationships and relationships in organization (2 hours)-** Duties and rights of employees. Duties and rights of managers. Strategies in solving problems of superfluity of workers. Management of dismissals. Retirement. Principe of attracting. Alternative mechanisms of compromises. Integrations of employees. Unemployment and employment of working force in Croatia. Problems of season's employment. 11. **Cultural differences in HRM (2 hours) –** Human being as the most important factor in each organizational structure. Developing and non-developing countries. Human resources benchmarking. Equality of national and ethnics minorities. Knowledge management and intellectual capital. Demographic tendencies and offering of work force. 12. **Relationship between HRM and business results (2 hours) –** Human resources as the base of concurrences for modern business companies. General model of relation between impact of HRM at the business results, analyzing the profit at individual's, organizational and activity's level. Efficacy of management. 13. **Ethic and professional approach (2 hours) –** Ethical approach in management activities in human resources. Ethical principles in HRM. Professional approach in process of professional selection of employees. Ethics of civil servants. The role of professional adviser's in HRM. Problems of corruptions. Professional secrets. Gender equality. 14. **Measurement of contributions of HRS for company's efficacy (2 hours) –** Estimates of functional efficiency – general and specific indicators for productivity, quality, services in relation to company concurrency or standards. Measurement the contribution of human resources for business efficacy. Measure the efficacy of HRM department. Quantitative indicators in follow up activities for estimating business efficacy. Analyzing the examples. 15. **Practical examples and case studies (2 hours) –** Analyzing organizational management functions's of human resources at practical examples.
Exercises	Regular monitoring students at lectures and seminars, estimates of their seminar works and critical papers, testing thought semester (3 colloquiums).

Realization and exam	Using the system for e-learning in monitoring the efficacy of student's work. At the end of semester the final evaluation of teaching process and teachers will be done. Students will be able to comment the content and methods of teaching as well as literature for this course. Teachers will use the evaluation forms for improving their teaching process. The Universities student's survey will be used.
Quality control	Students will regularly and active participate in teaching process. E-learning system will be used as a support for registrations of student's reports and for teacher's feedback. At the end of semester; students will provide feedback for teachers by using anonymous student's survey.
Literature	Mondy, R. (2008). Human resource management, 10th ed. New Jersey: Pearson Prentice Hall

Course title: ENTREPRENEURIAL STRATEGIES

Lecturers	Full Prof. Ksenija Vuković, PhD; Assist. Prof. Kristina Detelj, PhD; Tamara Šmaguc, PhD
Language of instruction	Croatian and English
Study level	Master
Study programme	Economics of Entrepreneurship
Semester	Winter
ECTS	5
Goal	The main objective of the course is to enable students to identify and evaluate entrepreneurial occasions. The course presents the possible entrepreneurial strategies and develops the ability to analyse and select a suitable one. The aim is to encourage the students to take a strategic approach to entrepreneurship that will enable an innovative approach to entrepreneurial venture. The course also enables students to understand the qualitative methodological approach and provide them with knowledge needed in the implementation of smaller scale qualitative research in entrepreneurship.
General and specific learning outcomes	/
Content	1. Qualitative research in entrepreneurship (research problem, questions, methods…). 2. Data sources and methods for qualitative research. 3. Interview as a data collecting method. 4. Selecting direction: Mission, Vision, Goals 5. Entrepreneurial orientation of the enterprise and Entrepreneurial intensity 6. Strategic Entrepreneurship 7. Entrepreneurial business model 8. Encouraging creativity within the organization 9. Entrepreneurial opportunity 10. Networking Strategy

Seminars	During the semester students in teams of 3 have to find a real-life entrepreneur and do an interview with them. The interview has some basic, generic questions about the decisions to become an entrepreneur, educational background, enterprise foundation, business planning in practice, troubleshoots etc. But, every team also has to add questions to get the entrepreneurs views on the certain aspect of the business (types of entrepreneurs, decision making, resources based view of a business, risks, mission and vision etc.). The interview is done and analysed in accordance with the theoretical foundations for qualitative research. During the seminary classes with teacher's guidance the students define the research problem, develop research questions and objectives. They are taught how to apply semi-structured interview technique (designing a guide for an interview, creating a transcript and editing empirical material). For the purpose of analysing of qualitative data they learn to use different types of coding in the research of entrepreneurship and strategic entrepreneurship and the role of linguistic expression and vocabulary of the researcher in the written and oral presentation of the results of qualitative research of entrepreneurship and strategic entrepreneurship.
Realization and exam	Classes: Lectures, Seminars; Examination: Seminar presentation, Interview with the real-life entrepreneur, Written examination.
Related courses	1. MIT Sloan school of management, 15.911 - Entrepreneurial strategy 2. University of Washington, Foster School of Business - ENTRE 510: Entrepreneurial Strategy 3. Harvard University Extension School MGMT E-5420, Innovation, Entrepreneurship, and Business Transformation
Literature	Basic: 1. Lectures 2. Greener, S. (2008). *Business Research Methods*. Ventus Publishing Aps, available free on bookboon.com (and on Moodle) – chapters 1-5 and 9&10. 3. Kuratko, D.F., Morris, M.H., Covin, J.G. (2011). *Corporate Innovation & Entrepreneurship*, South-Western Cengage Learning. 4. Wickham, P. A. (2006). Strategic Entrepreneurship, 4th Edition, Prentice Hall. Additional: 5. Burns, P. (2013) *Corporate entrepreneurship, Innovation and strategy in large organizations* (3rd ed.), Palgrave McMillan. 6. Kuivaniemi, L. (2010). *Evaluation and Reasoning the Entrepreneurial Opportunity Process*, University of Jyväskylä. 7. Hitt, M.A., Ireland, R.D., Camp, S.M., Sexton, D.L. (2006) *Strategic Entrepreneurship*, Blackwell Publishing.

Course title: OPERATIONS MANAGEMENT

Lecturers	Assoc. Prof. Nikolina Žajdela Hrustek, Ph. D.
Language of instruction [Croatian / English]	English
Study level [Bachelor / Master]	Master
Study programme	Economics of Entrepreneurship (EP)
Semester [Summer / Winter]	Winter
ECTS [number]	6
Goal	The aim of the course is to acquaint students with the basic concepts of Operations Management necessary for understanding and developing the models needed to model and optimize business processes. Within the course, students will master mathematical programming with an emphasis on linear programming, dynamic programming, methods of solving transport problems, simple stock models, Markov analysis and the basics of game theory and project management. The adopted methods will be applied in the preparation of analysis and solving business problems, within which, in addition to teamwork skills, they will also develop presentation skills.
General and specific learning outcomes	/
Content	1. Introduction to Operations Management - Definition, role and significance of operations management 2. Operations management and linear programming - Setting and graphical presentation of standard problems of linear programming 3. Operations management and linear programming - Linear models - simplex method - standard problem for maximum 4. Linear models - Game Theory 5. Transportation problem of linear programming - Methods for solving transportation problems 6. Methods for setting the initial basic solution - North-West Corner Method, Minimal Costs Method, Vogel method 7. Methods for testing the program and obtaining the optimal solution - Stepping Stone Method, MODI Method

	8. Degeneration of transportation problems basic solutions 9. Inventory models 10. Simple Inventory models 11. Optimization of storage capacities by dynamic programming 12. Business forecasting - Determining the stability of supply and demand with Markov chains 13. Project Management 14. Quality and Quality Management 15. Modeling and Simulation - Fundamentals
Exercises	Solving practical problems in seminar classes using adopted algorithms and methods of operations management.
Realization and examination	Evaluation elements: Preliminary exam 1 (25 Points) Preliminary exam 2 (25 Points) Brief examination 1 (10 Points) Brief examination 2 (10 Points) Activity (10 Points) Research seminar 20
Related courses	-
Literature	1. Robert Jacobs, Richard Chase, (2013), Operations and Supply Chain Management 13th Edition 2. Rusell R.S., B.W. Taylor III, Operations management, Along the Supply Chain, VI edition, John Wiley & Sons (Asia), 2009. 3. Dilworth J.B., Operations Management, Providing value in goods and services, Third edition, The Dryden Press, Fort Worth, 2000.

Course title: DISCRETE STRUCTURES WITH GRAPH THEORY

Lecturers	Prof.dr.sc. Blaženka Divjak, Doc.dr.sc. Marcel Maretić, Ph.D., Damir Horvat, lecturer
Language of instruction:	English
Study level	Master
Study programme	within the graduate studies in Informatics: Information and Software Engineering (IPI), Business Systems Organization (OPS), Databases and Knowledge Bases (BPBZ) and Teacher of Informatics (TI).
Semester	Winter
ECTS	6
Goal	The main goal of the course is to introduce the students to the mathematical theories necessary for information sciences (*discrete mathematics, graph theory*). One of the goals of this course is to support the students' developing skills of rigorous mathematical thought, necessary for a successful career in ICT. Students should become familiar with different formalisms. Students should be able to observe connections between formal theory and real-world situation. This course aids to development of mathematical strictness (to a certain degree) and facilitates students to adequately apply formalisms to specific problem situation. Additionally, the goal is to develop connections between discrete mathematics, informatics and algorithmic thinking specially related to cryptography and using graphs to solve problems in ICT.
General and specific learning outcomes	
Content	1. Models and structure of mathematics (2 hours) Mathematical models. Characteristics of mathematical models. Structure of mathematics. Role of axioms in mathematical theory. Basic and derived notions, relations between notions. Theorems. Examples and evolution of well known mathematical theories. 2. Methods of proving statements in mathematics (2 hours) Propositional and predicate logic. Propositions and operations with propositions. Complex expressions related to AND, OR. Implication and its characteristics. Structure of statement. Techniques of mathematical proof: direct proof, proof by cases, proof by contraposition, proof of (several) equivalent statements, counterexamples. Mathematical induction as instrument of proving on natural (integer) numbers. Peano's axioms. 3. Relations (4 hours) Set as the basic mathematical notion. Paradoxes of the set theory. Cantor's and Zermelo's to the set theory. The power set. Operations on sets (union, intersection, set difference, complement of a set) and their properties. Venn's diagrams. Problems with discrete sets and continuum. Cartesian products of sets (discrete and continuous sets). Sets of numbers. Complex numbers. Relations, binary relations, properties of binary relations. Matrix of incidence. Functions (domain, range, bijection, countability of sets). Inverses functions and composition of functions.

4. Congruences with applications (2 hours)
Equivalence relation. Quotient set of an equivalence relation. Set partition induced by equivalence relation. Congruences. Congruence operations (addition, subtraction, multiplication). Solving congruences. Chinese remainder theorem. Determining numbers through residues. Applications of congruences in codes and crypotography (International Standard Book Number, Universal product Code, cyphers).

5. Well ordered sets and lattices (4 hours)
Partial order on a set, definition and basic examples. Lexicographic order. Comparability of elements in partially ordered set. Hasse's diagrams and their implementation. Linearly or totally ordered set. Notion of minimal and maximal, least upper and greater lower bound in partially ordered set. Well ordered set.
Lattice: definition and examples. Divisibility of integer numbers as relation of partial order. The largest common divisor and Euclidean algorithm. The least common multiple. The lattice of divisors of a natural numbers. Well ordering principle (any nonempty set of natural numbers has a smallest element). Equivalence of principle of mathematic induction and well ordering principle on a set. Prime numbers and their characteristics. The sieve of Eratosthenes. The fundamental theorem of arithmetic (every integer number larger than 2 can be written as a product of powers of distinct prime numbers). The Goldbach's conjecture.

6. Graphs (2 hours)
Definition of graph and basic characteristics of graphs. Degree of vertex, multiple edges, pseudograph. Subgraph. Special graphs: complete graph, bipartite graph, and complete bipartite graph. Regular graphs. Euler's proposition (the sum of the degrees of the vertices is an even number equal to twice the number of edges). Number of odd vertices is even. Isomorphism of graphs. Connection of isomorphic graphs over permutation matrix. Invariants of isomorphic graphs. Walk, closed walk, path in graph.

7. Paths and cycles (4 hours)
Eulerian circuit as closed Eulerian path and Eulerian graph. Connected graphs. A graph is Eulerian if and only if it is connected and every vertex is even. Solution of problem of Koeningsberg's bridges. Hamiltonian cycle. Hamiltonian graph. The Petersen graph as a counterexample to Hamiltonian graph. Open problem of necessary and sufficient condition for Hamiltonian graph. Incidence matrix and adjacency matrix. Characteristics of adjacency matrix. Algorithm for finding Eulerian path and cycle. Problem of deadlocks.

8. Weighted graph. Shortest path problem. (2 hours)
Weighted graph. Shortest path between two vertices in a weighted graph. Graph application. The traveling salesman's problem. Dijkstra's algorithm and improved Dijkstra's algorithm. The Floyd-Warshall algorithm. Comparison of these two algorithms, their complexity and possible usage. The Chinese postman problem in Eulerian graph and in graph which is not Eulerian. "Eulerization" of graph.

	9. Trees (2 hours) Tree as a connected graph which does not contain any cycles. Properties of a tree. Forest. Rooted tree. Binary tree. Binary tree searching. Sorting algorithm. Binary tree in presentation of algebraic identity. Minimal spanning tree. Algorithms for minimal spanning tree. Notion of subgraph. Spanning subgraph. Weight of tree. Problem of finding minimal spanning tree. Minimal spanning tree algorithms. Kruskal's algorithm. Prim's algorithm. Tree searching. Passing through graph and tree. 10. Directed graphs (4 hours) Directed graph. Directed trail, directed path. Tournament: definition and features. Existence of directed Hamiltonian path in every tournament. Lattices and critical path. Problem of distribution. Critical path method - CPM, PERT. Applications in project planning and management. Transported network. Value of a flow. Notion of f-augmenting path. Flows and cuts. Max flow – min cut theorem. Proving theorem. Examples of application. 11. Graph coloring (2 hours) Problem of four colors. Historical review and Appel-Haken solution. Graph vertex coloring. Chromatic number of graphs and examples. Applications of chromatic number on schedule problems. Cliques and number of cliques. Coloring of graph edges. Chromatic number theorems. Chromatic numbers of some known graphs. Theorem (Vizig, Gupta). Matching in graphs. Maximum matching in graph. Matching in bipartite graphs. Hall's theorem.
Exercises	Seminars follow lectures At the seminars, exercises related to the theory discussed in the lectures are addressed. Emphasis is, wherever possible, on practical exercises that may be related to some realistic problem. It also shows how some exercises can be solved in some programming tools or languages such as Python, SAGE, and Maxima. Students also solve two practical exercises in Python (or SAGE, or Maximi) One exercise pertains to discrete mathematics and is mainly related to some application in the theory of numbers and combinatorial, while the other task is related to the theory of graphs.
Realizationand examination	Continuous assessment of students' learning is done throughout the semester. Elements for assessment: 3 monthly tests; homework in e-learning system; exercises and simple problem solving in classrooms (quizzes); project work in teams on project posing and project solving. If student doesn't satisfy criteria during semester, she/he will be assessed by written and oral examination.
Related courses	-

Literature	*Primary:* 1. Goodaire E. G., Parmenter M. M., *Discrete Mathematics with Graph Theory,* Prentice Hall, New York, 2002. *Additional:* 1. Divjak B., Lovrenčić A., *Diskretnamatematika s teorijom grafova,* TIVA-FOI, Varaždin, 2005. 2. Garnier R., Taylor J., *Discrete Mathematics for New Technology,* Institute of Physics Publishing, Bristol & Philadelphia, 1999. 3. Veljan D.: *Konačnamatematika s teorijomgrafova*, Algoritam 2003 4. Tucker, A.: *Applied Combinatorics*, John Wiley & Sons, New York, 1995 5. Sedgewick, R.: *Algorithms in C++, Part 5: Graph Algorithms*, Addison-Wesley, Boston, 2002. 6. Barwise, J., Etchemendy, J.: *The Language of First-Order Logic,* CSLI, Stanford, 1992. 7. Red. Nečepirenko, M. I.: *Algoritmy I programmyrešenijazadačnagrafahisetjah*, Nauka, Novosibirsk, 1990. 8. Knuth, D. E.: *The Art of Computer Programming: sorting and Searching*, Addison-Weslay, Reding, 1973 9. Garey, M. R., Johnson, D. S.: *Computers and Intractability*, W. H. Freeman & Co., New York, 1979.

Course title: SOFTWARE ANALYSIS AND DEVELOPMENT

Lecturers	Full Prof. Neven Vrček, Ph.D., Assoc. Prof. Zlatko Stapić, Ph.D., Assist. Prof. Boris Tomaš
Language of instruction	Croatian and English
Study level	Master
Study programme	Information and Software Engineering
Semester	Winter
ECTS	6
Goal	The goal of the course software analysis and design is to introduce the students to the life cycle and development phases of a modern software product with the emphasis on architectural design and implementation of mobile software products. Software development has become an important branch of industry which has its patterns and related standards. The course deals with all the phases of the software development life cycle, which the new software product must undergo at the beginning of its creation: analysis of the system's domain, specification of the software requirements, methods and techniques of software modelling, software development, software testing and removal of errors. In this way students learn about basic approaches used in development and engineering of complex, software-based systems, and they also learn about modern tools that facilitate software development and steps of software development lifecycle.
General and specific learning outcomes	/
Content	1. Paradigms of software systems' development life cycle Life cycle of a software product. Approaches to the development of software system and possible variations: waterfall, spiral, agile. Complex development cycles (parallel development, feedback). 2. Software system development life cycle Project specificities in software industry. Relationship between the project and the development cycle of a software product. Characteristic methods of planning and tracking the project in development of a software product. Expenses of a product. Project teams and their characteristics: specialization areas, required knowledge, overlapping of the knowledge areas. Virtual project teams and tools that support group work (teamwork, groupware). 3. Analysis of software system requirements – users' requirements Definition of user's requirements. Business processes and influence on users' requirements. Sources of users' requirements. Organizing the users' requirements. Techniques of gathering the users' requirements: interviews, inquiries, business documents, ... 4. Analysis of software system requirements – system requirements Definition of system requirements. Types of system requirements. Mapping between user and system requirements. Functional and non-functional requirements. Transition and dynamic modelling. Organizing and documenting of functional and non-functional requirements.

	5. Software system modelling Software system architecture and basic construction elements. Software modelling diagram techniques. Standards and approaches to modelling of software system. Basic concepts of OO approach. Inheriting, encapsulation, polymorphism. Object- oriented approach in program languages and tools. 6. UML paradigm UML diagrams and their use in design phase of software development. Concepts of software product development design. Definition of the software product development design. Basic questions of architecture development (e.g. data requirements, managing the memory, exceptions, etc.). Design principles (hiding the information, cohesion and pairing). Interactions between the design, functional and non-functional requirements. Design oriented to quality of the attributes (ex. reliability, usability, performance, possibilities of testing, tolerance of errors, etc.). Architectural styles, reusability. Interoperability. SOLID design principles. 7. Tools for development and modelling of software systems Types of tools for development and modelling of software systems (ex. architectural, for static analysis, for dynamic estimation, etc.). Typical tool architectures. Possibilities and limitations of tools. 8. Software system architecture Layers of software system architecture and typical architectures. Characteristic technologies in each of the layers. Connecting the layers and integration of the software system. Influence of the architecture on characteristics of the software system (resistance to incidents, malfunctions, speed). 9. Components and integration Component paradigm. Reusability of the program code. Types of software components. Technologies for the development and integration of software components. Managing the transactions of the components. Integration of the components. Market of the software components. 10. User interface and user experience General principles of the design of human computer interface. Psychology of the human computer interface. Basic elements of visual design (e.g. colors, icons, letter types, etc.). Reply time and feedback information. Design approaches (e.g. Oriented to me, the forms, questions-answers, etc.). Localization and internationalization. Advanced design methods of the human computer interface. Design of augmented virtual reality. Metaphors and conceptual models. 11. Prototyping Purpose of the prototype in software industry. Types of prototype: horizontal and vertical. Prototype planning. Documenting the prototype. Testing scenarios. Relation between the prototype and the real system. Software tools for prototype development. 12. Metrics in the software development The principles of software metrics and their applicability. Types of metrics: lines of program code, functional points. Metrics and life cycle. Methods for estimating complexity of software system. Static and dynamic code analysis. 13. Software testing Significance and approaches to testing of software system. Testing of the components and the entire integrated software system. Relation of

	software performance and users' requirements. Testing scenarios. Analysis of the range of questioning (e.g. branch, basic course, multiple conditions, data flow, exceptions, etc.). Processing of the exceptions (writing testing examples for starting the exceptions' processing). Integration testing. Testing based on operational profiles. Testing of non-functional requirements (e.g. usability, security, compatibility, accessibility, etc.). Regression testing. Testing tools. Defining the system acceptability. Testing in the domain of DevOps. 14. Specific program architectures Transaction and analytical software architectures. Critical demands. Design trade off related to goals of the design and development. Data warehouses, OLAP systems, architectures for data mining, ERP systems, distributed systems.
Exercises	Laboratory exercises guide students through the development process of a complex mobile system, focusing the artifacts used and created in each phase, from conceptual modeling through continuous integration, delivery and deployment of final product. During exercises the students will work with the tools covering the full software development lifecycle as well as with technologies of mobile applications development. Agile software development practices are employed as well as industry related tools for source code versioning, project and issues management.
Realization and exam	**Classes:** lectures and exercises **Exam:** team project and oral exam
Related courses	1. University of Goetenborg. - Software Analysis and Design 2. Georgia Tech University / Udacity - Software Architecture & Design 3. University of Alberta / Coursera - Software Design and Architecture Specialization 4. Escuela Politécnica Superior - Software Analysis and Design Project 5. The IEEE Computer Society - Software Design Course 6. University of Sheffield, Object Oriented Programming and Software Design, Software Development for Mobile Devices
Literature	Basic: 1. R. Stevens, P. Brook., K. Jackson, S. Arnold: Systems Engineering, Coping with Complexity, Prentice Hall, 1998. 2. M Fowler with K Scott, UML Distilled: Applying the Standard Object Modelling Language, Addison-Wesley, 1997. 3. S Bennett, S McRobb R Farmer, Object-Oriented Systems Analysis and Design using UML, McGraw-Hill, 1999. 4. P Stevens, R Pooley, Using UML - software engineering with objects and components, Addison Wesley, 2000. 5. Sommerville, Software Engineering, 5th edition, Addison-Wesley, 1996. 6. R S Pressman, Software Engineering: A Practioner's Approach, 5th edition, McGraw- Hill, 2000 (or the European adaptation by D. Ince). 7. T Gilb, Principles of Software Engineering Management, Addison-Wesley, 1988.

Course title: PHYSICAL DESIGN OF DATABASES

Lecturers	Full Prof. Alen Lovrenčić, Ph.D., Assoc. Prof. Markus Schatten, Ph.D.
Language of instruction	Croatian and English
Study level	Master
Study programme	Databases and Knowledge Bases
Semester	Summer
ECTS	5
Goal	This course complements the knowledge required for profound understanding of Systems Database Management Systems (DBMS), their functioning and practical application. This course uses knowledge from many other courses, for example Databases 1, Algorithms, Data structures etc., and represents their logical continuation in the similar context. The students are acquainted with the way a software system works. Software systems are the second most dominant system regarding their presence in a computer, right after the operating systems. DBMS is quite a complex system which itself contains various aspects that enable its functioning. In this course the students are introduced to many of these aspects appearing in most known DBMSs. This course is therefore useful not only to students planning to explore DBMS development, (it is assumed that the number of such students is limited) but to all the students interested to use a DBMS. The course will help them understand possibilities and limits of the system they are working with, which are inevitable owing to objective theoretical difficulties. It will also help them understand unfavorable criticism related to that particular system, accounted for by a lack of inadequate solutions that the system offers. Finally, the course helps the students choose the appropriate DBMS. In addition, students who intend to work in the field of information science, especially in the database field, are given a different perspective of the database world. They are introduced to the lower, physical level and algorithms which enable declarative work, common in contemporary DBMSs.
Content	**1. Introduction (2 hours)** The concept of DBMS. Historical development of DBMS. Physical, conceptual and outside level of DBMS. Language for database work. Relation model. Charts and attributes.

2. **Discs and databases (2 hours)**

Managing disc space. Managing storage. Documents. Documents of fixed and variable length. Pages. Pages of variable and fixed length. Data banks. Indexes. Systematic DBMS catalogues. Sorting in secondary memory. Sorting by connecting and evaluation of complexity.

3. **Organization of data banks and data bank objects**

Heap data banks. Sorted data banks. Hash data banks. Choice of data bank system. Representation of relation objects. Documents. Fixed length documents. Document titles. Notes. Variable length documents. Changes in documents.

4. **Linear indexes (2 hours)**

Sequential data banks. Dense and rare indexes. Primary and secondary indexes. Composite indexes. Indexes with doubled keys. B+-tree indexes. Organization of B-tree index. Searching B+-tree index. Adding value to B+-tree index. Deleting values from B+-tree index. Evaluation of operation complexities in B+-tree index.

5. **Hash chart-based indexes (2 hours)**

Hash chart-based indexes. Static hashing. Expansive hashing. Additions to expansive Hash chart. Deleting from expansive Hash chart. Evaluation of operation complexities in expansive Hash index. Linear hashing. Adding elements into linear Hash chart. Deleting elements from linear hash chart. Evaluation of operation complexities in linear Hash chart.

6. **Indexes for multidimensional data (2 hours)**

Data cubes. Grid data banks. Searching grid data banks. Inserting values into Grid data banks. Evaluation of operation complexities in Grid data banks. R-trees. Operation on R-trees. Evaluation of operation complexities on R-trees. Index bitmaps. GiST and GiN indeces

7. **Queries (2 hours)**

Relation algebra. Selection, projection, natural connection, -connection operators. Cartesian product. Group operators– union, difference, cut. Elimination of multiple lines. Grouping and aggregation. Sorting. Chart review. Sorting while reviewing. Reviewing complexity.

8. **Queries (cont.)**

Single-phase algorithms for relation operators. Selection case – without index, unsorted data. Selection – without index, sorted data. Selection – B+-tree index.

	Selection – hash index. Sorting-based projection. Hashing-based projection. Projection and indexes. 9. **Queries (cont.) (2 hours)** Natural connection – nested loops. Connection done by connection-based sorting. Connection with help of hashing. Union and difference with help of sorting. Union and difference with help of hashing. Sorting-based double-phase algorithms. Hashing-based double-phase algorithms.Index-based algorithms. Multi-phase algorithms. 10. **Optimizing and query translating** Parsing of a query. Syntax analysis. Translation trees. Query plans. Rules for query improvements. Rules for commutability and associability. Selection rules. Pushing away selections. Rules on connections and products. Rules for erasing double lines. Rules linked to grouping and aggregation. 11. **Optimizing queries (cont.) (2 hours)** Advancing query plan. Grouping associative and cumulative operators. SDBM-led statistics. Estimation of plan cost. Estimation of exit size. Estimation of inter-result size. Estimation of projection size. Estimation of selection size. Estimation of connection size. Connections with several conditions. Connections of a bigger relation number. Estimation of other operators. 12. **Optimizing queries(cont.)** Heuristics for lowering the plan price. Left and right argument of the connection and their difference. Connection trees. Algorithm for optimizing connection sequence based on dynamic programming. Algorithm for optimizing connection sequence based on greed method. Creation of final question plan. Choice of selection method. Choice of connection method. Forwarding for unary operators. Forwarding for binary operators. 13. **Competitiveness in DBMS (2 hours)** Concept of transactions. Serial and serialized plans. Locking. Implementation of locking and unlocking. Deadlocks. Solving deadlocks by finding cycles in a directed mathematical graph. Prevention of deadlocks. Problem of livelocks. Planning locking. Double-phase locking. Divided and exclusive keys. Incremental keys. Problem of phantom documents. 14. **Competitiveness in DBMS (cont.) (2 hours)** Competition control in tree-indexes. Ensuring competitiveness using time traps and shots of database. Problem of dirty data. Connecting locking and time traps. Transactions which read uncertified data. View seriability. Solving deadlocks using time traps. Very long transactions. Problems of long transactions. Sagas. Compensation of transactions. **15. Recovery from system crash** Logs. Other data structures for recovery of database. Logging protocol by writing in advance. Work with control points. Analysis phase. Transaction repetition phase. Phase of deleting unfinished transactions. Media recovery. Media mirroring. RAID5 discs.

Exercises	**Seminars** Seminar projects deal with new methods which appear in DBMS, and withrelated areas not otherwise covered. They can also be connected tocriticism of the way of implementation of certain theoretical concepts in DBMSs used by students. This individual student's project is significant foracquiring knowledge about the area, the real DBMS and differences between theory and practice. For that reason seminar projects have a major influence on student's final course grade. **Exercises** Laboratory exercises are based on developing algorithms connected to databases in C programming language.
Realization and exam	Classes: lectures, seminars and exercises Examination: Seminars (50%), written examination (25%), oral examination (25%)
Related courses	**1.** Berkeley: http://inst.eecs.berkeley. edu/~cs186/sp18/ **2.** Cornell: http://www.cs.cornell.edu/Courses/cs432/2003fa **3.** Princeton: http://www.cs.princeton.edu/courses/archive/spring03/cs425 **4.** Washington: http://www.cs.washington.edu/education/courses/444/ **5.** Toronto: http://www.cs.toronto.edu/~csc443h **6.** Brown: http://www.cs.brown.edu/courses/cs127 **7.** Yale: http://zoo.cs.yale.edu/classes/cs437
Literature	**1.** Oracle Database Concepts, Oracle Corp., 2015. **2.** Ramakrishnan, R.: Database Management Systems, McGraw-Hill, 1998 **3.** Garcia-Molina, H.; Ullman, J.D.; Widom, J.: Database System Implementation, Prentice-Hall, 2000 **Additional:** **1.** Ullman, J.D.; Widom, J: First Course in Database Systems,Prentice-Hall, 2001. **2.** P. Atzeni, V. De Antonellis: Relational Database Theory, The Benjamin/Cummings, 1993. **3.** Aho, A.; Hopcroft, J.; Ullman, J.D.: Algorithms and data structures, Addison-Wesley, 1983 **4.** J. van Leeuwen: Handbook of Theoretical Computer science, Elsevier & MIT Press, 1990. **5.** D.E. Knuth: The art of Computer programming: Searching and Sorting, Addison-Wesley, 1973.

Course title: INTERNET SECURITY

Lecturers	Full Prof. Miroslav Bača, Ph.D.; Asst. Prof. Igor Tomičić, Ph.D.
Language of instruction:	Croatian and English
Study level	Master
Study programme	Databases and Knowledge Bases
Semester	Summer
ECTS	4
Goal	This course focuses on the acquisition of main informatics knowledge and skills which are necessary for working with Internet security and networked systems, especially in an environment which is networked on a daily basis, and the implementation of the knowledge and skills in everyday life. Students are acquainted with the most common failures, weaknesses, safety risks, precautions and means of protection, as well as the ways of gathering, processing, storing and comparing of related data and their usage in complete security systems. In addition, they learn about the latest accomplishments in Internet security. The course is structured in a way that provides a solid introduction into of the most important characteristics of Internet security. Nowadays it is impossible to imagine any kind of business activity without a computer network. Development of computer networks is limited by development and connections within the Internet, which is another assumption this course is based on. Internet security has implications on security of all computer networks, either existing on the Internet or connected to or through the Internet. Most of the companies know very little about flaws of the networks they are using, so education about it will be of great help in raising the level of knowledge and awareness of security in general. The course is targeted on the end user in a networked environment. It deals with principal threats, safety risks, weaknesses, precautions and protection of networked computers. The course is divided into lectures, seminars and exercises. The course objectives can be classified in four groups: 1. to introduce the students to failures in Internet security, 2. to explain failure development with a special focus on development of software, 3. to increase the level of ethics when using the Internet, 4. to introduce the students to legal assumptions and encourage them to think about these assumptions.
General and specific learning outcomes	
Content	1. Introduction (2 hours) Definitions of security and protection terms in the context of computer networks. Analysis of current status of computer security in Croatia and the world. Goals which are to be achieved by security aspects. Categories of people and actions which can threat Internet security. Current status of software for securing the safety of computer networks. Responsibilities and obligations of users. Threats identification and risk comprehension. 2. Computer networks (2 hours) Computer networks in general. Kinds and types of computer networks. Ethernet and its monitor. Transceiver. Repeater. Package-switch. Bridge. Router. OSI model.

3. TCP/IP protocols (2 hours)

The importance of understanding TCP/IP protocols for Internet security. Research of addresses, networks and servers. Work with networked monitor. Inspection of network configurative databases. Comprehension of accessible network databases. Address resolution protocols. DNS. UDP. Network and transportable layer. WWW. Data transport.

4. Internet coding (2 hours)

Usage of coding in the work with the Internet. Usage of coding in network operating systems and applications. DES; IDEA, RC5, Hash functions, Asymmetrical public key and infrastructure.

5. Basic hypotheses about Internet security (2 hours)

Internet security and computer networks in achieving absolute security. Principal terms and the most threatened parts of the Internet. The ethic of using the Internet and its security. Elementary tools and methods for threatening Internet security. Potential goal observing and noting down the activities. Logging on the system and searching for the weakest users. Objectives selection.

6. Discovery of weaknesses and failures (2 hours)

Internet protocols TCP/IP, UDP, DNS. Systems saving, Internet systems saving, scanning, discovering 'live systems'. Operating system recognition, listing, passwords, appropriate system configurations. Controlling systems of computer networks, security on a network layer, computer networks on several locations. WWW, e-mail, news, FTP, telnet, LDAP. Human failures and technical mistakes, spying of network infrastructure.

7. Attacks on network operating systems (2 hours)

Network operating systems Windows NT, Windows 2000, Windows Me, Windows XP. Network operating systems UNIX, Linux, open source. Cryptography within operating systems. Using mechanisms of authentication. Finding and stopping the usage of rear door in operating systems.

8. Attacks on network applications (2 hours)

Differences between commercial and open source network applications. Deficiencies in remote controlling and managing. Advanced techniques in remote controlling. Attacks on WWW. Attacks on the ultimate user of network applications. Usage of rear door in network applications. Attacks on e-mail.

9. Attacks on network hardware(2 hours)

Differences between wired and wireless communication and network architecture development. Security on a network layer. Security on a transport layer. Telephone exchanges and VPN networks. Network devices and firewalls. Attacks through distributed withholding of services. Package filtering and port scanning. TCP/IP failures.

	10. Malicious computer programs (2 hours) Types of malicious computer programs and their effect on Internet security. The most frequent ways of using network weaknesses. Types of malicious computer programs-viruses, worms, Trojan horse, hoax, spam. Software and hardware for prevention and stopping of malicious computer programs spread. 11. Hacking techniques into networked systems and the Internet (2 hours) Hacking techniques into computer system. Hack tracking. Techniques and methods of detection of hacks into computer systems. Methods of prevention and stopping of hacks into computer system. 12. Forensics and hack proving (2 hours) Attacker detecting. Attacker tracking. Evidence gathering and documentation. Definition of digital proof for purpose of proving the act. Ways of communicating with authorities. Ways of accepting, storing and delivery of evidence material. 13. Prevention and Internet protection (2 hours) Organizational, technological and technical assumptions of Internet security. Net applications without security failures. Complete methods of risk evaluation. Software and hardware firewalls. Software and hardware protection models. New models and techniques in keeping and securing Internet safety. 14. Ethics and legal regulations (2 hours) Ethics in using the Internet and its meaning. Legal regulations in Croatia and the world. Systems for detection of unauthorized hacks, diary analysis. Digital signatures. Privacy on the Internet. Inspection of legal regulations concerning computer crime in Croatia. 15. Conclusion (2 hours) Review of current developing projects in Croatia and the world for securing the safe Internet. Comparative analysis of the newest practical accomplishments in securing undisturbed Internet activity. Comparative analysis of the newest methods for undisturbed Internet activity. Directions for development of security systems. Biometrics implementation into security systems on the Internet.
Exercises	Auditory + practical exercises Practical exercises are based on working with security tools and detecting security failures and threats on PC oriented computers in a networked environment. The follow-up includes setting up prevention systems and networked environment protection and operating them; detection, tracking and analyzing of hack traces in computer system. Upon completing the exercises students have to perform individual monitoring of a certain computer system, and give a qualitative assessment. 1. Internet domains Ways of determining of an Internet domain owner. Whois service. DNS enquiries. Nslookup application.

	2. Package route determination Package route determination by tracer and retrace express applications. 3. Internet address cover-up Usage of web-based proxy server. Connecting to proxy server. Using ftp service. 4. Using e-mail clients Analysis of e-mail messages. Sending and hiding data. Using samspade application. 5. Using Usenet service and web server Analysis of Usenet messages headings. Text search on web servers using logical criteria. 6. Group searching Using WinMX service and Gnutell service. 7. IRC IRC IceChat clients installation, database transfer. Using ICQ services. 8. Protection PGP. Web-based remailer.
Realizationand examination	Classes: lectures, seminars and exercises Examination: written examination and seminars
Related courses	1. Carnegie Mellon University (Electronic Commerce Institute) http://www.andrew.cmu.edu/user/mml 2. University of Notre Dame (Illinois Institute of Technology) http://www.nd.edu/~dcnoway/mgt425 3. Columbia University (Department of Computer Science) http://www.cs.columbia.edu/~hgs/teachnig/security 4. University of Virginia (Department of Computer Science) http://www.cs.virginia.edu/~evans/cs551 5. Wright State University, College of Engineering & CS, Dayton, Ohio http://www.cs.wright.edu/~pmateti 6. The University of Arkon, Wayne College http://www.eng.wayne.edu/coe 7. Universitat Trier, Trier, Deutschland http://www.uni-trier.de/uni
Literature	Basic: 1. Lecture materials available on: http://www.foi.hr/studiji/dodiplomski/IS/kolegiji/si 2. Du, Wenliang. Internet Security: A Hands-on Approach 2nd Edition, 2019. 3. Bača, M. Uvod u računalnu sigurnost (Introduction to Computer Security), Narodne novine, 2004. 4. Garfinkel, S., Spafford, G., Practical UNIX and Internet Security, O'Reilly & Associates, Inc., Sebastpol, CA, 1996 Additional: 1. Garbis, J., & Chapman, J. W. (2021). Zero Trust Security: An Enterprise Guide. Apress. 2. Bellovin, S., Cheswick, B., Firewalls and Internet Security, Addison Wesley, Reading, MA, 1994. 3. Casey, E., Digital Evidence and Computer Crime: Forensic Science, Computer and Internet, Academic Press, San Francisco, CA, 2000. 4. Lockhart, A., Network Security Hacks, O'Reilly Media, Inc., Gravenstein Highway North, Sebastopol, 2004.

5. Rhee, M.J., Internet Security, John Wilwy & Sons Ltd, England, 2003.
6. Hunt, C., Networking Personal Computers with TCP/IP, O'Reilly & Associates, Inc. Sebastopol, 1995.

Unit 1.

1. Garfinkel, S., Spafford, G. Practical UNIX & Internet Security, O'Reilly & Associates, Inc., Sebastopol, CA 1996.

Unit 2.

1. McClure, S., Scambray, J., Kurtz, G., Hacking Exposed:Network Security Secrets & Solutions, McGraw-Hill, Osborne, 2003
2. Tanenbaum, A.S., Computer Networks, Prentice Hall, 2002.

Unit 3.

1. Blank, A.G., Blank, A., TCP/IP JumpStart: Internet Protocol Basics, Sybx, 2002.
2. Hunt, C., TCP/IP Network Administration, O'Reilly, 1997.

Unit 4.

1. Buchmann, J.A., Introduction to Cryptography, Springer-Verlag, 2000.
2. Srallings, W. Cryptography and Network Security: Principles and Practice, Prentice Hall, 2002.

Unit 5.

1. Cheswick, W.R., Bellovin, S.M., Rubin, A.D., Firewalls and Internet Security: Repelling the Wily Hacker, Addison-Wesley Professional, 2003.
2. Northcutt, S., Zeltser, L., Winters, S., Fredrick, K., Ritchey, R.W., Inside Network Perimeret Security: The Definitive Guide to Firewalls, Virtual Private Networks (VPNs), Routers, and Intrusion Detection systems, Sams, 2002.

Unit 6.

1. Blank, A.G., Blank, A., TCP/IP JumpStart: Internet Protocol Basics, Sybx, 2002
2. McClure, S., Scambray, J., Kurtz, G., Hacking Exposed:Network Security Secrets & Solutions, McGraw-Hill, Osborne, 2003.

Unit 7.

1. Fogie, S., Peikari, C., Windows Internet Security, Prentice Hall, PRT, 2001.
2. Schetina, E., Green, K., Carlson, J., Internet Site Security, Addison-Wesley, 2002.

Unit 8.

1. Fogie, S., Peikari, C., Windows Internet Security, Prentice Hall, PRT, 2001.
2. Stallings, W., Cryptography and Network Security: Principles and Practice, Prentice Hall, 2002.
3. Schetina, E., Green, K., Carlson, J., Internet Site Security, Addison-Wesley, 2002.

Unit 9.

1. Twicky, E.D., Cooper, S., Champman, D.B., Building Internet Firewalls, O'Reilly, 2000.
2. Cheswick, W.R., Bellovin, S.M., Rubin, A.D., Firewalls and Internet Security: Repelling the Wily Hacker, Addison-Wesley Professional, 2003.

Unit 10.

1. Icove, D., Seger, K., VonStorch, W., Computer Crime-A Crimefighter's Handbook, O'Reilly & Associates, Inc. Sebastopol, 1995.
2. Skoudis, E., Zeltser, L., (2003.): Malware: Fighting Malicious Code, Prentice Hall PTR, Upper Saddle River, New Jersey

Unit 11.

1. Northcutt S, Novak, J. Network Intrusion Detection, New Riders Publishing, 2002.

Unit 12.

1. Icove, D., Seger, K., VonStorch, W., Computer Crime-A Crimefighter's Handbook, O'Reilly & Associates, Inc. Sebastopol, 1995.
2. Northcutt S, Novak, J. Network Intrusion Detection, New Riders Publishing, 2002.

Unit 13.

1. Icove, D., Seger, K., VonStorch, W., Computer Crime-A Crimefighter's Handbook, O'Reilly & Associates, Inc. Sebastopol, 1995.

Unit 14.

1. Dragičević, D., Kompjuterski kriminal i informacijski sustavi (Computer Crime and Information Systems), Informator, 1999.
2. Saunders, K. M. Practical Internet Law for Business, Artech House, 2001

Course title: DATA WAREHOUSES AND BUSINESS INTELLIGENCE

Lecturers	Full Prof. Kornelije Rabuzin, Ph.D.
Language of instruction	English
Study level	Master
Study programme	Data Bases and Knowledge Bases / Business Systems Organization
Semester	Summer
ECTS	5
Goal	Goal of this course is to introduce the students to basic principles of constructing and applying data warehouses technology, which should result in better decisions and performance improvements. At the end of the course, students should be able to select a data warehouse project, justify the price of a project, plan a data warehouse project, estimate the completeness of the plan, choose the appropriate architecture components, build a good quality data warehouse, integrate the knowledge of business systems and IT and thus achieve the maximum value of such an investment.
General and specific learning outcomes	
Content	Structural basics 1. Introduction to data warehouses and business intelligence Data warehouses (DW). Business intelligence (BI). Decision support systems (DSS). Differences between data warehouses and operational databases. Data Mart. OLAP Systems. 2. Framework for understanding data warehouses General architecture. Data warehouse components. Goals of building a data warehouse. Complexity of building and using data warehouses. Information retrieval. 3. Modeling data warehouses Dimensional modeling. Business processes. Granularity concept. Identifying facts. Entity, star and snowflake models. General data warehouse architecture application. Practical guidelines. ERA diagram. Drawbacks of ERA diagram in the context of building data warehouses. Bus architecture. 4. Fact tables Transactional fact table. Periodical fact table. Accumulating fact table. Non-additive data. Semi-additive data. Additive data. Data atomicity. Data quality. Non-existing data. Aggregated data. Allocating. 3NF. Denormalized tables. 5. Dimensional tables Dimension concept. Selecting dimensions. Number of dimensions. Degenerative dimensions. Mini-dimensions. Outrigger. Junk dimensions. Role-playing. Attributes. Altering attribute values in dimensional tables. Codes. Data hierarchy. 6. Building a data warehouses (a step-by-step guide) Requirements. Analysis. Design. Construction. Organization. Expansion. Data integration and distribution. Data quality validation. Analysis of different properties (redundancy, normalization) and the desire to (not) include them in the data warehouse. Basic development requirements. Simplicity. Velocity. 7. Planning and managing the data warehouse implementation and development project

	Project planning. Development and organization of data warehouses. Business requirements analysis. Analysis of data warehouse technology implementation costs. Initial organization. Dimensional modeling. Technical design. Physical design. Software package selection. Analytical requirements. Data acquisition. Setting up the solution. Data warehouse management. **8. Metadata management** Importance of metadata. Storing and managing metadata. Metadata standards. Data warehouse usage. Purpose. Potential. Applications. Users and user needs. Usage. **9. Information processing: queries and reports** Business queries modeling. Users and environment. Functions. SQL. Economy considerations. Trends. **10. Analytical processing** Multi-dimensional analysis. OLAP architecture. OLAP system types. ROLAP. MOLAP. Technical requirements and considerations. **11. Data mining** Statistical analysis. Knowledge discovery. Deductive databases. **12. Analysis of concrete practical examples (Part I)** An example of building a data warehouse (orders management, sales, education, items storage). **13. Analysis of concrete practical examples (Part II)** An example of building a data warehouse (customer relationship management, employees management, financial services). **14. Assignment – modeling a data warehouse of a selected business systems** Project phases. Model construction. Dimensional modeling. Model analysis. Discovering possible drawbacks. Discussion. **15. The current practice** Implementation approaches. Product analysis. Guide for product evaluation. Examples. Final remarks.
Exercises	Using adequate graphical tools, the students learn to design and build a data warehouse and create different data reports.
Preconditions	Databases I
Realization and examination	Class: lectures, seminars, laboratory exercises Examination: Students take two written exams throughout the semester. After passing the laboratory exercises and presenting the seminar project, students can take the final oral exam.
Related courses	1. Carnegie Mellon University, Data warehouses 2. Imperial College, London, Department of Computing, Knowledge Management Techniques.
Literature	**Basic:** **1.** Lectures **2.** Ralph Kimball, Margy Ross: The Data Warehouse Toolkit, Wiley, USA, 2013. **3.** Ralph Kimball, Margy Ross, Warren Thornthwaite, Joy Mundy, Bob Becker. The Data Warehouse Lifecycle Toolkit. Wiley. 2008. **Additional:** **1.** W. H. Inmon: Building the Data Warehouse, 4th edition, Wiley, 2005. **2.** Arshad Khan: Data Warehousing 101: Concepts and Implementation, Khan Consulting and Publishing, 2003.
Online sources	http://en.wikipedia.org/wiki/Data_warehouse

	http://www.dwinfocenter.org/ http://datawarehouse.ittoolbox.com/

Course title: ERP SYSTEMS

Lecturers	Prof. Ruben Picek, Prof. Neven Vrček
Language of instruction:	Croatian and English
Study level	Master
Study programme	Information and Software Engineering/Business Systems Organization
Semester	Winter
ECTS	5
Goal	Introducing students to the role of ERP systems in modern companies. The course describes the way ERP system is used in business, and shows relation between business processes and modules which make such complex information systems. Structure of ERP systems is analyzed on theoretical and practical level. Importance of organizational preparation for selection and implementation of ERP system is emphasized. The course analyses the methods and the tools for evaluation of organization, selection and implementation of ERP systems and maintenance of achieved effects. Projects structure, resources, roles and responsibilities needed for efficient implementation are also being analyzed. Student will, through the various roles, learn how to work in one commercial ERP system.
General and specific learning outcomes	
Content	1. Introduction into business information systems Historical development: MRP, MRPII, ERP. Definition and concept of ERP systems. Role of ERP system in the modern enterprise (once-present). Advantages and disadvantages. ERP market - overview of the leading ERP software packages. 2. Architecture of ERP systems Structure and possibilities of ERP modules. Limitation of ERP systems and need for development of special modules. Structure (core / modules RDBMS) and capabilities of ERP modules. Limitations of ERP systems and the need for developing additional modules. Practical work with ERP system. 3. Reasons for implementation of ERP systems How ERP can improve effectiveness of a company's business. Business analysis of the need for change. Business process modeling and Business process performance and improvements, BPR. Impact identification and quantification. Strategic decision: new ERP yes / no. Calculation of return on investment and all costs associated with deploying and maintaining ERP system (software licenses, consultants, education ...) 4. Business process Modeling, Reengineering and Alignment with ERP systems Strategic goals and their influence on business processes. Organizational infrastructure and support to key business processes. Analysis of business processes. Map of business processes. Analysis of gap between business processes and possibilities of ERP systems. Increasing of efficiency of business processes and reorganization of business processes connected to implementation of ERP system.

5. Selection of ERP systems

Selection - strategic decisions. Organizational infrastructure and support key business processes. Selecting opportunities (buy standard system, own development, rent ASP, outsourcing). Selection criteria. Selecting approaches. The process of selecting ERP system. Methods of selection. Criteria for ERP system evaluation. Tools to support selection / evaluation of ERP solutions. Misconceptions and errors with the selection

6. Project management of ERP system implementation

Project team structure (roles and responsibilities). Planning the dynamics of project activities. The definition and analysis of organizational preparation. Methods and tools for the analysis of organizational preparation. Preparing Organizations (key users and their education). Challenges and risks of the implementation. Cost

7. Implementation of ERP systems

Analysis of technological infrastructure needed for implementation of ERP systems. Problems connected to local and global installations. Project team structure. Project management and dynamics of project activities. Key users and their education. Setting ERP systems.

8. Methodologies of ERP systems

Analysis of technological infrastructure needed for implementation of ERP systems.

9. Managing configuration and changes of ERP systems

Key parameters and possibility of their change. Monitoring organizational changes and their input into system. Definition and analysis of organizational readiness. Methods and tools for analyses for organizational readiness. Preparation of organization. Planning development of missing knowledge.

10. Effects and business failures of ERP system implementation

The effects of the ERP system implementation in organization. Problems. The reasons for failure of ERP implementation. Errors. Real side of implementation. Commercial failures vs. effects. The analysis of case studies - practical examples.

11. Cloud ERP systems

ERP systems in Cloud. The architecture of the cloud ERP solutions. Models. Types. Differences in On-premise and Cloud ERP systems. Acceptance of Cloud ERP Systems. Analysis of Key Drivers and Barriers, Researches (Gartner, Forester group, Faculty scientific research's). Examples in Azure platform.

12. ERP systems and interoperability

Connecting ERP systems with an external program. Analysis of different approaches linking ERP systems. Connecting ERP system and e-business (matrix). The possibility of linking ERP system and the relevant standards.

	Technical and semantic connectivity problems. Integration of the new technologies and Cloud ERP system. 13. Intelligent ERP systems (iERP) Trends and new technologies. Impact of digital business transformation and related technologies (CC; IoT, ML, AR, VR,,…) on ERP systems.
Exercises	On exercises students will use one standard commercial ERP system and will be introduced to its parameters, setup principles and usage from different roles. Working in one virtual organization they will be familiarized with basic business modules (business function) and their connection. The goal is through the various roles take all aspects of ERP systems.
Realization and examination	Classes: lectures, seminars and exercises Exam: written and seminars
Related courses	1. City University, London (Business Engineering with ERP Systems), UK http://www.city.ac.uk/ 2. Central Michigan University, USA http://sap.mis.cmich.edu/
Literature	1. M. Bradford, Modern ERP: select, implement, et use today's advanced business systems. Raleigh, NC: North Carolina State Univ., 2015. 2. A. Maheshwari, Digital transformation: building intelligent enterprises. Hoboken, New Jersey: Wiley, 2020. 3. A. Leon, ERP demystified. New Delhi: Tata McGraw-Hill, 2008. 4. A. Leon, Enterprise resource planning, 2. ed., 9. reprint. New Delhi: Tata McGraw Hill, 2010. 5. Daniel E. O'Leary. Enterprise Resource Planning Systems: Systems, Life Cycle, Electronic Commerce, and Risk, Cambridge University Press; 2000 6. Bret Wagner, Ellen Monk: Concepts in Enterprise Resource Planning, Third Edition, 2008. 7. Godfrey Glenn: Enterprise Resource Planning 100 Success Secrets: 100 Most Asked Questions: The Missing ERP Software, Systems, Solutions and Applications Guide, 2008.

Course title: KNOWLEDGE BASES AND SEMANTIC WEB

Lecturers	Full Prof. Sandra Lovrenčić, Ph.D., Vlatka Sekovanić, mag.educ.inf.
Language of instruction:	Croatian and English
Study level	Master
Study programme	Databases and Knowledge Bases
Semester	Winter
ECTS	5
Goal	Goal of course Knowledge Bases and Semantic Web is to teach students about two important, intertwined areas that are dealing with intelligent structuring and intelligent data (information) processing in the Web environment. Structured data, in mutual dynamic interaction, with combination of classic search and deductive derivation, result in knowledge bases. Lately, concept of knowledge base is replaced by concept of ontology. Semantic Web is placed in Web context and ensures intelligent approach to heterogeneous, distributed information content. Application areas are constantly spreading and today comprise knowledge management (including business rules systems), electronic commerce (including automatic negotiation systems), information exchange, natural language processing etc. The course will give students necessary theoretical knowledge, teach them about modern programming languages and tools, and train them through practical work on computers to use and develop Semantic Web systems . After the completion of the course, the students should be able to: 1. Be able to identify and explain the constituent elements of Semantic Web applications 2. To be familiar with the latest technologies and tools for knowledge bases development within the Semantic Web 3. Understand and describe the basic principles, goals and structure of the Semantic Web 4. Understand the concept of knowledge bases and describe their structure 5. Understand the concept of ontology as a knowledge base and adopt the method of ontology development and validation 6. Understand the purpose and possibilities of knowledge bases and explain their use 7. Know how to carry out structural subsumption and Tableau algorithm for reasoning over knowledge bases 8. Know how to develop a knowledge base (ontology) with standardized languages using description logics
General and specific learning outcomes	
Content	1. Semantic Web Vision – Current Web. From initial vision of Web towards Semantic Web - historical development. Development phases. Fundamental principles of Semantic Web. Application areas. 2. Semantic Web Layers (technologies) - Purpose and interconnection of Semantic Web technologies. Technology and languages pyramid: URI/IRI, XML, data exchange, ontologies, queries, rues, logic, proof,

	trust, user interface and application, cryptography. Other technologies and standards of Semantic Web. 3. Architecture for knowledge management within Semantic Web - knowledge representation with ontologies (knowledge bases). Ontology definition. Types of ontologies. Formal representation of ontologies. Ontology development methods. Ontology examples. Tools for knowledge representation. Evaluation of knowledge bases. 4. Introduction to Description Logics (DL) – Definition and development. Connection to first order logic. Knowledge representation in DL. ALC language – syntax and semantics. TBox, RBox and ABox. Extensions of ALC language. Knowledge base modelling in DL. Reasoning over knowledge base in DL: structural subsumption and tableau algorithm. 5. Basic format for knowledge representation within Semantic Web – RDF and RDF Schema. RDF graph. Basic concepts – resources, properties, statements. Resource description. RDF Serializations. Data types. Reification. Containers and collections. Classes and instances. Class hierarchy and inheritance. 6. Enhancement of expressiveness and support to reasoning over knowledge bases - OWL1 – sublanguages (layers), OWL2 – profiles. Development and current possibilities. Constraints and interconnectedness of languages. Equivalent and disjoint classes. Object and data properties. Inverse, equivalent, disjoint and negative properties. Special properties. Property restrictions. Property chains. Keys. Class combinations. Restriction of data types. 7. Knowledge base search – Syntax and semantic of query language. Basic query forms. Query modifiers. Simple and complex queries. Linked open data (LOD cloud). DBpedia. Examples of search engines. 8. Application of knowledge bases and development of the field of Semantic Web – Existing soultions that apply Semantic Web technolgies. Examples of knowledge bases and applications from various domains (knowledge management, electronic commerce, medicine…). Knowledge bases as part of knowledge representation and reasoning in Artificial Intellgience. Web of data and graph databases.
Exercises	Exercises - As part of the exercises, students will use modern tools and languages to work with knowledge bases (ontologies) and to perform knowledge reasoning. They will develop smaller formal ontologies, as well as learn about some of the possibilities of technologies for the development of the Semantic Web. Seminars - As part of the seminars, students will compare and analyze individual topics from lectures (for example, specific sample knowledge bases or reasoning tools). They will also independently process (critical review) and present certain topics from the area covered by the subject.

Realizationand examination	Class: lectures, seminars, exercises Examination: written exam, seminar paper, exercises, activity
Related courses	1. Ontology Engineering for the Semantic Web, University of Manchester, School of Computer Science, http://syllabus.cs.manchester.ac.uk/pgt/2021/COMP62342/ 2. Semantic Web and Linked Data,University of Jyväskylä, Faculty of Information Technology, http://www.mit.jyu.fi/ai/vagan/itks544.html 3. Ontology Engineering, Tetherless World Constellation (TWC) at Rensselaer Polytechnic Institute, https://tw.rpi.edu/web/Courses/Ontologies/2020 4. Semantic Web, Maastricht University, https://www.maastrichtuniversity.nl/meta/415108/semantic-web 5. Semantic Web Techniques, University of New Brunswick: Faculty of Computer Science, http://www.unb.ca/academics/calendar/graduate/current/courses-/fredericton-courses/computer-science-courses/cs-6795.html
Literature	Basic: 1. C. M. Keet, An Introduction to Ontology Engineering, London: College Publications, 2020 2. M. Uschold, Demistifying OWL for the Enterprise, San Rafael, CA: Morgan & Claypool, 2018 Additional: 1. F. Baader et al., An Introduction to Description Logic, Cambridge, UK: Cambridge University Press, 2017 2. R. Arp, B. Smith and A. D. Spear, Building Ontologies with Basic Formal Ontology, Cambridge, MA: The MIT Press, 2015 3. P. Szeredy, G. Lukácsy and T. Benkő, The Semantic Web explained: the technology and mathematics behind Web 3.0, Cambridge, UK: Cambridge University Press, 2014 4. D. Wood et al., Linked Data: Structured Data on the Web, Shelter Island, NY: Manning Publications, 2014 5. RDF, RDFS; OWL and SPARQL standards 6. Lecture materials

Course title: MULTI-AGENT SYSTEMS

Lecturers	Assoc. Prof. Markus Schatten, Ph.D., Bogdan Okreša Đurić, M.Inf. Tomislav Peharda, mag. Inf.
Language of instruction	Croatian and English
Study level	Master
Study programme	Databases and Knowledge Bases
Semester	Winter
ECTS	4
Goal	The main objective of the course is to introduce students to the fundamental theoretical and practical principles of multi-agent systems. The course is focused on the formalization of multi-agent systems' features by applying various approaches including reasoning about knowledge, game theory, swarm theory, organization theory, automated negotiation, logic argumentation and automated planning. At the end of this course students should be able to: present several application domains as a multi-agent system, model multi-agent systems using various formalisms including Kripke structures, finite automata, matrix algebra; analyze the features of multi-agent systems (calculating satisfiability of formuale) in the context of a given Kripke structure by using PLKT (a formal multi-agent system language) andunderstand multi-agent system implementation problems. Students will also be introduced to multi-agent system implementation methodology and applications of agent technology by implementing a multi-agent system of their own.
Content	1. Introduction Overview. Global computing. Agents – a definition. Multi-agent systems (MAS). MAS interdisciplinarity (distributed systems, artificial intelligence, game theory, social science). Some views on MAS. Critics of MAS. 2. Symbolic logics Preposition logic: syntax, semantics, logic consequence, catalogue of equality for preposition logic. First order logics: syntax, semantics, logic consequence, catalogue of equality for first order logic 3. Intelligent agents

	What is an agent? Agent and objects. Agents and expert systems. Agents and artificial intelligence. Environments. Agents as intentional systems. Intelligent agent's abstract architecture (formalization). 4. Deductive reasoning agents Introduction. Agents as theory provers. Selection of actions through deductive reasoning. Belief-desire-intention (BDI) agent model. Finite automata. Agent oriented programming. 5. Practical reasoning agents Practical reasoning. Intentions in practical reasoning. Intentions vs. desires. Automated planning. Box world. STRIPS. Implementing practical reasoning agents. Agent control loop. 6. Interaction and agreement Introduction. Agent interaction. Game theory. Nash equilibrium. Prisoners Dilemma (PD). Iterated (PD). Backward induction. Axelrod's tournament. Other symetric games. Agreement. Protocols. Auctions. Negotiation. Biateral negotiation. Qualitative valuations. Fuzzy sets. Multilateral negotiation. Negotiation strategies. Argumentation. Logic argumentation. Abstract argumentation. 7. Reasoning about knowledge Possible worlds' model. PLK language (proposition logics + knowledge). Examples of knowledge calculations in Kripke structures. General knowledge and distributed knowledge. Group knowledge. Characteristics of agent knowledge. Temporal operators: temporal operators for the future, temporal operators for the past. PLKT language. PLKT language graphic representation. Forgetfulness operators and PLKTF. Graphical PLKTF (GPLKTF). 8. Methodologies Introduction. MAS methodologies overview. Network science. Graph theory. MetaMatrix model. Matrix algebra. Modeling dynamics. Organizational design of MAS. 9. Swarm intelligence Introduction. Swarms in nature. Characteristics of swarms. Stigmergy. Self-organization. Social insects. Ants. Agent based modelling of ant colonies. Spanning trees. Minimal spanning trees. Combinatorial optimization. Ant

	colony optimization (ACO). ACO algorithms. Travelling salesman problem (TSP). ACO for TSP.
Exercises	During the whole semester laboratory exercises will introduce students to the practical aspects of the theoretical knowledge presented in the lectures. Content of exercises: a. Simple agents b. Agent behavior c. Agent communication d. Agent's and system's services e. Agents with finite state machine behavior f. Agents with event (trigger) behavior g. BDI agent infrastructure h. Agent's knowledge base i. Automated planning j. Auctions k. Negotiation l. Example MAS applications
Realization and exam	Classes: Lectures, Laboratory exercises; Examination: Practical project, written and oral examination.
Related courses	1. Imperial College, London, Department of Computing, Multi-Agent Systems 2. Stanford University, Department of Computer Science, Multi-Agent Systems 3. Rice University, Department of Computer Science, Reasoning about Knowledge
Literature	Basic: 1. Lectures 2. Fagin, R. et al. Reasoning About Knowledge, The MIT Press, 2001. 3. Wooldridge, M. An Introduction to MultiAgent Systems, John Wiley & Sons, 2002 Additional: 1. Maleković, M. Agent Properties in Multi-Agent Systems. Informatica, An International Journal of Computing and Informatics, 1999, 23, 283-288.

	2. Maleković, M. and M. Čubrilo. Some Properties of Forgetfulness in Multi-Agent Systems. Proceedings, 2002 IEEE International Conference on Intelligent Engineering Systems, INES 2002, pp. 361-362. 3. Minker, J. Logic Based AI, Kluver Academic Publishers, Boston, 2000 4. Subrahmanian, V. S. et al. Heterogeneous Agent Systems, The MIT Press, 2000
Internet sources	https://www.turing.ac.uk/research/interest-groups/multi-agent-systems

Course title: ORGANIZATIONAL PERFORMANCE MEASUREMENT

Lecturers	Asst. Prof. Martina Tomičić Furjan, Ph.D., Full. Prof. Robert Fabac, Ph.D.
Language of instruction	Croatian and English
Study level	Master
Study programme	Business Systems Organization
Semester	Winter
ECTS	5
Goal	The development of an organizational performance measurement model and its corresponding measurement system is a process covered by the continuum of strategic planning of an organization. Each model is, like any organization, unique and specific, but it is possible to define procedural guidelines and steps, which organizations can apply to make the development process easier and more successful. This course is aimed for students in graduate level to learn how to develop a strategic plan for an organization, that includes performance measurement as its focus, using Balanced Scorecard as the most common performance measurement method.
General and specific learning outcomes	
Content	1. Organizational strategy documents. Strategic plan as a source of organizational goals. Strategic information system development plan that should support the achievement of organizational goals. Performance measurement plan that enables management to see at any time, through the use of IT, how far the organization is from achieving its goals. Harmonized development of these documents as a precondition for managing performance measurement. 2. Metamodel of organizational documents. Processes of creating organizational documents. Data model of organizational documents. Process and data perspectives of organizational documents management. Metamodel of methods for creating organizational documents. 3. Basic Concepts of Performance Measurement. Systematic view of organization in the environment. Input-process-output-outcome presentation. Reasons for introducing performance measurement: continuous organizational management and targeted program valuation. Syntax and semantics of organizational goals. 4. Strategic Management Continuum.

Organizational mission. Mission development. Organizational vision. Relationship between the vision and strategic goals. All elements of the strategic management continuum.

5. Modeling of the Strategic Management Continuum

Structure of the Strategic Management Continuum. Results of the application of the management method. Metamodel of the Strategic Management Continuum.

6. Development of strategic management based on performance

Basics of Balanced Scorecard. Development of a performance measurement management model using BSC method (BSC model). A table for analyzing strategic goals. SWOT analysis as a source of strategies. Activities for strategy implementation. Activity goals. Paths of organizational goals. Setting goals to the BSC model perspectives: finance, users, internal processes, and learning and growth. Perspectives of the BSC model for private and public sector organizations. Cause and effect chains in the strategic map of goals. (2 hours)

7. Ontology of performance measurement

Metamodel SWOT analyzes through a process and data view. Modeling cause and effect chains. Metamodel of strategic themes. Metamodel of the table for analyzing strategic goals.

8. Measurement instruments of the BSC model

Relationship between goals and measures. The value of the measure as an indicator of achieving the goal. Structure of the measuring instrument: measure ID, name of measure, type of measure, method of measurement, limit value, factors of influence. Factors of influence. Table for analyzing measures. Cause and effect chain of measures. Leading measures and lagging measures. Determine value of measures.

9. Metamodel of measuring instruments

Metamodel of the strategic map of measures. The link between the SWOT analysis metamodel, goals and measures. Performing a unique meta-model of BSC methodology. Metamodel of the table for analyzing measures. Modeling the link between goals and measures.

10. Cascading goals and measures.

Decomposition of strategic goals. Strategic maps of goals. Tactical maps of goals. Goals and Organizational Forms. Matrix of goals classification. Cascading goals. The cause and effect chain of tactical goals.

11. Metamodel of organizational management in cascading

Modelling the process of goals. Semantic of strategic and tactical goals. Activity flow diagram of cascading the organizational goals. Metamodeling the cascading method.

12. Operative use of the BSC model

Introducing the BSC model as an organization management system. Key roles in organizational use/application of the BSC model in organizational use/application of the BSC model: owner, manager, BSC model designer, BSC model administrator, database administrator (BP). Verification and validation of the BSC model.

	13. Tools for performance measurement support Software tools that support the measurement of organizational performance. Structure of CASE tools repository for model development. Use of CASE tools for model development. **14. Process for CASE tool development supporting the BSC model** Ontology of CASE measurement support tool. Metamodel of the BSC method as core for a CASE tool. Model of applying the BSC method. Metamodel of the results of the BSC method. **15. Examples of BSC management support tools** Microsoft Office Business Scorecard Manager. Microsoft Office Business Scorecard Builder. Dialog strategy. AdoScore. Structure and ways of using these tools. Tools for strategic organizational measures vs. Tools for diagnostic organizational measures.
Seminars and exercises	In seminars, students solve problems and discuss examples of organizational performance measurement. As additional assignment, students can choose to make a presentation of a theme of interest and introduce it to other students in the group. In exercises, students develop a performance measurement model for a real-life organization and implement it in a CASE tool (AdoScore).
Exam	Student presentations at seminars (optional), real-case performance measurement model development in lab. exercises, oral exam.
Related courses	1. Performance Measurement and Performance Indicators - https://www.ntnu.edu 2. Measuring and improving business performance - https://www.ecornell.com
Literature	**Basic:** 1. Organizational performance measurement - course materials, available on the e-learning system. **Additional:** 1. Kaplan, R.S.; Norton, D.P.: Using the Balanced Scorecard as a Strategic Management System. Harvard Business Review, 1996. 2. Norton, R.S; Kaplan, D.P.: The Strategy-Focused Organizations: how balanced scorecard companies thrive in the new business enviroment. Harvard Business School, Boston, 2001. 3. Dobrović, Ž.: Strategic Planning under Uncertainty: Building the metamodel, Journal of Information and Organizational Sciences, Faculty of Organization and Informatics, Varaždin, 2002. 4. Niven P.R.: Balanced Scorecard: Step-by-Step, John Wiley & Sons, Inc., 2002. 5. Tomičić M., Dobrović Ž.: Metode oblikovanja strateške mape ciljeva kod izgradnje BSC, Zbornik radova savjetovanja CASE 18, Opatija 2006.

Course title: INTELLIGENT SYSTEMS

Lecturers	Full Prof. Božidar Kliček, Ph.D., Assoc.Prof. Dijana Oreški, Ph.D.
Language of instruction:	Croatian and English
Study level	Master
Study programme	Databases and Knowledge Bases
Semester	Winter
ECTS	4
Goal	This course studies how to realize the intelligent behaviors of a computer. The ultimate goal of intelligent systems (IS) is to make a computer that can learn, plan, and solve problems autonomously. Although IS has been studied for more than half a century, we still cannot make a computer that is as intelligent as a human in all aspects. However, we do have many successful applications. In this course, we will study the most fundamental knowledge for understanding Artificial Intelligence. We will introduce some basic search algorithms for problem solving; knowledge representation and reasoning; pattern recognition; fuzzy logic; and neural networks.
General and specific learning outcomes	
Content	1. Introduction Overview of intelligent systems taxonomy, methods and architectures. 2. Formal methods, search methods and heuristics; genetic algorithms Mathematical models, graphs and decision trees. Induction and search trees. Simple tree searching methods: first in depth, width and iterative deepening. Heuristic search. Partial search. Formal models of forward and backward chaining, conflict resolution, hybrid approaches. Optimization algorithms. Local minimum problem. Genetic algorithms: introduction, problem representation, description of algorithms, operations: selection, crossover, mutation. A typical example of genetic algorithm application, parameter variation. Technical resources for implementation. Variations of genetic algorithms. Parallel genetic algorithms. Comparison with other paradigms. 3. Uncertainty The probability theory, the finite probability spaces, conditional probability and the Bayesian theorem, the independence of complex events, and random variables. Bayesian networks and directed acyclic graphs. Types of Bayesian Networks. Dempster-Schafer theory of belief. Fuzzy sets, fuzzy logic and fuzzy reasoning. 4. Knowledge representation Object oriented Systems. Encapsulation, binding variables, messages and call functions, framework-based systems. 5. Agents Intelligent agents. Intelligent agents. Agents and Objects, Architecture, Multi-Agent Systems. Properties, structure, types, environment, environment description. 6. Learning Symbolic learning. Induction. Decision trees learning. Case based reasoning: basics, calculation problems, modified metrics, choice of relevant features. 7. Neural networks

	Neural Networks: biological and artificial neurons. Supervised learning (perceptron, single layer and multilayer), radial neurons, time delay networks. Neural networks for unsupervised learning. Overview of neural network models, fuzzy neural networks, hierarchical and modular networks. 8. Deep learning Deep learning foundations. Technologies that are drivers of deep learning. 9. Big data Big data characteristics. Understanding of 4V-s. Organization, analysis and interpretation of big data. 10. Artificial intelligence - the revolution of human society in the 21st century What are the Artificial Intelligence perspectives? Will machines destroy us? Will we live in the "Matrix," like the toys in the hands of powerful computers and robots, whose future power can not even be considered? Or will humanity enjoy the benefits of the new technological revolution?
Exercises	1. Chaining and searching Techniques for searching. Heuristic search. Backward and forward chaining – benefits and limitations. Comparison of chaining approaches. 2. Genetic algorithms Introduction to genetic algorithm theory. Basic concepts - chromosomes, genes, genotypes, generations, fitness functions, reproductions, crossings, mutations. Genetic algorithms development phases - an overview of possible solutions to problems over the chromosomes, generating more generations of chromosomes, chromosome efficiency, random selection. Analysis of a simple example of using genetic algorithms. Accounting Tasks. Creating a example of genetic algorithms - XpertRule Knowledge Builder. Determining the variables. Defining attributes. Making a procedure. Connecting variables and genetic algorithms through procedures. Making decision trees. The optimization. Programming Tasks. Optimization with genetic algorithms. Creating Complex Programming Examples - XpertRule Knowledge Builder. 3. Uncertainty – Bayesian nets Bayesian theorem. Belief measures – characteristics. Example of mathematical calculations. 4. Uncertainty factors Definition of fuzzy variables. Differences between uncertainty and fuzzy variables. Impact of uncertainty on reasoning. Operations with fuzzy variables. Examples and case studies. 5. Big data Overview of tools for storage, visualization and analysis of big data. 6. Neural networks Neural networks principles. Basic terminology - neurons, input and output layers, weights, internal activation, sigmoid, tanh. Matematical models of neural networks. Neural networks modeling in BigML tool. Back-propagation algorithm. Multilayer network. Unsupervised learning. Training and testing of network. Learning of networks. Parameters of learning. Unsupervised and supervised learning. Neural networks learning tools. Learning and testing. Determination and initialization of weights in the network. Setting up learning parameters and checking learning outcomes. Network optimization. 7. Deep learning Deep learning basics. Technologies for deep learning. Overview of principles and tools for deep learning. 8. Python for Data science

	Python specifics for big data analytics. Lists in Python. Functions and pacakages. NumPy. Jupyter notebooks. Pandas. Matplotlib. Git.
Realization and examination	Classes: lectures and exercises
Related courses	1. Foundations of AI, Albert-Ludwigs-Universität Freiburg, Institut für Informatik
Literature	Basic: 1. Luger, G.F. Artifical intelligence: structures and strategies for complex problem solving. 6th ed., Pearson Addison Wesley, Boston, 2009. 2. Munakata, T. Fundamentals of the new artificial intelligence: neural, evolutionary, fuzzy and more. 2nd ed., Springer, London, 2008. 3. Hopgood, A.A. Intelligent Systems for Engineers and Scientists. 2nd ed., CRS, Boca Raton, 2000. Additional: 1. Proceedings of the AAAI National Conference on Artificial Intelligence 2. Proceedings of the AAAI Innovative Applications of Artificial Intelligence Conference 3. Proceedings of the Florida AI Research Symposium Conferences (FLAIRS) 4. Proceedings of the Knowledge Discovery and Data Mining Conference

Course title: FINANCIAL MATHEMATICS

Lecturers	Full Prof Zlatko Erjavec, PhD Petra Žugec, PhD
Language of instruction [Croatian / English]	Croatian / English
Study level [Bachelor / Master]	Bachelor
Study programme	Information and Business Systems
Semester [Summer / Winter]	Winter
ECTS [number]	5
Goal	Introduction to basic concepts of financial mathematics necessary for understanding and development of models required for financial management and business calculations.
General and specific learning outcomes	1. Understand relevant factors that affect the business operation of an organization and individuals, and apply basic methods and concepts of business planning, management and accounting 2. Keep track of professional literature in Croatian and a foreign language, prepare and independently deliver presentations in Croatian and a foreign language to professional and general public, and critically evaluate a presented professional topic. 3. Understand and apply appropriate mathematical methods, models and techniques to solving problems in the information and business systems field.
Content	1. INTRODUCTION (2 hours) Introduction to the course – explanation of goals and purpose of the course. Repeating of definition, characteristics and graphs of elementary functions (1 hour) Arithmetic and geometric sequence - repetition. Interest -basic notations. Decursive and anticipative interest. (1 hour) 2. SIMPLE AND COMPOUND INTEREST (2 hours) Simple interest and simple discount. Compound inerest (1 hour) Nominal rate of interest. Sub-annual compounding. Annual effective interest rate. Derive of formula for equivalent rates. Continuous compounding. (1 hour) 3. ANNUITIES (3 hours) Accumulated value of a due simple annuity of n payments. Accumulated value of an ordinary simple annuity of n payments. Use of M. Excel financial function FV and Goal Seek tool.(1 hour)

	Discounted value of a due simple annuity of n payments. Discounted value of an ordinary simple annuity of n payments.. Small concluding payment. Use of M. Excel financial function PV, NPER, RATE. (1 hour) Ordinary general annuities. Other general annuities. Perpetuities. Ordinary simple perpetuity. Annuities whose payments vary. (1 hour) 4. LOAN (2 hours) Basic notions. Types of loans according to means of payment. Loan payment by equal annuity (amortization). Construction of amortization schedule. Use of M. Excel financial functions PMT, RATE, IPMT and PPMT. (1 hour) Notion of refinancing a loan and types of loan refinancing. Loan payment through equal principal repaid. (1 hour) 5. ASSESSMENT OF INVESTMENT (1 hour) Notion of investments. Some methods of assessing investments justification: method of Net present value (NPV) and method of Internal rate of return (IRR). Use of M. Excel financial functions - NPV, IRR and MIRR. 6. DEPRECIATION (1 hour) Notion of depreciation and basic notions. Depreciation base. Methods of depreciation. The straight-line method. The declining-balance method. The sum-of-years digits method. The physical-service method and depletion. Use of M. Excel financial functions SLN, DB, DDB and SYD. 7. SIMPLE AND COMPOUND DISCOUNT (1hour) Simple discount. Equivalence between a simple interest rate and a simple discount rate. Annual effective discount rate. Accumulated value of principal in compound discount. Relation between a compound discount rate and a compound interest rate. Loan payment through equal annuity with respect of compound discount. Comparison of annuity in compound discount with annuity in compound interest. 8. LIFE INSURANCE (2 hours) Repeating of basic terms of probability theory. Conditional probability. Survival probability. Mortality tables. (1 hour) Pure endowment. Whole-life and n-year life annuity due. Discrete whole-life insurance. Endowment policy. (1 hour) 9. ANALYSIS OF PRACTICAL TASKS (1 hour) Analysis of practical tasks which teams of students complete through semester and present through seminars. Problems noticed in data gathering, team work and application of financial mathematic on practical problems. Propositions of new subjects for practical work.
Exercises	Regular attendance and active participation on classes, regular studying and doing homeworks, participate in preliminary exams and solving a practical task in teams.

Realization and examination	Efforts and knowledge of the students is assessing during semester through homeworks, presentations, problem task solving (practical tasks) in groups and three monthly tests . Student may achieve maximum of 100 points. If he/she gets more than 50 points, he/she passes the course. Students who do not fulfill the above mentioned criteria (at least 50 points) are subjected to written and oral examination, but only after they meet requirements for signature which is confirmation of regular attendance on classes.
Related courses	/
Literature	1. Zima, P., Brown, R. L.: *Mathematcs of Finance*, Schaum`s O.S.,1996. 2. Mc Cutcheon, J.J., Scott, W.F.: *Introduction to Mathematics and Finance*, Butterworth-Heinemann, 1989.

Course title: COMPUTER NETWORKS

Lecturers	Asst. Prof. Nikola Ivković, Ph.D., Assoc. Prof. Ivan Magdalenić, Ph.D., Elvis Popović, mag. Inf.
Language of instruction:	English
Study level	Bachelor
Study programme	Information and Business Systems
Semester	Summer
ECTS	6
Goal	This course introduces computer networks, network services and applications, and provides conceptual and practical knowledge for a successful IT career. The students are prepared to solve communication problems and determine parameters important for quality of service and efficient communication. The importance of layered approach of ISO-OSI and the modern Internet model will be explained and the inner working of networks is studied through the application, transport, network, and link layer, which is demonstrated by relevant protocols and network applications. The goal of the course is also to prepare students for more advanced topics and specialization in some areas for which conceptual and practical knowledge of computer networks is necessary such as computer security, internet of things, network application development, multimedia streaming, etc. This course develops critical thinking and promotes expert opinions and decisions based on the analytical approach, research, modelling, and simulation.
General and specific learning outcomes	1. Keep track of professional literature in Croatian and a foreign language, prepare and independently deliver presentations in Croatian and a foreign language to professional and general public, and critically evaluate a presented professional topic. 2. Understand and apply processes, methods and technologies pertaining to IT services and resources management, and provisioning and support of different ICT related services. 3. Understand and apply contemporary technical concepts and practices in information technologies (computer architecture, operating systems, computer networks).
Content	1. INTRODUCTION Computer networks, network elements, edge, core, access networks, data transfer, datagram switching, circuit switching, the structure of Internet, protocols and services. Performance, delays, packet loss, transmission rate, throughput, utilization. Modern internet model, ISO/OSI referent model, layers, encapsulation. The area of network security, attacks on network infrastructure and applications, malware, denial of service, packet sniffing, IP spoofing. 2. APPLICATION LAYER Conceptual and implementational aspects of application protocols and networked applications. Choosing a transport layer service model and an available protocol. The architecture of networked applications (client-server and peer-to-peer).

	Sockets and computer process in a network. Examples of important network protocols (e.g. DNS, Web, HTTP, e-mail, SMTP, POP3, IMAP, MIME, file transfer and automatic synchronization, SSH, …). Cookies, cache and proxies. Attacks on DNS and abusing DNS for multiplying attack. 3. TRANSPORT LAYER Multiplexing/demultiplexing, reliable data transfer over unreliable channel, efficiency of reliable transfer protocol, establishing connection, attack by abusing mechanism for TSP connection, flow control, congestion control, protocols UDP and TCP, fairness of TCP. Stateful and stateless protocols. 4. NETWORK LAYER – INTRODUCTION AND DATA PLANE Network layer service models, forwarding, routing, the architecture of router, switching datagrams, switching virtual circuits, data plane, protocols IPv4, IPv6, ICMP, IP addressing, subnetting, NAT, DHCP, fragmenting, tunneling. 5. LINK LAYER Link layer services and their implementation, error detection and error correction, multiple accesses protocols, MAC addresses, Ethernet, switch, bridge, hub, links, VLAN, local networks in data centers. 6. SYNTHESIS OF LAYERS Putting layers in together and examples of joint action of protocols and mechanisms. The lab practice is based on recording and analyzing real network traffic, using simulations, and network tools like traceroute, ping, nslookup, ipconfig, ifconfig, arp, netsh.
Realization and examination	Classes: Lectures, seminars and laboratory exercises Exam: Written and oral exam and seminars
Related courses	Similar courses at MIT.
Literature	Basic: Kurose, J.F.; Ross, K.W. Computer Networking: A Top-Down Approach. 8th edition, Pearson, 2021. Additional: Andrew S. Tanenbaum, Nick Feamster, David J. Wetherall. Computer Networks, 6th edition, Pearson 2021 L. L. Peterson , B. S. Davie. Computer Networks: A Systems Approach, 6th edition, Morgan Kaufmann, 2021

Course title: DATABASES I

Lecturers	Ph.D., Full Prof. Kornelije Rabuzin, Bogdan Okreša Đurić, Ph.D.
Language of instruction:	Croatian and English
Study level	Bachelor
Study programme	Information and Business Systems
Semester	Summer
ECTS	6
Goal	The goal of this course is to familiarize the students with the relational databases technology. Upon completing the course, the students should be able to understand the three components of the relational database management system, i.e., structural, operational and integrity component. In addition, they should be able to create and manage a relational database (including its creation, modification, queries, indexes, security and transactions) by using SQL.
General and specific learning outcomes	1. Keep track of professional literature in Croatian and a foreign language, prepare and independently deliver presentations in Croatian and a foreign language to professional and general public, and critically evaluate a presented professional topic. 2. Understand and apply key aspects of information technology (programming, algorithms, data structures, data and knowledge bases). 3. Understand and apply study skills needed for lifelong learning and continuation of education at the graduate level.
Content	1. Introduction Introduction to content and goal of the course, literature, organization of the classes and examination. 2. Database management systems (3 hours) Introduction to database management systems. Database. Database management system architecture. Data models. Database overview: relational databases, object / relational databases, temporal databases, deductive databases, object-oriented databases. An overview of systems and their features. 3. Basics of relational data model (2 hours) Relational data model. Relation. Structural component of the relational model. Operational component of the relational model. Integrity component of the relational model. Equality of relations. The key. Entity integrity. Reference integrity. Catalog of relational operators. 4. Introduction to SQL (2 hours) Overview of relational query languages: RA, SQL, QUEL, QBE. Introduction to SQL: SQL as a standard query language for relational and object / relational database management systems, database creation, database modification, relational algebra and SQL. SQL standard. 5. Creating objects (2 hours) Creating tables. Data types. Integrity constraints. Indexes. Change tables (ALTER). Users. Roles. Privileges. 6. Basic queries in SQL (queries over one relation) (2 hours) SELECT. FROM. WHERE. Projection. Selection: NULL, partial relation, arithmetic comparison operators, 3VL logic. Operators: IS [NOT] NULL, IN, BETWEEN, LIKE.

	7. Complex queries in SQL (multi-relationship queries) I (2 hours) Joins: natural join, LEFT JOIN, RIGHT JOIN. Union, cross-section and difference. Horizontal division of the relation (GROUP BY). HAVING clause - group conditions. 8. Complex queries in SQL (queries over multiple relations) II (2 hours) External reference. Sub queries and conditions (ANY, ALL, EXISTS). Functions. Stored procedures. Triggers. 9. Integrity constraints (2 hours) Types of integrity constraints. Implementation. Reference integrity. Maintaining referential integrity. Cycle. Database security: database security, database object security. Views. View update. 10. Transactions. (2 hours) Examples of transactions. A valid transaction. Transaction execution control module. Comparative execution of a set of transactions. Problems when executing transactions. BEGIN. COMMIT. ROLLBACK. ISOLATION LEVEL. 11. Conceptual database design (2 hours) Graphic languages for conceptual database design. Concepts and reality. Objects. Connecting objects. Graphic languages: ER, ORM, UML. Entity sets. Attributes. Connections. Diagrams. Multiplicity of binary connections. Types of relationships. Roles in relationships. Relationship attributes. Transformation of an n-ary relationship into a binary relationship. 12. UML modeling (2 hours) Associations. Classification. Generalization. Aggregation. Subtypes and super-types. Partitions. Generalization and inheritance. Weak entities. Constraint modeling: constraint classification, keys, uniqueness, referential integrity, degree of connection. 13. Logical database design (2 hours) The problem of logical database design. Database schema. Redundancy. Normalization. Database dependencies. Review of normal forms. Translating ER-diagrams into a relational database schema. 14. Logical database design - Part II (2 hours) Database dependencies. Functional dependencies. Join dependencies. Determining the key. 3NF and BCNF. Decomposition and its properties. The connection between conceptual and logical design. 15. Database management system development trends (2 hours) NoSQL and New SQL database management systems. Data warehouses. Business intelligence. Business analytics. Big data. Introduction to Databases II.
Exercises	By using an adequate database management system, the students acquire knowledge and skills needed for database administration and management.
Preconditions	Mathematics I
Realization and examination	Classes: Lectures, seminars and exercises. Examination: Students take two written exams throughout the semester. After presenting their seminar paper and passing laboratory exercises, the students are able to take the final oral exam.
Related courses	1. Monash University, Australia, “Introduction to databases”; 2. Stanford University, USA, “Data Management and Data Systems”; 3. Imperial College London, UK, Computing department, “Introduction to databases”.

Literature	Basic: 1. Lecture slides 2. Abraham Silberschatz, Henry Korth, S. Sudarshan: Database System Concepts, 7th Edition, McGraw Hill, 2019. 3. Elmasri Ramez, Navathe Shamkant: Fundamentals Of Database System, Pearson India, 2017. Additional: 1. Luc Perkins, Eric Redmond, Jim Wilson: Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement, 2nd Edition, Pragmatic Bookshelf, 2018. 2. Maleković M, Rabuzin K: Uvod u baze podataka, FOI, 2016. 3. C. J. Date: An Introduction to Database Systems, Addison Wesley, 2004.
Online sources:	1. http://www.microsoft.com/access 2. http://www.microsoft.com/sql 3. http://www.oracle.com , http://www.sybase.com 4. http://www.software.ibm.com/data/db2/ 5. http://www.acm.org 6. http://www.opengroup.org/index.htm 7. http://thebestweb.com/db/sqlrefs.htm

Course title: BUSINESS PROCESSES

Lecturers	Asst.Prof. Martina Tomičić Furjan, Ph.D., Assoc.Prof. Igor Pihir, Ph.D., Ana Kutnjak, M. Econ., Larisa Hrustek, M. Econ.
Language of instruction	Croatian and English
Study level	Bachelor
Study programme	Information and Business Systems, Economics of Entrepreneurship
Semester	Summer
ECTS	4 ECTS
Goal	Introduction to basic organizational business processes and presentation of a company as a system. Study in detail business logic and algorithms of typical business processes. Systematize information, material and other organizational flows. Explain the role of the latest information and communication technologies in company's performing, analyzing, and managing business processes.
General and specific learning outcomes	1. Consolidate the business logic and algorithms for realization of typical business processes, and a model of business rules specific for a given business field in different organizations. 2. Formally describe, by using appropriate methods and techniques, basic business processes and their execution algorithms. 3. Compare the applicability of algorithms of particular process flows in a concrete case. 4. Analyze optimal solutions in a business environment and align the design of an organization with the architecture of its information system. 5. Recommend the application of adequate methods and algorithms for solving a business problem situation, and formulate the options for support, automation and improvement based on the application of ICT. 6. Apply techniques and methods of project management to information and communication technologies (ICT) development and implementation projects. 7. Define and quantify project goals and subgoals, and relate them to activities, including risk analysis and indicators. 8. Prepare a project execution plan (time plan of activity execution, budget, required human resources and communication plan). 9. Determine information and material flows linking business processes into a logical business technology. 10. Analyse a business process model and data model for a given business field.

Content	1. Introduction to Operations Management. Concept of an organization. Systematic, organizational and functional presentation of an organization. Basic transformational process and the relation of a company with its environment. Organization as a system, its processes as elements of the organizational system, information, material and other flows as relationships between the elements. 2. Product planning and selling. Description of the planning process and product sales. Concept and phases of the sales cycle. Customer and buyer identification. Customer needs analysis and value proposition canvas creation. Demand forecasting as a technique of sales planning. Forecasting methods (method of time series and regression analysis). Measures of forecasting accuracy. Use of Excel for forecasting. Analysis of activities and data required to carry out sales planning. 3. Production and resource planning. Description of production and resource planning. Technical and technological production planning: process and product design, generating basic technical and technological documentation, generating Bill of Materials. Operative production planning: Master Production Schedule, Master and structural data of materials, Bill of materials explosion. Independent and dependent demand, Material requirements planning, Planned order releasing as results of MRP. Analysis of activities and data required to carry out production and resource planning. 4. Production capacities planning and scheduling in real conditions. Capacity requirements planning. Strategies of occupation of production capacities. Relationship between work order and workplace. Rational „lean" production management. Methods of scheduling according to the number of jobs and the number of capacities needed for jobs. Optimal division of labor on one, two or more resources. Supervision of work done. Personnel scheduling. Analysis of activities and data required to carry out production capacities planning and scheduling. 5. Purchasing, stock and warehouse management. Description of materials and production resources purchasing, Purchasing and stock management. Parameters of stock management. Models of stock management. Parameters of stock management. Stock costs. Minimal and maximal order quantities. Economic Order Quantity for different demand management models. Warehouse management. Technologies in warehouses. Warehouse management systems. Analysis of activities and data required to carry out Purchasing, stock and warehouse management. 6. Supply chain management. Concept of supply chain. Supply Chain Management. Managing supply chain elements Role and significance of suppliers in the supply chain. Contemporary ICT in SCM. Global supply chains. Distribution of materials and goods through the supply chain. Basics of the Transportation problem. Analysis of activities and data required to carry out supply chain management.

	7. Sales and operations planning. Framework of sales and operations planning (S&OP). Methods for conducting a „game plan" for allocation of capacities/resources and for determining strategies for demand fulfillment. Optimal production quantity in relation to production goals and resource constraints. Quantitative methods for S&OP. Costs determination for different production operative plans. Concept and general model of linear programming. Graphical model of linear programming – output mix problem in case studies. Analysis of activities and data required to carry out sales and operations planning. 8. Queuing and simulations. Concept of mass serving systems and queuing in production. Elements of a mass serving system. Serving users in mass serving systems Single server model. Multiple server model. Applying simulations to optimize queues. Basics of Monte Carlo simulations. Analysis of activities and data needed to optimize queues and run simulations. 9. Project planning and time analysis. Concept of projects and project planning. Project goal definition. Project team formation. Project planning through defining activities, project deliverables and project implementation responsibilities. Network diagram and Gant charts as a graphic presentation of project plans. Preceding's matrix. Rules of creating network diagrams. Project time analysis. Time calculation on the network diagram. Critical activities, critical path and project duration. Time reserves. Feedback and project supervision. Project implementation plan. Defining and quantifying project goals and objectives, and related activities, project deliveries and responsibilities. Computer tools for project planning and management. Analysis of activities and data required for project planning and time analysis. 10. Project examples, methodologies and certifications. Examples of goals, sub-goals, activities and project deliveries of real life projects. Project application: project structure, resource and cost planning. Examples of project implementation plans (implementation timetable, budget, required human resources and communication and sustainability plan). Methodologies and certifications in project management. 11. Quality assurance in processes. Concept of quality. Principles of total quality management (TQM). Quality costs. Product quality and service quality. Quality from the perspective of the manufacturer and the buyer or user of the product. Impacts of quality on productivity. Statistical quality control. Control cards and areas of application. Analysis of activities and data required for quality management. 12. Human resource management. The concept of human resource management. Historical development of human resource management. Fundamentals of Job Design and workplaces. Development and trends in human resource management. Employees as a strategic enterprise resource. Analysis of activities and data needed to implement HR management.

	13. Information systems for business process planning and implementation. The role of information systems in the planning and implementation of business processes. Information technologies in product design, production process design, product manufacturing and business support. Overview of functional requirements for creating software modules in SW tools and reviewing existing tools to support business process planning and implementation. Review of the criteria for deciding whether to purchase or develop tools to support business process planning and implementation. 14. Development trends in operations management. Actual development trends in the field of business process design, planning and implementation. The influence of development trends on the organization and the environment in which it operates. New information technologies and their application for improving business processes. The influence of new information technologies on the structure, culture and social system of organizations. 15. Introduction into related disciplines: business process modeling, organizational performance measurement, digital transformation of organizations. Concept of business technology and business process modeling. Methods and models for measuring organizational and process performance. Frameworks and methods for digital transformation.
Exercises	Students solve problems and discuss examples connected to algorithms for particular business processes. Every unit of lectures is accompanied by seminars, enabling the students to apply the acquired knowledge on practical examples.
Exam	written and oral exam
Related courses	1. Operations Management or Management of Operations in all business schools in Europe (e.g. Manchester Metropolitan University-Business School) and USA (e.g. University of Chicago- Graduate School of Business or MIT-Sloan).
Literature	Basic: 1. Operations Management - course materials, available on the e-learning system. Additional: 1. Russell, R.S., Taylor B.W.: Operations Management, John Wiley and sons, USA, 2011. 2. Brown, S., Bessant, J., Lamming, R.: Strategic Operations Management, Routledge, UK, 2013.

Course title: KNOWLEDGE MANAGEMENT

Lecturers	Full.Prof. Sandra Lovrenčić, Ph.D., Vlatka Sekovanić, mag.educ.inf.
Language of instruction:	Croatian and English
Study level	Bachelor
Study programme	Information and Business Systems
Semester	Winter
ECTS	4
Goal	The goals of the course are to familiarise students with the field and elements of knowledge management in organisation and to train them to apply the learned knowledge in practice. Students will learn the entire cycle of knowledge conversion in organisation and the mechanisms, technologies (with a focus on artificial intelligence) and the infrastructure that underpins it. They will be able to use the acquired knowledge for analysis and assessment of the situation and the disposition and design of knowledge management solutions, as well as for semantic modeling and reasoning. After the completion of the course, the students should be able to: 1. Connect types of knowledge, knowledge locations and infrastructure for knowledge management in organization. 2. Connect processes and subprocesses for knowledge discovery, knowledge acquisition and storing, knowledge sharing and knowledge application, and pertinent mechanisms and technologies. 3. Interpret the state of knowledge management in an organization based on of the impact of knowledge management on different elements of the organization. 4. Create a proposal of a priority order of knowledge management processes and subprocesses in an organization based on the value of factors determining the. 5. Formulate the possibility of support, automation and improvement on the basis of implementation of ICT in a knowledge management system in a particular business domain. 6. Devise a knowledge management system of a particular problem domain by linking all the elements of the of the knowledge management infrastructure in an organization in accordance with requirements specification. 7. Develop model of knowledge management system in cooperation with users, for scenarios and requirements related to a field of application being developed. 8. Design a relatively simple conceptual and semantic model of knowledge in an organization for a given business field. 9. Solve a simple knowledge reasoning problem.

General and specific learning outcomes	1. Analyze the state, identify opportunities and define problems faced by organizations and individuals in implementing ICT, and formulate solutions with the use of ICT. 2. Keep track of professional literature in Croatian and a foreign language, prepare and independently deliver presentations in Croatian and a foreign language to professional and general public, and critically evaluate a presented professional topic. 3. Understand and apply study skills needed for lifelong learning and continuation of education at the graduate level. 4. Understand contemporary organizational concepts and manage organizational culture.
Content	1. Knowledge management - the concept, scope and importance of knowledge management, development of knowledge management. 2. Knowledge - Pyramid of Knowledge (DIKW), alternative views on knowledge, types of knowledge, locations of knowledge, characteristics of knowledge, knowledge and belief. 3. Knowledge management processes - the importance of the knowledge management process for the organization, the knowledge conversion cycle, significant approaches to the knowledge conversion cycle, processes and subprocesses, integrated approach to knowledge conversion. 4. Knowledge management pyramid - processes, systems, mechanisms, technologies and infrastructure, interconnectedness. 5. Knowledge management models - comprehensive approach to knowledge management, significant theoretical models, connection of models with elements of organization. 6. Knowledge management technologies - support for processes and mechanisms, standard technologies for knowledge discovery, knowledge acquisition and storage, knowledge sharing and knowledge application, artificial intelligence in knowledge management (data mining, knowledge representation and reasoning, analytics and visualization of large datasets, machine learning, natural language processing, conversational agents, expert systems, neural networks, cognitive computing, augmented reality, Internet of Things, semantic technologies…), examples of technology application, knowledge management tools. 7. Mutual influence of knowledge management and organisation - the impact of knowledge management on employees, processes, products and performance; the influence of contextual factors on the importance of knowledge management processes and sub-processes: characteristics of tasks, knowledge and environment; determining the appropriate knowledge management processes and sub-processes and the overall solution; assessment of knowledge management in the organization: types and method of assessment. 8. Semantic modelling - the need for formalization of knowledge, concept, conceptual network, associations, modeling problem, possible worlds, metamodeling, elements of logical reasoning, operators of knowledge and belief, reasoning about knowledge, conceptual and semantic model of knowledge in the organization. 9. Continuity of knowledge management - knowledge management strategy and planning, knowledge management maturity model, organizational learning and organizational memory, knowledge continuity management.

Exercises	In the course of the exercises students use program tools to work on structuring and representation of information and knowledge of a certain domain and present their work.
Realization and examination	Classes: Lectures, exercises Exam: Preliminary exam, seminar paper, practical work
Related courses	1. Organizational Knowledge Management, Massey University, https://www.massey.ac.nz/study/courses/organisational-knowledge-management-157340/ 2. ICT and Knowledge Management, Maastricht University, https://www.maastrichtuniversity.nl/meta/415880/ict-and-knowledge-management 3. Knowledge Management, University of Southampton, https://www.southampton.ac.uk/courses/modules/mang3010 4. Knowledge Management Systems, The University of Sydney, https://www.sydney.edu.au/units/ISYS5050/2022-S1C-NE-CC
Literature	**Basic:** 1. Dalkir, K. (2017.) Knowledge Management in Theory and Practice, Third Edition, MIT Press 2. Becerra-Fernandez, I.; Sabherval, R. (2014) Knowledge Management: Systems and Processes, Second Edition, Routledge **Additional:** 1. Rhem, A. J. (2017) Knowledge Management in Practice, CRC Press, Boca Raton

Course title: INFORMATICS SERVICES MANAGEMENT

Lecturers	Full Prof. Vjeran Strahonja, Ph.D., Assoc. Prof. Renata Mekovec, Ph.D., Asst. Prof. Katarina Pažur Aničić, Ph.D.
Language of instruction:	Croatian and English
Study level	Bachelor
Study programme	Information and Business Systems
Semester	Summer
ECTS	4
Goal	• The goal of the course is to provide a detailed review of informatics services management and delivery, and to prepare students for professional service delivery, including determining service strategy, service design, service management of delivered service, in accordance with service science methodology.
General and specific learning outcomes	1. Analyze the state, identify opportunities and define problems faced by organizations and individuals in implementing ICT, and formulate solutions with the use of ICT. 2. Understand relevant factors that affect the business operation of an organization and individuals, and apply basic methods and concepts of business planning, management and accounting. 3. Understand and apply ethical principles, legislative regulation and norms that are applied in the professional field of discipline. 4. Understand and apply processes, methods and technologies pertaining to IT services and resources management, and provisioning and support of different ICT related services. 5. Understand and apply study skills needed for lifelong learning and continuation of education at the graduate level. 6. Understand the basic vertical fields of ICT implementation (industry, healthcare, traffic, tourism, state, etc.) and its horizontal applications (office systems, DSS, CRM, semant, DMS, etc.). 7. Understand the state and trends in the development of contemporary information and communication technologies (ICT), understand their impact on the individual, organization and society, and assess their applicability in a given context.
Content	1. Introduction to the Service Economy (4 hours) Definition of a service. Nature of a service. Service properties. Role of services in the society. Areas of providing services and service customers. Types and levels of services and customer relations. Classification of services. Technology-based services and e-services. Market of informatics services – history, trends, qualitative and quantitative indicators. 2. Informatics services (2 hours) Types and areas of services. Design, system development and consulting services. Forms and method of service delivery. Service delivery processes and process models. Results and deliveries. 3. Service strategy (2 hours) Strategic service planning. Managing service portfolio and catalog. Organizational models. Planning and managing projects in service organizations. The culture of service organizations. Professional ethics.

	4. Service design (4 hours) Service added value concepts and strategies. Service life cycle. Service design methodology. Service design approaches and processes. Service design concepts and methods. Service design tools. **5. Informatics services management concepts and frameworks (2 hours)** Functions, processes and roles of IT services management. ITIL. ISO 20000. Tools for IT Service Management. **6. IT Service Provision Processes (4 hours)** Service centre and help desk. Receiving and processing requests. Computer support systems. Incident management. Problem management. Configuration management. Change management. Release management. **7. Managing customer and provider relationships and service level (4 hours)** Relationship models. User / customer pyramid. Quality of service. Defining the value and level of service. Service Level Agreement. Service Objectives (SMART). Documenting, monitoring, measuring and reporting service levels. **8. Service Delivery Management (2 hours)** Reliability, availability and maintenance of the system. Reactive and proactive policy. Planning and risk management. Capacity management. Service continuity management. Availability management. Financial management. **9. Service Operations Management (4 hours)** Managing Supply and Demand Market. Managing requests and orders. Tactical planning and management. Capacity planning and management. Resource allocation. Calculation and control. Supervision and quality control of services. Support functions. **10. Skills for Information Society. (2 hours)** Skills management cycle. ICT competencies. Competence management concepts and frameworks. European Qualifications Framework.
Exercises	Exercises are performed in groups, using adequate program tools. Students solve practical tasks, based on predefined tasks and case studies related to providing informatics services. The students are introduced to quantitative models of service management with focus on service design. The implementation of teaching strategies that are geared to the student and the development of his critical thinking, such as problem based learning, project based learning, and work based learning, is based used. The goal of the exercises is the improvement of the students' understanding of theoretical basics and practical competences related to informatics services design through teamwork. Basic criteria of students' performance evaluation are the quality of preparation and elaboration of both individual tasks and group projects.
Realization and examination	Classes: lectures and exercises Examination: written and oral
Related courses	1. Carnegie Mellon, Human-Computer Interaction Insitute, 05-452/05-652 Service Design 2. Georgia State University, CIS 8620 - Management Of Information Services 3. Umeå University, Advanced Service Design 4. Norwegian University of Science and Technology, TPD4156 – Design 7 – Service Design 5. University of Denver, COMM-4309 Service Design

Literature	Basic: 1. Bordoloi S.K, Fitzsimmons, J.A., Fitzsimmons, M.J. Service Management: Operations, Strategy, Information Technology 9th Edition, McGraw-Hill Education, 2019. 2. ITIL Fundation, ITIL 4 Edition, AXCELOS 2019 3. Orand, B., Foundations of IT Service Management with ITIL 2011: ITIL Foundations Course in a Book, CreateSpace Independent, 2nd edition, 2011. Additional: 1. Smallwood, R.F. Information governance, concepts, strategies and best practices, Wiley, 2014. 2. Kimbell, L. The service innovation handbook, BIS, 2016. 3. Osterwalder, A. et. al. VALUE proposition design: how to create products and services customers want, John Wiley & Sons, 2014. 4. Smith, K.J., The Practical Guide To World-Class IT Service Management, The Anima Groupp, 2017.

Course title: CUSTOMER RELATIONSHIP MANAGEMENT IN DIGITAL ENVIRONMENT

Lecturers	Sandro Gerić Iva Gregurec
Language of instruction [Croatian / English]	English
Study level [Bachelor / Master]	Bachelor
Study programme	undergraduate
Semester [Summer / Winter]	Summer
ECTS [number]	4
Goal	This course will enable students to master the theoretical and practical knowledge required to work in domains that are directly related to customer relationship management. In doing so, the theoretical concepts of marketing and customer relationship management are upgraded with practical skills in using ICT tools and technologies in customer relationship management domain. The course enables the students to upgrade and to refine their knowledge of marketing and e-commerce and to gain essential knowledge in organizational and business models as well as customer relationship management technologies and tools.
General and specific learning outcomes	
Content	1. Values for clients in marketing. (4 hours) Evolutionary development of marketing management. The concept of value as the basis of market exchange. The gap between clients and managers. Expected value and its dimensions. Basic dimensions of perceived value. 2. Customer Value Research and Customer Satisfaction (4 hours) Customer value research approaches (group interviews, in-depth interviews, pillar techniques, long-travel techniques, key event techniques). Relationship between pleasure and value. Relationship between company satisfaction and profitability. Approaches to customer satisfaction research. 3. Customer Satisfaction Management Process (4 hours) Designing and building a process of continuous monitoring of customer satisfaction. Customer orientation as a company culture.

	4. Introduction to Customer Relationship Management (4 hours) Defining Customer Relationship Management. The importance of knowing your clients. Acquiring new clients while retaining existing ones. Customer loyalty. Using Customer Information. Target marketing. One-on-one marketing. Optimizing customer experiences. Sales management versus customer relationship management. 5. Customer Relationship Management as a Business Process (8 hours) The process of managing customer relationships. Benefits and the costs of managing customer relationships. Assessing a company's willingness and ability to introduce customer relationship management. Organizing and integrating business, employees, technology and processes. Communication strategies in marketing. Collecting Customer Information and Data. Predicting customer behaviour. Client Segmentation. Customer Profitability. Personalization and optimization of communication channels. Client interaction modelling. Process Automation in Marketing and Sales. Planning a client relationship management program. 6. Customer Relationship Management Technology (6 hours) The technological basis of customer relationship management. Computerization and ICT support of data warehousing. Analysis of customer data and data mining. E-commerce and customer relationship management via the Internet and Mobile Technologies. Additional customer service through the World Wide Web. Client privacy issues. Choosing a CRM tool. Integration of customer relationship management into e-business information system. Website Optimization. Tracking users on the web. Collecting customer data.
Exercises	-
Realization and examination	Attendance of classes, seminars and computer exercises. Making homework assignments. Preliminary exam laboratory exercises. Seminar paper. Preliminary exam.
Related courses	-
Literature	1. Palmatier, R.W., Steinhoff, L.: Relationship marketing in the digital age, Routledge, London and New York, 2018. 2. Buttle, F., Maklan, S.: Customer relationship manadement-concepts and technologies, Routledge, London and New York, 2015. 3. Peelen, E., Beltman R.: Customer relationship management, Pearson, Harlow, 2013.

Course title: DATA MINING

Lecturers	Full Prof. Božidar Kliček, Ph.D., Assoc.Prof. Dijana Oreški, Ph.D.
Language of instruction:	Croatian and English
Study level	Bachelor
Study programme	Economic of Entrepreneurship
Semester	Summer
ECTS	4
Goal	This course introduces several fundamental concepts and methods for data mining. The objective is to familiarize the students with some basic learning algorithms and techniques and their applications, as well as general questions related to analyzing and handling large data sets. Several software's and data sets publicly available will be used to illustrate the application of these algorithms. The emphasis will be thus on data mining algorithms and applications, with some broad explanation of the underlying principles.
General and specific learning outcomes	1. Analyze and evaluate business performance and suggest business system improvements. 2. Identify and understand relevant factors that affect the business operation of an organization and individuals, and apply basic methods and concepts of business planning, management and accounting. 3. Identify key data and information for making rational business decisions. 4. Model business processes and data in organizations, and apply models in the development organizational and information systems. 5. Identify and understand relevant factors that affect the business operation of an organization and individuals, and apply basic methods and concepts of business planning, management and accounting. 6. Understand and apply appropriate mathematical methods, models and techniques to solving problems in the information and business systems field.
Content	1. Introduction Introduction to data mining: aims of the field, challenges of big data world. Knowledge discovery in data process: main phases, business problem definition, understanding and preparation of data. Multidisciplinary approach: foundations, scientific approach, logic, philosophy of science, statistics, theory of information, databases, artificial intelligence and machine learning. 2. Data Types of data: temporal data, text data, meta data. Types of knowledge: tables, groups, rules, decision trees, clusters, taxonomy, probabilistic networks, neural networks. Knowledge in databases: relational databases, multidimensional databases, OLAP, deductive databases, meta data. 3. Statistics Logic in knowledge representation, deductive and inductive systems, knowledge discovery. Statistics: sample definition, hypothesis testing, Bayesian approach. Fuzzy logic.

	4. Knowledge discovery in data Steps of knowledge discovery data: business problem understanding, data, data preparation, modelling, evaluation, knowledge representation. Data warehousing: identification and data cleaning, data acquisition, data reduction and data visualization. 5. Data mining methods Data mining. Classification task: description, methodology. Decision tree techniques: C4.5, classification and regression trees, advanced methods. Rules: sequential methods. Bayes classifier. Nearest neighbors approach, regression methods: logistic regression, discriminant function. Multicriteria classification. Rules induction: association rules. 6. Neural networks Neural networks algorithms. Principles of application. Design of neural network architecture. Understanding of basic principles of neural networks. Training and testing of network. 7. Deep learning Deep learning basics. Technologies for deep learning. Overview of principles and tools for deep learning. 8. Clustering Cluster analysis: conceptual clustering. Probabilistic and causal nets. Probabilistic networks. Bayesian approach. 9. Big data Overview of tools for storage, visualization and analysis of big data. Application of big data. 10. Application of data mining Selection of data mining tasks and methods. Knowledge representation: taxonomy, preferences of users. Evaluation of knowledge: statistical approach, mathematical approach. Data visualization. Application for decision making. Legal aspects. Overview of tools for data mining. 11. Case studies Analysis of applications in various domains. Data driven decision making.
Exercises	1. Data mining Data mining basics. SAS tools. Basics possibilities of modelling, diagrams representation. Repository of models and diagrams. 2. Data set characteristics Server-side processing asynchronous data model. Parallel processing, simultaneously processing multiple models. Multiplexing algorithms. Application of SAS to create data sessions. Application of SAS for knowledge representation. 3. Data set description Preprocessing data sets for learning, validation and testing. Partitioning by variables classes. Transformation. Data elimination. 4. Descriptive statistics Statistics and graphical representation of variables, distributions. 5. Charts Types of charts in SAS: histograms, multidimensional graphical representation, area plots, bubble plots. Dynamic data processing and data sampling. Interactive data connection. 6. Application of data mining Example 1: analysis of web data mining. Links analysis based on frequency of usage. Example 2: life style of young people analysis.

	7. Decision trees Classification and regression trees basics, selection of decision trees algorithms based on pruning. Pruning criteria: Hi-square, F-test, Gini, entropy, reduction of variance. Rules induction based on decision trees. Sensitivity analysis and variable importance. 8. Neural networks Neural networks principles. Basic terms - neurons, input and output layers, weights, internal activation, sigmoid, tanh. Mathematical models of neural networks. Neural networks modeling in BigML tool. Back-propagation algorithm. Multilayer network. Unsupervised learning. Training and testing of network. Learning of networks. Parameters of learning. Determination and initialization of weights in the network. Setting up learning parameters and checking learning outcomes. Network optimization. 9. Deep learning Deep learning foundations. Technologies that are drivers of deep learning. Overview of principles and tools for deep learning. 10. Association rules Discovering interesting relations between variables in large databases. Market based analysis. 11. Big data Overview of tools for storage, visualization and analysis of big data.
Realization and examination	Classes: lectures and exercises Exam: The knowledge is being regularly tested in exercises class, and each student has to, in order to qualify for the final exam, individually do and document one project of data mining. After that, knowledge is tested at the oral exam.
Related courses	1. Data mining (Jozef Stefan International Postgraduate School, Slovenija) 2. Knowledge discovery in databases (University of Ljubljana, Slovenija) 3. Learning from structured data (University of Bristol, UK) 4. Data mining (Stanford University, USA) 5. Data mining (University of Helsinki, Finska)
Literature	Basic: 1. Data mining and knowledge discovery handbook. Editors Oded Maimon, Lior Rokach. Springer, New York, 2005. 2. Bramer, M. A. Principles of data mining. Springer, London, 2007. Additional: 3. Han, J., Kamber, M. Data mining : concepts and techniques. 2nd ed. Morgan Kaufmann, San Francisco, 2006. 4. Berry, M., Linnof, G. Data mining techniques : for marketing, sales, and customer relationship management. 2nd ed. Wiley, Indianapolis, 2004. 5. Cox, E. Fuzzy modelling and genetic algorithms for data mining and exploration. Morgan Kaufman, Amsterdam, 2005. 6. Advances in knowledge discovery and data mining. Editors Usama M. Fayyad et al. AAAI, Menlo Park, 1996.

Course title: BUSINESS DECISION MAKING

Lecturers	Full Prof. Nina Begičević Ređep, Ph.D., Assist. Prod. Nikola Kadoić, Ph.D., Barbara Šlibar, M.Inf., Tihomir Hunjak, Prof. Emer.
Language of instruction:	Croatian and English
Study level	Bachelor
Study programme	Information / Business Systems
Semester	Summer
ECTS	4
Goal	The objective of the Business Decision Making course is to introduce students with basic concepts of business decision making and with the findings of decision theory that are necessary for quality decision making (problem defining and information gathering) and development of models for analysis and making business decisions. Special attention will be given to the elements of decision quality. Also, the decision-making approaches, decision making styles, and hidden traps in decision making will be addressed. Within the course, students will be introduced with quantitative and qualitative decision-making methods and decision support systems. Students will apply adopted methods as well as systems within the given assignments and case studies in ICT projects.
General and specific learning outcomes	1. Identify and understand relevant factors that affect the business operation of an organization and individuals, and apply basic methods and concepts of business planning, management and accounting. 2. Identify key data and information for making rational business decisions. 3. Understand and apply appropriate mathematical methods, models and techniques to solving problems in the information and business systems field. 4. Understand and apply contemporary methodological approaches to developing organizational and information systems, and designing organizations and organizational structures. 5. Understand the basic principles and methods of organizational management and have the ability to successfully work in a team.
Content	1. Introduction to business decision making (2 hours) – Introduction to the course – objectives and purpose of the course. Concept, definition, and role of the business decision making. Decision making problems. Phases of the decision-making process. 2. Decision making theories and elements of quality decision making (2 hours) - Structure and type of decisions. Elements of quality decision making. Qualitative and quantitative dimensions of the decision. Normative and descriptive decision theory. 3. Decision making approaches (2 hours) - Decision making approaches. Group decision making. Techniques of the group decision making. Morphological analysis. Delphi Method. Nominal group Technique. Brainstorming. 4. Decision making in an organizational context (2 hours) - Importance and influence of organizational structure on decision making in an organization. The influence of organizational culture on the behavior of decision makers. Ethics of decision maker.

	5. **Decision making styles and conflicts in decision making (2 hours)** – Decision making styles. The Vroom-Yetton decision model. Types of conflicts in an organization. Causes of conflict. Ways of responding to conflicts. Sources of power in an organization and its influence on decision making. Organizational policy. 6. **Errors in decision making (2 hours)** - Approaches to the decision making (behavioral, humanistic, psychodynamic, cognitive). Errors (biases) in decision making: the status quo bias, the anchoring bias, the framing bias, the sunk-cost bias, etc. 7. **Creative problem solving and critical thinking (2 hours)** - The importance of creativity in business. Theories of creativity and the creative problem solving. Creativity Techniques. Elements of critical thinking. Levels of critical thinking. 8. **Negotiating and decision making (2 hours)** - The importance and role of negotiation in decision making and problem solving. Preparation for negotiation. Negotiation Strategies. Types of Negotiators. Analysis of examples. 9. **Simple methods for multi-criteria decision making (2 hours)** - The importance of multi-criteria decision-making methods. An overview of basic multi-criteria decision-making methods. Ranking by appraisal of group members. Ranking based on assigning ranks by group members. Basic assumptions of voting theory. Voting Methods. Advantages and disadvantages of simple methods for multi-criteria decision making. 10. **PrOACT Approach to Decision Making and a rational method for making tradeoffs (2 hours)** – Elements of PrOACT approach: Problem, Objectives, Alternatives, Consequences, Tradeoffs, Uncertainty, Risk Tolerance, Linked Decisions. A rational method for making tradeoffs (The Even Swap method). 11. **Simple Additive Weighting Method (2 hours)** - Criteria and types of criteria. Criteria values. Scales of criteria values. Criteria weights. Methods for determining the weights of criteria. Direct assessment. SWING method. Rank reciprocal method. Normalization and the role of normalization. Types of normalizations (according to highest, lowest and range of values). 12. **Pairwise comparison and basics of AHP method (4 hours)** - Determining priority of alternatives and weights of criteria based on their pairwise comparison. Saaty's scale of relative importance. Inconsistency in comparison. Approximate solution method. Aggregating the weights of criteria and local priorities of alternatives into global priorities of alternatives. The sensitivity analysis. 13. **Information systems as a support to decision making (2 hours)** - The role and importance of decision support systems. Analysis of examples of application of decision support systems in decision making. 14. **An overview of the functionalities of decision support systems (2 hours)** – Analysis of examples of the application of decision support systems in ICT projects. Analysis of decision support systems functionalities and practical work. Application of decision-making methods with the support of decision support systems.
Exercises	The seminars follow the lectures and students analyze concrete problems through the perspective of topic delivered on lectures.
Realization and examination	Classes: Lectures, and seminars Exam: Activities on classes and tests

Related courses:	1. University of Cambridge, Faculty of Economics and Politics http://www.econ.cam.ac.uk/faculty/sciubba/Teaching/teaching.html 2. University of Oxford, Said Business School, (MBA Programme) http://www.sbs.ox.ac.uk/html/mba_corecourses.asp 3. Sveučilište u Ljubljani, Ekonomski fakultet http://www.uni-lj.si/Clanice/SP03/ef03.pdf
Literature	Basic: 1. Sikavica, Hunjak, Begičević Ređep, Hernaus: Poslovno odlučivanje, Školska knjiga, Zagreb, 2014. Additional: 1. Albright, Winston. Data Analysis and Decision Making. Cengage Learning. 2015. 2. Sauter. Decision Support Systems for Business Intelligence. Wiley. 2011.Kesić, T.: Marketinška komunikacija, MATE, Zagreb, 1997.
Online sources:	1. Teaching materials available on LMS Moodle

Course title: SOFTWARE ENGINEERING

Lecturers	Full Prof. Vjeran Strahonja, Ph.D., Assoc. Prof. Zlatko Stapić, Ph.D.; Assist. Prof. Boris Tomaš Ph.D., Marko Mijač, Ph.D., Dijana Peras, M.A.
Language of instruction:	Croatian and English
Study level:	Bachelor
Study programme:	Information and Business Systems
Semester:	Summer
ECTS [number]	6
Goal	The goal of Software Engineering course is to give students the insights into the most important phases, activities and the best practices of software product development, management of development project, tools to support this process, and associated technologies. The discipline of Software Engineering is a young discipline of science and the profession, but it is being highly intensively developed and is constantly undergoing numerous changes. By having insights into the most important stages of the development process, as well as understanding the mentioned process, students will gain fundamental knowledge about this complex area, which will give them a solid ground for their further development in these areas of development of software, applications for mobile or smart devices, web applications, and other systems like internet of things, embedded systems and alike.
General and specific learning outcomes	/
Content	Lectures 1. Software Engineering as a Discipline (2) Definition of discipline of software engineering and software. Positioning software engineering in relation to other disciplines. Professional software development in response to the software crisis. Engineering approach to development. Professional ethics. 2. Software Engineering Methodology (3) General structure of software engineering methodologies. Object-oriented and agile methodologies for the development of software systems. Software product development process.

Primary and secondary activities in program development (modeling, programming, documentation, testing, verification, validation, management ...). Program development methods and techniques. Roles in program development. Development and work environments.

3. Models and Modeling in Software Engineering (3)
   Modeling as the basis of engineering design. Object-oriented development of software systems. Historical development, sources and role of UML in software development. Modeling of structure, behavior and interactions. Model hierarchy and metamodels.
4. Analysis and specification of user requirements (2)
   Engineering requirements. Functional and non-functional requirements. Requirement engineering processes. Claim elicitation. Request specification. Requirement validation. Manage user request changes. User requirements specification document. Good practice examples.
5. Software product structure and behavior design (8)
   Object-oriented design. UML diagrams of structure, behavior and collaboration. Develop use cases and / or user stories. Diagram of classes, objects and packages. Behavior modeling of activity diagrams and state machines. Modeling of interaction with sequence diagrams, communication and timing. Components and deployment diagrams. Software product specification document.
6. Software Product Development (8)
   Integrated development environments. Implementation of object-oriented principles in the selected programming language and development environment. Prototyping user interfaces. Implementation of UI concepts and experience in selected development environment and UI design tools. Implementation of working with data. Development frameworks. Organization of code. Code versioning.
7. Software System Development Management (2)
   Project planning and management. Risk management. Cost of development and implementation. Versioning and quality management. Tools for team-based development and project management of software system development.
8. Testing and delivery of software product (2)
   Testing and checking the quality of the software product. DevOps basics. Preparing a software product for delivery. Delivery and maintenance of software. Tools and technologies for checking and delivering software.

Exercises	Laboratory exercises are following the content of lectures and practically represent all stages of software development process that are theoretically addressed in lectures. Based on the practical part of exercises presented by the teacher, and on materials available in learning management system, students are required to implement additional assignments.
Realization and examination	Classes: lectures and exercises Exam: three project-related assignments (analysis, design, implementation), final exam or oral exam
Related courses	1. Introduction to Software Engineering, Carnegie Mellon University, https://www.cs.cmu.edu/~aldrich/courses/413/ 2. Introduction to Software Engineering, University of Adelaide, https://www.adelaide.edu.au/course-outlines/108366/1/sem-2/ 3. Introduction to Software Engineering, Douglas College, https://www.douglascollege.ca/course/cmpt-2276
Literature	Basic: 1. Sommerville I., Software Engineering, 8th edition or newer, Addison Wesley, 2007 or newer Optional: - Teaching and other course materials available in the learning management system, - Authorized sources, web materials, and books on topics that the course addresses, which due to frequent and major changes in technologies and tools are to be defined for each generation of students separately.

Course title: BUSINESS ENGLISH LANGUAGE 1

Lecturers	Andreja Kovačić, Ph.D., Senior Lecturer
Language of instruction [Croatian / English]	English
Study level [Bachelor / Master]	Bachelor
Study programme	Economics of Entrepreneurship
Semester [Summer / Winter]	Summer
ECTS [number]	4
Goal	Acquire typical phraseology and language structures needed for efficient oral and written communication in common types of business situations. Understand and apply concepts and basic Business English vocabulary pertaining to topics including organization, recruitment and employment, business contacts and cultural differences in the business world, business correspondence. Increase confidence in communication in English as one of the basic prerequisites for a businessperson's professional competitiveness and success. Develop linguistic competences in English as a Foreign Language (reading and listening skills, and, in particular, oral and written communication skills in an international business context).
General and specific learning outcomes	
Content	1. Education and training. Skills and qualifications. 2. Employment and recruitment. Job advertisements. 3. Applying for a job. Writing a CV. 4. Company and organizational structure. 5. Company restructuring. 6. Economic sectors. 7. Organizations in public and private sector. 8. Cultural differences in the business world. 9. Establishing business contacts. Spoken business communication. 10. Telephoning in the business context. 11. Business meetings – organizational aspects. 12. Business meetings – communication aspects. 13. Introduction to business communication. 14. Contemporary technologies in business correspondence. Electronic mail. 15. Analysis, interpretation and use of business vocabulary and terminology.

	16. Analysis, formation and interpretation of multi-word phrases in Business English. 17. Identification, interpretation and use of collocations in the business context related to selected areas of Business English.
Exercises	In the exercises students are required to more closely engage with the language inputs, concepts and topics introduced in the lecture. Types of tasks included in the exercises material include: vocabulary consolidation and extension, analysis of shorter written and multimedia texts (comprehension, summarizing of key ideas, etc.), grammar practice, identification and application of concepts related to course units, tasks related to specific communication skills.
Realization and examination	Lectures (attendance in 5 assigned sessions during the semester is required). Exercises (attendance in Week 2-15 sessions during the semester is required). Assessment of student work includes: 2 mid-term exams, obligatory presentation, attendance and engagement in classes.
Related courses	Business English Language 2 English for Information Technology Business Communication
Literature	1. Study materials organized by units (Word documents and presentations on the course webpage) 2. Emmerson, P.: Business Vocabulary Builder: Intermediate to Upper-intermediate, Macmillan, 2009. (selected chapters) 3. Emmerson, P.: Email English, 2nd edition, Macmillan, 2013. (selected chapters) 4. Hall, D., Jones, R. Raffo, C.: Business Studies, 3rd edition, Causeway Press, 2007. (selected chapters) 5. Oxford Business English Dictionary for Learners of English, Oxford University Press, 2005.

Course title: TESTING AND QUALITY OF SOFTWARE PRODUCTS

Lecturers	Full Prof. Valentina Kirinić, Ph.D., Marko Mijač, Ph.D
Language of instruction [Croatian / English]	Croatian and English
Study level [Bachelor / Master]	Bachelor
Study programme	Information / Business Systems
Semester [Summer / Winter]	Summer
ECTS [number]	6
Goal	The goal of the course is to enable students to participate in planning, conducting and documenting software product testing, as well as performing quality evaluation activities. Through lectures and laboratory exercises, students will be familiarized with different principles, best practices and commonly used techniques and tools for testing, debugging and profiling software products. This is complemented with widely accepted metrics and techniques for software quality evaluation. Demonstrated knowledge will serve as a preparation for students' own projects.
General and specific learning outcomes	/
Content	1. An introduction to testing and quality of software products Reflection on your own competences, experiences and practices in the field of software product testing and quality. Importance and good practice in the field of software product testing and quality. Motivation: professions / jobs related to software product testing and quality. Definition and key concepts. Validation, verification, testing and quality assurance of software products. 2. The fundamentals of software product quality Quality within a software product development project. Planning, assuring, controlling and improving software product quality. Software product quality standards and recommendations. Software quality management techniques (static and dynamic). Measures / metrics, models and tools for software product quality assurance. Documenting the process of software product quality evaluation.

	3. The fundamentals of software product testing Definition and key concepts in software testing. Testing goals. Position and the role of testing activities in the software process. Similarities and differences with regard to other related activities (SQM, formal verification, debugging, software implementation). Software errors - causes and effects. Testing principles. 4. Software product testing process and its documentation Planning, preparation, design, organization and execution of tests. 5. Phases in software product testing Development testing. Release testing. User testing. 6. Software product testing techniques Categorization of testing techniques. White-box and Black-box techniques. Experience-based and intuition-based techniques. Source-code based techniques. Error-based techniques… 7. Agile testing and test-driven software development Fundamental principles of test-driven development. Fundamental and advanced concepts in unit testing. Patterns and good practices. 8. Testing non-functional requirements Testing performance, reliability, security of software products. 9. Tools, libraries, and software frameworks for testing Benefits of automated testing. Examples of popular tools. Integration of testing into a process of automated delivery of software products (DevOps).
Exercises	Laboratory exercises are in line with the content of the lectures and serve as a preparation for the student's own project. Laboratory exercises will make use of appropriate tools for software product testing and quality evaluation. Appropriate tools for software product testing and quality evaluation will be used in the laboratory exercises.
Realization and examination	Classes: lectures and exercises Exam: theoretical knowledge is evaluated during the semester through written preliminary exams (or written and oral final exam). Students demonstrate acquired practical skills by working on a project and defending it.
Related courses	1. Software quality and testing (University of Gothenburg, Sweden) 2. Software testing (Johannes Kepler University Linz, Austria) 3. Testing and quality (University of Ljubljana, Faculty of Computer and Information Science, Slovenia) 4. Software quality and testing (University of Reading, UK)

Literature	Basic: 1. Lewis, W. E. (2016). Software testing and continuous quality improvement. Auerbach publications. 2. Desai, S., & Srivastava, A. (2016). Software testing: A practical approach. PHI Learning Pvt. Ltd.. 3. Fenton, N., & Bieman, J. (2014). Software metrics: a rigorous and practical approach. CRC press. Additional: 4. ISO/IEC/IEEE 29119-1:2013 Software and systems engineering -- Software testing -- Part 1: Concepts and definitions 5. ISO/IEC/IEEE 29119-2:2013 Software and systems engineering -- Software testing -- Part 2: Test processes 6. ISO/IEC/IEEE 29119-3:2013 Software and systems engineering -- Software testing -- Part 3: Test documentation 7. ISO/IEC/IEEE 29119-4:2015 Software and systems engineering -- Software testing -- Part 4: Test techniques 8. ISO/IEC 30130:2016 Software engineering -- Capabilities of software testing tools 9. Beck, Kent (2002). Test-driven development, by example. Addison Wesley 10. Osherove, Roy (2009). The art of Unit testing. Manning Publications

Course title: DESIGN THINKING IN DIGITAL TRANSFORMATION

Lecturers	Assoc. Prof. Igor Pihir, Ph.D., Full. Prof. Nina Begičević, Ph.D., Full. Prof. Stjepan Vidačić, Ana Kutnjak, M. Econ., Assist. Prof. Nikola Kadoić, Ph.D., Barbara Šlibar, M. Inf.
Language of instruction [Croatian / English]	Croatian and English
Study level [Bachelor / Master]	Bachelor
Study programme	Information and Business Systems
Semester [Summer / Winter]	Winter
ECTS [number]	6
Goal	The objective of the course is to acquaint the students with contemporary concepts of systems and design thinking with the aim of defining complex business problems and identifying ways of solving them, structured innovation process, and ultimately deciding on particular scenarios or variants of complex business problems in the context of digital transformation. Acquiring knowledge about digital transformation, implementation methods, trends and influence on the application of technological concepts in the improvement and transformation of business in order to achieve business goals and realize business concepts. Adopting the generic concept of system, systems thinking and systems approach as a methodology and tools that enable identification, analysis and problem solving in complex systems. Adopting a Design Thinking Method for the purpose of a structured, user-oriented process of innovating and creating added value for customers or users by enhancing the process or product in the context of digital transformation. Introduction to decision making processes in the context of digital transformation, and with the problems and challenges that can occur. Also, students will be acquainted with specific decision making methods and they will be able to apply them for making a decision within the problem-solving process.

General and specific learning outcomes	1. Keep track of professional literature in Croatian and a foreign language, prepare and independently deliver presentations in Croatian and a foreign language to professional and general public, and critically evaluate a presented professional topic. 2. Understand and apply study skills needed for lifelong learning and continuation of education at the graduate level. 3. Successfully communicate with clients, users and colleagues in speaking and writing using appropriate terminology, including the ability to communicate about one's professional field of discipline in a foreign language.
Content	1. Introduction to the course (2 hours) Defining basic concepts: digital transformation; business processes; business process modeling; business decision making, the link between decision making and digital transformation. Trends in digital transformation. Levels of automation and levels of computerization. Models of information and business system. 2. Business concepts of the organization (2 hours) Business system, organization and its environment. Objectives of the organization. System approach and system thinking. System, elements, structure and function. System principles. Business concepts in digital transformation of an organization. Purpose, goals, business process, product, improvement of business process and restructuring of business technology (business process reengineering). 3. Technology concepts of the organization (4 hours) Existing technologies and prevailing technological solutions (ERP; CRM; Cloud technologies; Mobile technology; Reference models; Supply Chain Management; Data Warehouses; Business Process Management and Organizational Performance Measurement). New technologies and new technological solutions (Social networks; Digital Platforms; Artificial Intelligence; Metamodels; Knowledge Management; Robotics and Autonomous Systems, etc.). 4. System and Design Thinking (4 hours) System definition, problem definition, domain definition. Design Thinking process. Concepts of innovation and innovation process. System and design potential for transformation. Design thinking process and method. 5. Design Thinking process (4 hours) Stages of the Design Thinking process. Methods and tools for implementing Design Thinking. Visualization; mapping user journeys (experiences); value chain analysis; mental maps; storm of ideas; concept development; testing assumptions; rapid prototyping; development in collaboration with the user; test launch. Defining the future state and developing scenarios (alternatives) that can be achieved through digital transformation. 6. Digital Transformation Impact Assessment (4 hours) Sorts and types of digital transformation effects. Develop scenarios and assess impact for their implementation. Risk assessment and calculation of return on investment methods. Scoring and evaluation of alternatives. Business planning and strategic decision making. Business Planning Methods. Business planning approaches and systems. Project cost-effectiveness methods. NPV. IRR. Return on investment period.

	7. Decision making and Digital transformation (2 hours) Decision making. Phases of decision making. Business decision making. An introduction to decision making methods. A framework for supporting digital transformation. Impacts of digital transformation. The link between decision making and digital transformation. 8. The impact of technological trends on decision analysis in agile organizations (2hours) The impact of Industry 4.0 on business decision making in agile organizations. Decision making myths in agile organizations. Formation of a data-driven organization. Data-driven decision making. 9. Review of decision making methods. Simple methods for decision making under conditions of uncertainty and risk (2 hours) Uncertainty in decision making. Rules for making decisions based on attitude to unknown; with a pessimistic attitude, with an optimistic attitude, a coefficient of optimism, minimizing regret. An Introduction to the Decision Tree. Introduction to the Risk Matrix. Introduction to sensitivity analysis. 10. Identifying and structuring decision making problems (4 hours) Identifying decision making problems, Structuring decision making problems: criteria, sub-criteria, alternatives. Phases of the decision making. Analytic Hierarchy Process (AHP). Hierarchical structure of decision problems. Pairwise comparison. The Eigenvalue method. Axioms of the AHP. Advantages and disadvantages of the AHP. Inconsistency analysis in the AHP. Group decision making by the AHP. 11. Decision making using the Analytic Hierarchy Process (AHP) (2 hours) Identifying and structuring a specific decision making problem from the ICT domain and digital transformation. Choosing a decision maker and applying the AHP in the decision making process. Application of the AHP to determine the weights of the criteria and priorities of the alternatives. Sensitivity analysis. BOCR (Benefits, Opportunities, Costs, Risks) hierarchical models.
Exercises	Students solve problems and discuss examples connected to particular lectures in real-life independents assignments combined together into the student team project. Every unit of lectures is accompanied by seminars, enabling the students to apply the acquired knowledge on practical examples and present their ideas through team projects.
Realization and examination	Preliminary exams. Additional activities are conducted within the class. Those activities will be evaluated. Class attendance. Student project. If students responsibilities will not be solved by up mentioned activities, they will have a final exam in form of the written and oral exam?
Related courses	

Literature	Basic: 1. Westerman, G., Bonnet, D., McAfee, A. (2014). Leading Digital – turning technology into business transformation. USA: Harvard business review press. 2. Rob Dekkers (2017) Applied Systems Theory, 2nd Edition, Springer. 3. Antoljak, V. (2018). Design Thinking za nedizajnere : kako riješiti poslovne probleme i uspješno inovirati. Zagreb: Školska knjiga. 4. Sikavica, Hunjak, Begičević Ređep, Hernaus. (2014). Poslovno odlučivanje. Školska knjiga. 5. Power D.J., Heavin C. (2018). Data-based Decision Making and Digital Transformation. Business Experts Press. Additional: 1. Gharajedaghi. J. (2006). Sytem Thinking – Managing Chaos and Complexity – A Platform for Designing Business Arhitecture. 2nd Edition. Butterworth-Heinemann / Elsevier. 2. Checkland, P. & Poulter, J. (2006). Learning for Action – A Short Definitive Account of Soft Systems Methodology and its use for Practitioners, Teachers and Students. John Wiley & Sons. (2006) 3. Osterwalder, A., Pigneur, Y., Bernarda, G., Smith, A. (2014). Value proposition design, Hoboken, New Yersey: John Wiley &Sons 4. Albright, Winston. (2015). Data Analysis and Decision Making. Cengage Learning. 5. Sauter. (2011). Decision Support Systems for Business Intelligence. Wiley.

Course title: DEVELOPMENT OF APPLICATIONS FOR MOBILE AND SMART DEVICES

Lecturers	Assoc. Prof. Zlatko Stapić, Ph.D.; Assist. Prof. Boris Tomaš, Ph.D.; Dijana Peras, M.A.
Language of instruction:	Croatian and English
Study level	Bachelor
Study programme	Development of software products
Semester	Winter
ECTS	6
Goal	The goal of the practicum of Development of Applications for Mobile and Smart Devices is to give students insight into the concepts and specifics of mobile and other smart devices applications development. This will be achieved through lectures, mentoring and hands-on project work. Using technologies and tools specific to the development of mobile and other smart devices, students will learn through teamwork to implement the agile scrum development process, and will master the skills of prototyping, code versioning, documenting, and quality assurance in development for the mentioned devices.
General and specific learning outcomes	/
Content	Lectures (15): Introduction to mobile and smart device development (2) Introduction to mobile development. Specific features of mobile development. Platform and device fragmentation. Mobile user interfaces and user experience. Possibilities and limitations of mobile technologies. Trends in mobile development. Mobile and smart applications development technologies (8) Native development technologies for mobile and smart devices. Multiplatform development technologies. Introduction to Swift and Kotlin. Development specifics for the Android operating system. Advanced concepts in Kotlin: user interface elements, connection to web services, use of mobile databases. Third-party development frameworks.

	Integration of technologies in development (3) Background Services Layer - Frames and Technologies. Data acquisition, processing and distribution technologies. Third-party technologies and their capabilities. Continuous integration and testing. Integration tools. **Monetization of applications (2)** Monetization as part of user requirements. The most common monetization models in mobile applications and their implementation. The impact of business models on software architecture and design. **Workshops (15):** **Project development - looking for a project idea (3)** **Defining functional and non-functional requirements (3)** **Development of application sketches and wireframes (3)** **Scrum development process (3)** **Integration of IoT and mobile applications (3)**
Exercises	**30 hours are reserved for exercises.** Integrated development environment (2) Mobile development fundamentals (4) User interface elements (4) Working with data (4) Working with web services (4) Background services (4) Notifications to users (4) Advanced development possibilities (4)
Realization and examination	**Classes:** lectures, exercises, and workshops **Exam:** independent assignments, practical work, project
Related courses	1. Become A Mobile App Developer, Udemy course, available at: https://www.udemy.com/course/become-a-mobile-app-developer-ios-android-windows 2. Mobile Applications Development, University of Southampton, https://www.southampton.ac.uk/courses/modules/comp6239 3. Mobile Applications Development, Continental College, https://www.centennialcollege.ca/programs-courses/full-time/mobile-applications-development/ 4. Mobile Applications Development, Open Universities Australia, https://www.open.edu.au/subjects/murdoch-university-mobile-applications-development-mur-ict376 5. Mobile Applications Development, St. Clair College, https://www.stclaircollege.ca/programs/mobile-applications-development

Literature	Basic: 1. Head First Android Development: A Brain-Friendly Guide, Griffiths D., O'Reily, 2018+ 2. Build anything on Android, official documentation for development of Android applications, available at https://developer.android.com/ Optional: 1. Teaching and other course materials available in the learning management system, 2. Development of mobile applications – a handbook. Stapić, Švogor, Fodrek, Varaždin 2016, in Croatian language 3. Authorized sources, web materials, and books on topics that the course addresses, which due to frequent and major changes in technologies and tools are to be defined for each generation of students separately.

Course title: ENGLISH FOR INFORMATION TECHNOLOGY

Lecturers	Andreja Kovačić, Ph.D., Senior Lecturer
Language of instruction [Croatian / English]	English
Study level [Bachelor / Master]	Bachelor
Study programme	Information and Business Systems
Semester [Summer / Winter]	Winter
ECTS [number]	3
Goal	The goal of the course is to improve students' linguistic competences with the aim to enable them to more efficiently use professional literature for the purpose of finding information and retelling disciplinary content accurately and meaningfully in speaking (presentation) or writing (creating notes or summaries). Developing these competencies is intended to prepare students for a future career in an environment dominated by the use of the English language. To accomplish that, students will become more familiar with the lexis and phraseology pertaining to the role of English as a global language and an essential means of communication in the informatics profession; specificities of the information technology jargon; computer systems, hardware and software; computer networks, internet and the World Wide Web; careers in informatics. It is expected that, after successfully completing the course, students will be able to understand and apply basic terminology in English as well as recognize main points in both written texts related to the aforementioned topics and multimedia sources, and logically structure and report the key points.
General and specific learning outcomes	
Content	1. English – lingua franca of information age. 2. Information and communication technology – its definition and role. 3. Digital transformation. 4. Data structure, organization and processing. Data vs. information and knowledge.

	5. Computer systems and personal computer. Characteristics (specifications) and purchasing computer equipment. 6. Computer software. 7. Information systems. 8. Computer networks. 9. Internet and the World Wide Web. 10. Careers in informatics. Academic degrees, professions and occupations in informatics. 11. Preparation and delivery of a presentation. 12. Writing summaries in English. Paraphrasing. 13. Terminology of English for information technology. Morphological and stylistic features of information technology jargon. Prefixes and suffixes. 14. Using dictionaries. 15. Grammar review: verb tenses and non-finite verb forms. 16. Typical language functions in information technology jargon. Making definitions.
Exercises	In the exercises students are required to more closely engage with the language inputs, concepts and topics introduced in the lecture. Types of tasks included in the exercises material include: vocabulary consolidation and extension, analysis of shorter written and multimedia texts (comprehension, summarizing of key ideas, etc.), grammar practice, identification and application of concepts related to course units.
Realization and examination	Lectures (attendance in 5 assigned sessions during the semester is required). Exercises (attendance in Week 2-15 sessions during the semester is required). Assessment of student work includes: 2 mid-term exams, obligatory presentation, attendance and engagement in classes.
Related courses	Business English Language 1 Business Communication
Literature	1. Study materials organized by units (Word documents and presentations on the course webpage) 2. S. Remacha Esteras and E. Marco Fabré, Professional English in Use: Intermediate to Advanced: ICT. Cambridge: Cambridge University Press, 2007. (selected chapters) A. Gardner and C. Lyon, AS & A Level ICT through Diagrams. Oxford: Oxford University Press, 2009. (selected chapters) 3. BCS Academy Glossary Working Party: BCS Glossary of Computing and ICT, 14th ed., Swindon: British Computer Society, 2016. (selected chapters) 4. L. Pile, *Presenting*, Surrey: Delta Publishing, 2006. (selected chapters) 5. *A Dictionary of Computer Science*, 7th ed., Oxford: Oxford University Press, 2016.

Course title: INTERACTIVE SYSTEMS DEVELOPMENT

Lecturers	Full Professor Božidar Kliček, Ph.D. Assoc. Prof. Dijana Plantak Vukovac, Ph.D. Full Professor Valentina Kirinić, Ph.D.
Language of instruction [Croatian / English]	Croatian / English
Study level [Bachelor / Master]	Bacherol
Study programme	Undergraduate study programme "Information Systems and Business Systems"
Semester [Summer / Winter]	Summer
ECTS [number]	6
Goal	Acquiring basic knowledge of human-computer interaction (HCI) and learning about the types and challenges of interactions encountered by the average user (or user with difficulty). Acquiring theoretical and practical knowledge of basic aspects related to usable design and user experience (UX), learning about the process of developing interactive systems, and applying various HCI methods of designing and developing interactive systems that are based on a user-oriented approach and user experience design.
General and specific learning outcomes	1. Identify and explain basic concepts and terminology in the field of human-computer interaction. 2. Explain the human and computer aspects of interactions. 3. Distinguish between types of interactions and interaction elements of different user interfaces. 4. Explain design principles and guidelines for great user experience of interactive systems. 5. Compare different approaches and processes of interactive systems design. 6. Distinguish and apply appropriate methods for analyzing user needs and requirements, and interaction design, according to the context of the interactive system usage and adapted to the end-user. 7. Develop different types of prototypes with appropriate methods and tools with the inclusion of multimedia elements, in accordance with the stage of development of the interactive system. 8. Compare, select and apply methods of evaluating the interactive system from the aspect of user experience evaluation, in accordance with the stage of development of the interactive system and the objectives of the evaluation.

Content	1. Human-Computer Interaction (HCI): About the Discipline and Basic Concepts The scope and interdisciplinarity of Human-Computer Interaction (HCI). Meaning of terms (usability, accessibility, user experience, interaction design, emotional design, etc.). Interactive system definition. The role of HCI in the process of developing interactive systems. 2. Human Aspects of Interaction A physiological communication model of a human based on the taxonomy of the senses. Conceptual connection between media and senses. Cognitive aspects of human-computer interaction. Social aspects of interaction. Emotional aspects of interaction. 3. Computer Aspects of Interaction Devices for direct manipulation. Devices for indirect manipulation. Fitts's Law and other principles. Display devices. Immersion devices. Other types of I / O devices. 4. Types of Interactions and Interface Metaphors Basic types of human-computer interactions. Overview of user interfaces by the type of interaction. Multimedia elements in user interfaces. 5. Interaction Design Principles and Guidelines General principles of interaction design. Specific principles and guidelines with regard to the type of interactions and achievement of a great user experience. 6. Approaches to Interactive Systems Design User experience goals in the design of interactive systems. User-centered design. Participatory design. Agile approaches. Other approaches. 7. Design of Interactive Systems for Different Types of Users Design for children. Design for elderly. Design for people with disabilities, and accessibility aspects of interactive systems. Design with respect to cultural differences. 8. The Process of Developing Interactive Systems for a Great User Experience Overview of the development process to achieve great user experience: analysis (research and analysis of user needs), design (conceptual design, interaction design), implementation (prototyping), evaluation, development / performance. The project team in the process of developing interactive systems. Management of the development process. 9. Users' Needs Analysis Methods The difference between users' needs and functional requirements. Methods for identifying users' needs: interviews, questionnaires, observation, focus groups, etc. Analysis of the context in which the user operates. Application of user needs analysis methods: user models, user flow, scenarios, storyboards, etc. 10. Design Methods Synthesis of users' needs and client requirements. Mental models of designers and users. Conceptual design methods: design thinking, personas, hierarchical task analysis, etc. Interaction design specifications. 11. Prototyping Methods Methods for designing low-fidelity prototypes: sketches, wire models. Methods for designing high-fidelity prototypes: graphical models, interactive prototypes. Digital tools for prototyping low- and high-fidelity of prototypes. 12. Methods for Evaluating Interactions and Interactive Systems

	Analytical evaluation methods: heuristic evaluation and other methods of assessment by HCI experts. User testing methods: thinking aloud, eye tracking, etc. User inquiring methods: usability evaluation questionnaires, user experience evaluation questionnaires. 13. Integration of user experience design into interactive system development Agile software engineering methodologies from a UX perspective. Characteristics and application of Agile UX method. Characteristics and application of the Lean UX method. Other methods. 14. The Future of Interactive Systems The social and legal impact of interactive systems. Multimodal interfaces and interaction. Predictions of key technologies developments and their impact on end-users.
Exercises	Laboratory exercises follow the content of the lecture and enable practical application of various methods and tools in all stages of the development of interactive systems. The last exercise will be allocated for presentations of student projects.
Realization and examination	Students are required to attend 50% of the lectures and 80% of the laboratory exercises, and work on practical assignments during exercises. During the laboratory exercises, they should design and implement their own interactive system development project. During the semester, they are required to pass two written midterm examinations (or a written and oral exam if they do not pass a midterm).
Related courses	CS 410/510 Top: Introduction to HCI, Portland University (https://docs.google.com/document/d/e/2PACX-1vRtp72MybfA9L2tvamDc1_37gkDsj7C9dfIq0JBbuoyv7AWBZ0P7JBrMmxHBt0h-Ue2Eyq2tweaq1ak/pub) MGA 240 Human-centered Design, Cyprus University of Technology (https://www.cut.ac.cy/studies/bachelor/bachelor-programmes/module-description/?languageId=1&contentId=110216) IFI7180.DT Prototyping, School of Digital Technologies, Tallinn University, https://ois2.tlu.ee/tluois/subject/IFI7180.DT
Literature	1. Preece, J., Rogers, Y., Sharp, H. (2019) *Interaction Design: beyond human-computer interaction*, (5th edition), Wiley, USA 2. Cooper, A., Reimann, R., Cronin, D., Noessel, C. (2014) *About Face: The Essentials of Interaction Design*, 4. izdanje, Wiley, USA 3. Hartson, R., Pyla, P. (2012) *The UX Book: Process and Guidelines for Ensuring a Quality User Experience*, Morgan Kaufmann, Elsevier, USA 4. *The Encyclopedia of Human-Computer Interaction*, 2nd Ed., Interaction Design Foundation (https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/)

Course title: Internet of things services

Lecturers	Asst.Prof. Darko Andročec, Ph.D., Asst.Prof Nikola Ivković, Ph.D.
Language of instruction [Croatian / English]	Croatian and English
Study level [Bachelor / Master]	Bachelor
Study programme	Information / Business Systems
Semester [Summer / Winter]	Summer
ECTS [number]	4
Goal	The goal of the course is to introduce students to creation of thing as a service, connect and publish data from IoT devices to the cloud, and interoperability with other systems. The role of network protocols and standards for the Internet of Things, as well as the principles of service-oriented architecture in building an IoT system, will be also addressed. Students will be introduced to the architectures and platforms of the Internet of Things and the Web of Things.
General and specific learning outcomes	
Content	1. Introduction to Internet of Things systems Definition of the Internet of Things (IoT). Sensors, actuators, microcontrollers, complex things. The most common use cases of the Internet of Things. (2 hours) 2. Cloud computing The definition of cloud computing. Basic models of cloud services: infrastructure as a service, platform as a service, application as a service. Cloud classification into public, private and hybrid, and examples of each type. Basic use cases. Advantages and disadvantages of this computational paradigms. (2 hours) 3. Cloud and fog topology Formal definition of cloud topology. Architectural overview of the OpenStack cloud. Basic architecture problems only in cloud and the need for fog computing. OpenFog reference architecture. Use cases for fog computing. (2 hours)

4. Middleware and IoT
   The definition of middleware. Types of middleware for the Internet of Things. Communication middleware between things and the cloud. Types of IoT platforms. (2 hours)

5. Protocol standardization for IoT
   Internet of Things standardization initiatives. M2N and WSN protocols. Problems in standardizing the Internet of Things. (2 hours)

6. Service oriented architecture for the Internet of Things
   Fundamentals of service oriented architecture and its use in the Internet of Things. Different types of services. SOAP, REST, WebSocket. Advantages and disadvantages of service oriented architecture for IoT. (2 hours)

7. The architecture of the Web of Things
   Using the web on IoT Devices. Sensor network frames. Overview of existing web property architectures and platforms. Portals for Web of Things. Different levels of architecture of the Web of Things (networked things, access, search, sharing, composition). (2 hours)

8. Creating a Web API for things
   Designing an API for things based on REST principles. Implementing RESTful things with HTTP and WebSockets. Resource representation using JSON. Real-time communication between things. (2 hours)

9. Protocols for connecting an IoT device to the cloud
   MQTT. COAP. Other protocols that can be used to connect an IoT device to the cloud. Using remote application programming interfaces of cloud service providers. (2 hours)

10. Describing and searching the Web of Things
    Web-level detection methods and protocols. Models for describing web things and their capabilities. Extension of the basic model with additional Semantic Web formats. (2 hours)

11. Platforms and software tools for collecting data from different sensors
    A way to collect data from different sensors. Examples of platforms and software tools that provide a unique way to store and retrieve data from different sensors. Configuration of these platforms. (2 hours)

12. Cloud services interoperability
    Definition of interoperability. Different types of interoperability. The basics of the Semantic Web and how to use it to achieve interoperability. Interoperability services of different cloud computing providers. (2 hours)

13. Interoperability of the Internet of Things and cloud services

	The specifics of the Internet of Things services and their interoperability with cloud services. JSON-LD protocol. Other useful semantic web recommendations and protocols. (2 hours) 14. Security risks and the problems of the Web of Things The anatomy of attacking the Internet of Things. Examples of malware focused on the Internet of Things. Security basics The internet of things related to physical security, cryptography, network and application layer security. Blockchain and IoT security. (2 hours) 15. Cloud and Fog IoT Data Analysis Cloud and fog storage specificities. NoSQL Database. The basics of data analysis for the Internet of Things. Fundamentals of machine learning for the Internet of Things. (2 hours)
Exercises	Practical computer lab exercises related to content of lectures described above
Realization and examination	Format of instructions: lectures, computer labs, partial e-learning. Student responsibilities: Passed laboratory exercises and passed theoretical part of the exam through continuous monitoring or through regular exam term.
Related courses	Related courses on Carnegie Mellon and ETH Zurich
Literature	1. Sudip Misra, Subhadeep Sarkar, Subarna Chatterjee: Sensors, Cloud, and Fog: The Enabling Technologies for the Internet of Things, CRC Press, 2019 2. Dominique Guinard, Vlad Trifa: Building the Web of Things: With examples in Node.js and Raspberry Pi, Manning Publications, 2016 3. Perry Lea: Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security, Packt Publishing, 2018

Course title: NETWORKED SYSTEMS DEVELOPMENT

Lecturers	Full. Prof. Neven Vrček, Ph. D. Assist. Prof. Boris Tomaš, Ph. D.
Language of instruction [Croatian / English]	Croatian and English
Study level [Bachelor / Master]	Bachelor
Study programme	Module 2 of Information and Business systems - Networked systems and video games
Semester [Summer / Winter]	Winter
ECTS [number]	6
Goal	Students are to be introduced to the architectural design of IoT systems, taking in consideration user requirements and peculiarities of business systems. In order to gain hands-on experience and a better understanding of IoT devices, students will participate in extensive lectures and project work focused on creating a smart business environment.
General and specific learning outcomes	/
Content	1. **Introduction to IoT systems and platforms** - from low-level sensors, microcontrollers and actuators to complete IoT services, comparison of low and high-level data models 2. **Analysis of business and existing physical systems and user requirements** - smart environment, smart factory, implementation of Internet of Things in different spheres of human activities 3. **Documentation and creating a manufacturing plan** - modelling of application and physical products, manufacturing technologies for producing IoT products 4. **Networked systems security and data security** - user privacy on integrated devices, security protocols for IoT, low and high-level security 5. **Service and data modelling for efficient communication** - modelling secure and efficient data models 6. **Communication protocols and telemetry** - real-time tracking of the state of an embedded device, defining a telemetry protocol

	7. **Embedded device prototyping** - prototyping a smaller scale model of a part of a smart factory, data collection and using Cloud services 8. **Prototyping of interoperable IoT systems** - exploring the problem of communication between different embedded devices and systems, defining architectural constraints and data models between systems that can efficiently communicate 9. **IoT system interface** - physical, web and mobile user interfaces, user experience and interface design, visualization of data collected by IOT services
Exercises	- Prototyping a simple IoT device - Consuming simple services - Comparison of different communication protocols (Lora, Sigfox, WiFi, ...) and serialization formats (JSON, ProtoBuffs, …) - Prototyping a small system as a part of a smart factory
Realization and examination	Classes: Lectures, workshop and laboratory exercises Examination: Midterms, a project and an oral exam
Related courses	**1.** Embedded System Design, Faculty of Electrical Engineering, https://www.fer.unizg.hr/en/course/esd_a **2.** Distributed Systems, Manchester University, http://www.cs.manchester.ac.uk/ugrad/syllabus-05-06/CS3052.php **3.** Introduction to the Internet of Things and Embedded Systems, Cousera course, available at: https://www.coursera.org/specializations/iot
Literature	Martin De Saulles: The Internet of Things and Business (Routledge; 1st edition (December 2016)) Song Guo, Deze Zeng: Cyber-Physical Systems: Architecture, Security and Application (Springer; 1st edition (September 2018)) Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner: Enabling Things to Talk: Designing IoT solutions with the IoT Architectural Reference Model (Springer; 2013 edition (October 2013))

Course title: INTRODUCTION TO KNOWLEDGE MODELLING

Lecturers	Full.Prof. Sandra Lovrenčić, Ph.D., Vlatka Sekovanić, mag.educ.inf.
Language of instruction	Croatian and English
Study level	Bachelor
Study programme	Information and Business Systems
Semester	Winter
ECTS	6
Goal	The main goal of the course is to introduce students to the basics of modelling and the presentation of domain knowledge and to automated reasoning as the core areas of artificial intelligence. Students will gain knowledge from automata theory and propositional and predicate logic, and they will apply this knowledge practically for modelling and problem solving in different domains of business. They will also learn the role of formalisms for knowledge modelling in the overall process of developing information and intelligent systems. After the completion of the course, the students should be able to: 1. Solve a given problem (word recognition, communication protocols etc.) in terms of finite and pushdown automata. 2. Test whether a given language is context-free and describe it by a nondeterministic pushdown automaton. 3. Construct a Turing machine for a given language recognition problem and for a given computation problem. Explain basic properties and differences in the modelling of problems in the field of information sciences by using propositional calculus and predicate calculus. 4. Model a given problem in the field of information sciences by using predicate calculus. 5. Express basic definitions and theorems, and explain concepts related to logical consequence. 6. Transform a given problem in the field of information sciences into the disjunctive, conjunctive and Skolem normal form. 7. Apply the Davis-Putnam-Logemann-Loveland algorithm in determining the satisfiability of a set of statements. 8. Apply a resolution rule and its modifications in determining logical consequence. 9. Analyze ways of finding solutions in logic programming languages and devise solutions to relatively simple given problems and implement them using a specified logic programming language.

General and specific learning outcomes	1. Understand and apply appropriate mathematical methods, models and techniques to solving problems in the information and business systems field. 2. Model business processes and data in organizations, and apply models in the development of organizational and information systems. 3. Understand and apply methods and techniques of information and software systems development in contemporary development environments. 4. Keep track of professional literature in Croatian and a foreign language, prepare and independently deliver presentations in Croatian and a foreign language to professional and general public, and critically evaluate a presented professional topic.
Content	1. Course introduction – overview of the field of study, formal systems, importance of automata theory, importance of automatic reasoning, modelling and presentation of domain knowledge and reasoning as fundamental fields of artificial intelligence, motivational examples 2. Regular languages and finite automata - basic concepts, regular languages, regular expressions, deterministic finite automata, nondeterministic finite automata, representation of automata, relationship of finite automata and regular expressions, examples of modelling selected problems 3. Context-free grammars – non-regular languages and the pumping lemma, Chomsky hierarchy of grammars, definition of context-free grammars, deterministic and nondeterministic pushdown automata, relationship of context-free grammars and pushdown automata, Backus-Naur form, examples of modelling selected problems 4. Turing machine - definition, deterministic Turing machine, nondeterministic Turing machine, language recognition and problem solving, variations of the Turing machine, examples of application 5. Knowledge modelling in propositional logic - syntax and semantics, interpretation and truth of propositions, logical consequence, examples of knowledge modelling 6. Reasoning in propositional logic - automatic reasoning, disjunctive and conjunctive normal form, resolution for propositional logic and its modifications, satisfiability problem and DPLL algorithm, examples of modelling and problem solving 7. Knowledge modelling in predicate logic - syntax and semantics, sentence translation, examples of modelling knowledge of selected business domains 8. Reasoning in predicate logic - prenex normal form, Skolem normal form, unification, Horn clause, resolution and its modifications, SLD resolution and clause search, logic programming, examples of modelling and solving business problems 9. Development of the field and application possibilities - other types of logic (fuzzy, modal, temporal…) and their significance for artificial intelligence, automated theorem proving, model verification, formal verification of software and hardware

Exercises	At laboratory exercises students work on assignemnts related to the practical application of course materials on knowledge modelling and problem solving in information sciences, including automata theory and logic programing languages.
Realization and examination	Classes: Lectures, exercises Exam: Preliminary exam, oral exam, seminar paper, practical work
Related courses	1. Logic and Proof, University of Oxford, https://www.cs.ox.ac.uk/teaching/courses/2021-2022/logicandproof/ 2. Logic for Computer Scientist, KTH Royal Institute of Technology, https://www.kth.se/student/kurser/kurs/DD1351?l=en 3. Theory of Automata and Formal Languages, University of Minnesota Duluth, https://www.d.umn.edu/~amsutton/cs3531f21/ 4. Formal Methods and Models, George Mason University, https://cs.gmu.edu/~gordon/teaching/cs330/syllabus.html
Literature	Basic: 1. Goranko, V. (2017.) Logic as a Tool: A Guide to Formal Logical Reasoning, Wiley 2. Mozgovoy, M. (2010.) Algorithms, Languages, Automata, and Compilers: A Practical Approach, Jones and Bartlett Publishers Additional: 3. O'Reagan, G. (2017.) Concise Guide to Formal Methods: Theory, Fundamentals and Industry Applications, Springer 4. Barwise, J.; Etchemendy, J. (2011.) Language: proof and logic, 2nd edition. CSLI publications 5. Bratko, I. (2011.) Prolog programming for artificial intelligence, 4th edition. Pearson Education Canada 6. Čubrilo, M. (1989). Matematička logika za ekspertne sisteme. Informator

Course title: PROCESS ORIENTED ARCHITECTURES

Lecturers	Prof. Neven Vrček, PhD Assoc. Prof. Katarina Tomičić-Pupek, PhD
Language of instruction [Croatian / English]	Croatian / English
Study level [Bachelor / Master]	Bachelor
Study programme	Information and Business Systems
Semester [Summer / Winter]	Winter
ECTS [number]	4 ECTS
Goal	New digital technologies are shaping information systems development paradigms. Creative business models based on effective and efficient business processes supported by modern technologies are essence of new enterprise architectures and key for competitive advantage of modern organizations. The objective of this course is to teach students theoretical foundations and tools for modelling and development of enterprise architectures. After finishing this course students should have detailed knowledge to generate applications based on business process models.
General and specific learning outcomes	
Content	Lectures: 1. Process foundations of enterprise architectures 2. Technical concepts of service oriented architectures 3. Technology foundations of service oriented architectures 4. SOA data modelling 5. User interface modelling for data entry and data analysis 6. Business process logic 7. Roles and authorizations 8. Process application integration 9. Application execution 10. Business process analytics
Exercises	Practical work: Work in professional software development environment. Development of software prototype – generation from business process model. Presentation of project results. 1. Develop business process model as a foundation for generation of process oriented application. 2. Describe business process architecture of business system.

	3. Describe determinants that influence collaboration capacities of business system. 4. Elaborate data model for process oriented architecture. 5. Develop process architecture in chosen software development environment.
Realization and examination	Lectures and seminars with partial e-learning activities. Independent assignments for students. Projects and written/oral exam.
Related courses	-
Literature	e-learning materials available at elf.foi.hr

Course title: SOFTWARE DEVELOPMENT

Lecturers	Full Prof. Vjeran Strahonja, Ph.D., Assoc. Prof. Zlatko Stapić, Ph.D. Marko Mijač, Ph.D. Dijana Peras, M.A.
Language of instruction	Croatian and English
Study level:	Bachelor
Study programme:	Development of software products
Semester:	Winter
ECTS	6
Goal	The goal of the Software Development course is to provide students with a thorough overview of the entire field of software product and system engineering and to teach students the methodological development of software products and software development trends. Students will be mentored in the practical and team work assignment of development of complete software product including its features and documentation.
General and specific learning outcomes	
Content	Lectures 1. Software development (2) Trends and requirements for software development. Professional software development and engineering approach to software development. Tools and environments to support development activities. Automated development. 2. Organization of project and software development process (2) Models and approaches to software development: classic and agile approaches to development. Roles and activities in development processes. Choosing a development approach. Improving the development process. Planning and budgeting of the development process. Agile planning. Risk management. Human resource management. Teamwork. Versioning and quality management. Tools and technologies to support software development project management. 3. Software design practices and specifications (4) Conceptual modeling. Modeling software product architecture. Architectural decisions. Modeling the structure of a software product. UML modeling. Object-oriented design. Prototyping user interfaces. User experience design. Document the design specification for the structure and behavior of the software product. Tools to support the design process.

	4. Software implementation practices and testing (4) Integrated development environments. Implementation of object-oriented principles in the selected programming language and development environment. Implementation of UI concepts and experience in selected development environment and UI design tools. Implementation of working with data. Development frameworks. Organization of code. Code versioning and continuous integration. Software product quality assurance. Clean code. Continuous and automated testing and delivery. Tools and technologies for checking and delivering software. 5. Practices for implementing non-functional requirements (2) Classification of non-functional requirements with respect to implementation. Aspects and importance of non-functional requirements in the overall functionality of the software. Redesigning a software product in the context of non-functional requirements. Practices for implementing non-functional requirements. 6. Architectural styles and templates (2) Architecture design. Decisions in the design process. Views on software architecture. Architectural design styles. Application architectures. Pure architecture. Three-tier architecture. Architecture design templates. 7. Component-based architecture (4). Component-based software engineering. Features of components. Principles of component-based design. Component design guidelines. Carrying out component design. 8. Advanced software engineering (3) Software frameworks. Software products as services. Service oriented engineering. Software process improvement (SPI). 9. Software Development Trends (3) Integration of the Internet of Things / Internet of everything development. Aspect oriented programming. Software production lines. Reactive programming in the context of software development. 10. Fundamentals of Software Engineering Economics (4) Fundamentals of program economics (value chain, costs and benefits; collaborative development, development or purchase, total cost of ownership) Complexity metrics and program cost estimates. Investment decision-making methods (net present value, investment return period).
Exercises	Laboratory exercises are following the content of lectures and practically represent all stages of software development process that are theoretically addressed in lectures. In addition to the practical part of the exercises presented by the teacher, students will develop independent project based on that materials and on the materials available on the e-learning system. Students will apply their own project idea, then plan, design, create and document the product. Finally, the students

	will defend their work. Students are assigned a mentor who mentors and guides them through the development process.
Realization and examination	**Classes:** lectures and exercises **Exam:** preliminary exam and project defense
Related courses	1. Software Engineering, Portland University, (https://www.pdx.edu/computer-science/cs554) 2. The Oregon Master of Software Engineering (OMSE) (http://pdx.smartcatalogiq.com/2019-2020/Bulletin/Courses/OMSE-Software-Engineering) 3. Computing Curricula -- Software Engineering Volume Final Draft of the Software Engineering Education Knowledge (SEEK), April 30, 2003 Edited by Ann E.K. Sobel CCSE Knowledge Area Chair (http://sites.computer.org/ccse/know/FinalDraft.pdf) 4. Software Engineering Institute - SE Curriculum (https://www.sei.cmu.edu/education-outreach/curricula/software-engineering/index.cfm)
Literature	**Basic:** 1. Sommerville I., Software Engineering, 8th edition or newer, Addison Wesley, 2007 or newer 2. Pressman, S. Roger: Software engineering: a practitioner's approach, 7th edition or newer, McGraw-Hill Higher Education, 2010 or newer **Optional:** 1. Teaching and other course materials available in the learning management system, 2. Authorized sources, web materials, and books on topics that the course addresses, which due to frequent and major changes in technologies and tools are to be defined for each generation of students separately.

Course title: BUSINESS COMMUNICATION

Lecturers	Full Prof. Goran Bubaš, Ph.D., Full Prof. Violeta Vidaček-Hainš, Ph.D., Assistant Antonela Čižmešija, M.Inf.
Language of instruction:	Croatian and English
Study level	Bachelor
Study programme	Information and Business Systems
Semester	1st semester (winter)
ECTS	3
Goal	Acquisition of general facts needed for more successful interpersonal communication in a business environment, as well as for efficient design of messages in public speaking, written communication, and information presentation. Acquisition of required knowledge and skills in important areas of applied business communication: presentations, sales communication, negotiation, meetings, interviewing, intercultural communication, electronic communication etc. Acquiring higher levels of competence for various types of communication activities in academic and business environment.
General and specific learning outcomes	1. Develop a plan of a presentation with regards to the available time and target audience. 2. Organize the content of a presentation in accordance with the concept, main points and academic argumentation. 3. Use information and communications technological tools to creatively design a presentation. 4. Participate in organizing the division of tasks and responsibilities among team members and assume responsibility for solving allocated tasks within the team. 5. Present solutions of the assigned tasks to other team members, participate in a discussion on a common solution and make self-critical assessment of their own contribution. 6. Be familiar with factors of communicative competence (knowledge, motivation, communication skills, contextual adjustment, etc.) in face-to-face communication and communication mediated by electronic/digital technologies. 7. Apply knowledge and skills related to communication skills, sales, negotiating, interviewing, team work, etc., for problem solving. 8. Choose and appropriate medium (tool/application) for electronic business communication and appropriately formulate the goals, content and way of communication. 9. Promote ethics in communication behavior in business as well as correct relationships toward business associates. 10. Develop techniques of constructive discussion and argumentation aimed at planning and performance of business activities during individual and group communication.
Content	1. Levels of analysis in business communication and models of the communication process (2 + 2 hours) Fields of business communication and factors of competence in business communication. Levels of communication phenomena (intrapersonal, interpersonal, intragroup, intergroup and mass communication). Models of the communication process.

2. Verbal and non-verbal communication (2 + 2 hours)

Factors of adequacy in business verbal communication. Rhetoric in verbal communication. Types and function of non-verbal messages. Non-verbal messages in business communication.

3. Interpersonal communication competence (2 + 2 hours)

Dimensions of interpersonal communication competence. Implementation of a model of interpersonal communication competence in business communication. Skills related to the dimension communication efficiency: interaction initiation, assertiveness, interaction management, adaptability. Skills related to the dimension orientation to others: empathy, support, self-disclosure, cooperation.

4. Business communication skills (2 + 2 hours)

Importance and methods of practicing business communication skills. Active listening. Persuasion. Self- presentation. Feedback. Conflict management.

5. Elements of efficient presentational communication (2 + 4 hours)

Definition and general goals of presentation. Possible situations for the implementation of presentation. Tasks of the presenter in each individual phase of the presentation: opening of the presentation, central part or the presentation of the topic, conclusion of the presentation. Appropriate structures of business presentation for different purposes. Types of presentation in relation to duration and elaborateness of preparation.

6. Preparation and implementation of presentations (2 + 4 hours)

Organization of preparation. Audience research. Principles of content preparation and methods for arranging presentation content. Content visualization. Types and methods of use of presentation media. Establishing the presenter's credibility. Attracting the attention of the audience. Additional techniques for the improvement of presentation effects.

7. Sales communication (4 + 2 hours)

Characteristics of a salesman which have impact on sales efficiency. Preparation of sales communication. Phases of sales communication. Types of customer approach. Assessment of customer/client needs. Information and presentation of product/service. Techniques of response to questions and complaints. Conclusion of sales communication. After-sales activities.

8. Negotiation (4 + 2 hours)

Definition of negotiation and negotiation situations. Characteristics of successful negotiators. Preparation of negotiation. Negotiation strategies. Tactics and techniques for initial, central and final phases of negotiation. Non-ethical techniques/tactics in negotiation.

9. Business meetings (2 + 2 hours)

Types of meetings. Meeting preparation. Drawing up the agenda of a meeting. Desirable and undesirable behavior of meeting participants. Effective conduct of participants in meetings. Meetings of workgroups, teams and committees. Informational meetings, problem-solving meetings and decision-making meetings. Meetings with clients and business partners.

10. Interviewing (2 + 2 hours)

Types of interviews. Interview preparation. Types and order of interview questions. Phases of an interview: opening, conducting, conclusion. Job interview. Interview for assessment of employee efficiency. Interviews for data gathering in designing information and intelligent systems.

	11. Written business communication (2 + 2 hours) Theme organization. Message structuring. Forms in written business communication. Factors of readability and clarity of a written message. Formation of sentences and passages in a text. Visual design of text. Argumentation and persuasion in written communication. Language, style and register in written business messages. Formation of written messages for various purposes. 12. Business communication through electronic media (2 + 2 hours) Electronic communication devices. Synchronous communications: (mobile) phone, instant messaging, chatrooms, audio and video conferences, web broadcasting. Asynchronous communications: e-mail, distribution lists, discussion groups, web forums, personal web pages, social networks. Meetings through the internet and cooperative systems. 13. Intercultural communication (2 + 2 hours) Cultural differences in verbal and non-verbal communication. Diversity and communication. Intercultural communication competence. Working in intercultural teams.
Exercises	Seminars: In the course of the seminars, the students practice various skills and techniques from the field of business communication. Also, they are introduced to the practical principles of efficient communication for various business needs. The following methods are used: self-assessment tests, quizzes and questionnaires, check-lists for the improvement of personal communication behavior in different areas, analysis of video-recordings of communication behavior, preparation and delivery of public speeches and presentations, role playing, creation and evaluation of written documents, design of multimedia documents, polls and interviews implementation, participation in web forum and use of learning management systems (Moodle).
Realization and examination	Classes: lectures, seminars Examination: written and oral examination, work on seminars, midterm exams
Related courses	1. Public Speaking, Metropolitan State University, MN, USA, https://www.metrostate.edu/academics/courses/comm-103 2. Business Communication, University of California, Berkeley, Haas School of Business, http://www.haas.berkeley.edu 3. Management Communication for Undergraduates, MIT Sloan Undergraduate Program in Management Science, http://mitsloan.mit.edu/
Literature	Basic: 1. Adler, R.B., Elmhorst, J.M., Lucas (2013). "Communicating at Work: Strategies for Success in Business and the Professions", 11th Edition. New York, NY, U.S.A: McGraw Hill. Additional: 2. Morreale, S.P., Spitzberg, B.H., Barge, J.K. (2006): "Human Communication: Motivation, Knowledge, and Skills", 2nd Edition. Belmont, CA, U.S.A.: Wadsworth/Thomson Learning.

Course title: ADVANCED COMPUTER NETWORKS

Lecturers	Asst. Prof. Nikola Ivković, Ph.D., Assoc. Prof. Ivan Magdalenić, Ph.D., Marko Peras, dipl. Inf., Asst. Prof. Igor Tomičić, Ph.D.
Language of instruction:	Croatian and English
Schedule:	60 teaching hours - 5 hours per week (2 hours lectures + 1 hour seminar + 2 hours laboratory work)
Study level	Bachelor
Study programme	Information / Business Systems
Semester	Winter
ECTS	6
Goal	The main goal of this course is to give students conceptual and practical knowledge in advance topics such as security, peer to peer architecture, wireless and mobile networks, multimedia streaming, routing, network management and network programming. This course develops critical thinking and promotes planning, making expert opinions and decisions based on the analytical approach, research, modelling, simulation and formal methods.
Content	1. NETWORK PROGRAMMING Socket API. Types of sockets. Transport service primitives. Data serialization problem. Clint-server architecture. Basic approaches in serving clients. Concurrent processing and communication. Versatile programming paradigms and libraries for network programming and multithreading. Testing and debugging of network applications. 2. SECURITY Attacks and countermeasures. Malicious code, botnet network, denial of service, attack intensification, intercept and capture, addresses spoofing, content modification and fabrication, resubmitting recorded packets. DNS attacks. Security requirements and types of attacks. Cryptography and its application in computer networks. Symmetric and asymmetric cryptography. Cryptographic hash functions. The technique of exchanging / cogenerating secret keys. Authentication protocols. Digital Signature. Certificate. Public Key Infrastructure. Application layer security, email security. Transport Layer Security and TLS. Network layer security (routing security, IPSEC…). Virtual private networks, security associations, security policy database. Wireless security. Types of firewalls and possible network

	configurations. Application proxy. Access control lists. Demilitarized zone.Intrusion detection/prevention system. 3. PEER-TO-PEER ARCHITECTURE Advantages and drawbacks of peer-to-peer architecture. Implementation challenges and possible solutions. Overlay network. Distributed hash tables. 4. ROUTING Routing algorithms, autonomous systems, routing protocols (RIP, OSPF, BGP,…). Broadcast, multicast, and anycast. 5. WIRELESS AND MOBILE NETWORKS Wireless links, CDMA, hidden terminal problem, exposed terminal problem. Taxonomy of wireless networks. Wireless Local Area Networks and IEEE 802.11 standards. Bluetooth, ZigBee, RFID. Mobile access networks. Mobility, mobile IP, handoff, mobility in cellular networks. 6. MULTIMEDIA Types of multimedia streaming applications. Disadvantages of the Internet for multimedia transmission and possible ways to mitigate them. Streaming stored audio and video, RTSP, HTTP for streaming stored multimedia, DASH. Content Distribution Networks (CDNs). Examples of streaming stored multimedia applications. Internet telephony (VoIP), real-time conversation. Adaptive reproduction delay. Packet loss recovery. Protocols: RTP, SIP, H.323. Quality of service (QoS) for multimedia transmission. Network support for multimedia, packet marking, isolation of traffic flows, connection admission. Scheduling mechanisms: FIFO, priority queuing, WFQ, policing mechanisms. 7. NETWORK MANAGEMENT Introduction to network management. Internet network management framework, SMI, MIB, SNMP.
Preconditions	Computer Networks
Realization and examination	Classes: Lectures, seminars and laboratory exercises The lab practice is based on programming, using simulations, and network traffic analysis. Team projects are based on programming, simulation or formal verification and have research, development or educational aspects. Exam: Written and oral exam and seminars
Related courses	Similar courses at MIT.
Literature	Basic:

	Kurose, J.F.; Ross, K.W. Computer Networking: A Top-Down Approach. 7th edition, Pearson, 2017. Peterson, L.L.; Davie, B.S. Computer Networks: A Systems Approach 5th Edition, Morgan Kaufmann, 2011 Additional: Tanenbaum, A.; Wetherall, D. Computer Networks: Pearson New International 5th Edition, Pearson, 2013

Course title: INFORMATION SYSTEMS SECURITY

Lecturers	Asst.Prof. Tonimir Kišasondi, Ph.D.
Language of instruction:	Croatian and English
Schedule:	60 teaching hours - 4 hours per week (2 hours lectures + 2 hours laboratory exercises)
Study level	Master
Study programme	Information / Business Systems
Semester	Winter
ECTS	5
Goal	Introducing the students to problematics of information system security, especially in conditions of dependency of business systems upon business content communication with support of information technology. European legal regulative and means of fulfillment of that regulative as a pre-condition for certification. Introduction to methods of design and development of security. Role of individual measures for reduction of risk levels in individual segments of information system. Development of skills of construction of particular security measures. The goal of exercises is to introduce the students to technical means for realization of particular forms of protection and security of information systems. After passing the colloquium of exercises, the students should be able to build and manage protection of segment of information system supported by computer through aspects of protection which may be implemented on that level.
Content	1. Meaning of information system protection (4 hours) Notion of security and protection of information system efficiency; reasons for protection of information system; dependency of organizational development of business system upon efficient protection of information system. Historical development of system of protection and security with indicators of possible directions of development. (2 hours) Meaning of information content; economical, cultural or political motives of threat; types and forms of threats throughout history; threats to hardware and structural elements of information system; threats to software foundations; threats to communication system; threats to operators. Notion of computer

	crime, origins, development and form of computer crime, carriers of illegitimate activities based upon information technology. (2 hours) 2. Approach to information system projecting (8 hours) Planning and projecting security and protection in course of information system development. Review of standards used in projecting security of information resources; means of realization of information system security according to place of threats and according to place and method of protection. (2 hours) Steps in development of security system of business information system; defining the policy of information system security; choice of strategies for development of security systems of information system; choice of responsible parties for building security systems; choice of approach to mode of realization of security system. Evaluation of significance of business system data content; external factors of business content significance, internal factors of business data content significance; evaluation of forms and intensities of threats to data content regarding the evaluated content. (4 hours) Risk analysis; evaluation of risk of a particular content; quantitative measures of evaluation; fields of application of this method and qualitative measures of evaluation. Choice of protection measure. Security measures. Risk management, analysis of risk types, priority setting, plan of information system security. Plan of recovery from disaster. Valorization of efficiency of security methods. (2 hours) 3. Organizational, program, technical and physical security meaures (12 hours) Modes of realization of organizational, program, technical and physical security measures. Means of technical security. Boundaries of organizational, program, technical and physical security measures. (2 hours) Protection measures of information systems; material carrier as a protection measure; program protection measures; protection on the level of operation system; protection on the level of applicative program support; safety copy with change of material carrier as protection measure; protection by cryptographic protection measures; symmetric crypto systems; asymmetric crypto systems; function of digital signature; modes of realization of digital

	signature; infrastructure of digital signature; fields of application of digital signature. (3 hours) Anti-virus protection; history of virus origins; notion of virus and types of malicious software; routes of virus infection; consequences of virus attack; types of virus according to method of hiding; types of virus according to method of operation; methods of prevention in anti-virus protection; methods for virus detection; possibilities of program solutions for virus identification; "cure" and recovery of infected system. (3 hours) Technical measures of protection; measures of protection on the level of computer system; measures for increasing redundancy of equipment, depending upon risk of content disappearance and continuity of system functionality; protection measures made by setting alternate power systems; impeding access into protected area; supervision of area during trespassing; safety locks; chip cards; biometric inspection; fingerprint; geometry of hand; geometry of head; constitution of eye iris; voice checking; combined measures of inspection; conditions of application of a particular measure; physical protection measures; structural protection measures; placement of sensitive informatic equipment in space; placement of equipment within the building; measures of fire protection; preventive measures, identification measures and measures of fire extinguishing. (2 hours) Organizational protection measures; choice of norm; application of norm; elaboration of required organizational and implemental acts as organizational measure; system of certification of measures applied according to particular norm. Protection measures in legal domain, relation of the state toward security system through passing of particular acts, normative acts related to security within business system. Validity check of applied protection measures. (2 hours) 4. Data security during processing and storage: (4 hours) Realization of security on the level of operational system; licences and copyrights; comparison of Windows protection systems and concepts of protection on Unix platform; protection system with use of password; policies of password assignment and change. Assignment of user interface, deletion and temporal revoking of user interface, rules of exclusion. Conditions and modes of security firewall setting . (2 hours)

	Security on the application level; creation of user interface; assignment of system resources according to problem domain of a workplace. Data storage on carriers with analogue inscription. Means of storage with digital inscription; system of security storage; normal storage; incremental storage; differential storage; daily storage; storage strategies. Multimedia systems of storage. (2 hours) 5. Other aspects of information system security (2 hours) Security standards. Legal protection of softwares; copyright; ownership of software product; licence rights. International aspect of information system protection. Efficiency analysis of the applied protection methods of information center content and users; evaluation of functionality of information protection. Ergonomical aspect of information system security. (2 hours)
Exercises	Exercises: 1. Safety settings in Windows XP operational system (2 hours) User accounts – types, creating, rights. Modes of system access (used security protocols). User groups. User account management. Local Security Settings – policy of user accounts, local politics, limitation of software access, IP security policy. 2. Security settings in NTFS file system (2 hours) Features and structure of NTFS file system. ACL. NTFS access rights to resources. Supervision and analysis of access control. Encrypted file system. 3. Security settings in Linux 1 operating system (2 hours) Linux users and groups – storing of user information; change of users and passwords. Means of system registration (used security protocols). Supervision of users – quote, setting limitations through PAM, bash limitation. Use of Webmin tool for configuration of users, groups and related properties. 4. Security settings in Linux 2 operating system (2 hours) Critical systemic configuration files. Following system notes – general security of notes, system notes. Cryptographic file system – Linux CryptoAPI. 5. Cryptography – PGP/GPG (2 hours) Asymmetrical cryptography. Implementation of asymmetric cryptography through PGP/GPG tools. Installation and configuration of PGP and GPG

	(GnuPG) tools (Windows/Linux). Generating the pair private/public key. Exchange of public keys through key-servers and key-server search. 6. Cryptography – PGP/GPG (2 hours) Use of PGP/GPG tools – encryption of files and e-mails, digital signature; file and e-mail decryption; digital signature validity check. 7. Anti-virus protection and firewall (2 hours) Norton Antivirus – installation, setting customization, media scanning, restoration of base with virus definitions, reports, carantine. Purpose of firewall, device for traffic filtering. Personal firewall – Integrated Windows Firewall (ICF), Kerio Personal Firewall, Sygate Personal Firewall – installation, configuration, filtering rule definition 8. Security data storage (1 hour) Types of security storage – copying (with or without compression), common backup, differential and incremental backup. Security storage of system computer settings. Application through Windows Backup Utility. In the course of exercises, the students use standard program tools, which are commercially used for support to electronic business operations, and apply them to practical examples. The students learn to create XML documents and their definitions, to transform XML documents and to transfer them into various specifications. Furthermore, the students use standard commercial tools for support to managing the chain of supply, learn about its parameters, setup principles and usage mode.
Preconditions	-
Realization and examination	Classes: Lectures, seminars and exercises Exam: Compulsory testing of practical work on computer as a pre-condition for theoretical part of exam, which is realized in written and oral examination. Written part of examination consists of seminar evaluation and several written tests during lectures, or written tests after lectures. Oral part of examination is evaluation of authenticity of previous results and possibility for grade improvement achieved through written exams. The exams are partially conducted through LMS.
Related courses	1. IT-Security, TUG (Techniche Universitat Graz)

	2. Telematik IV - IT Security, Albert-Ludwigs Univ., Freiburg 3. Computer and Network Security, University of Florida
Literature	Basic: 1. BS ISO/IEC 17799:2000 - BS 7799-1:2000 norma - Information Technology - Code of Practice for Information Security Management, BSI, UK, 2001. 2. Peltier R.T., Information Security Risk Analysis, Auerbach, CRC press, 2000. 3. Tudor J.K., Information Security Architecture, CRC Press LLC, USA, 2001. Exercises: 1. Bott E., Siechert C., Microsoft Windows XP Inside Out, Microsoft Press, 2001 2. Linux dokumentacija, URL: http://dokumentacija.linux.hr/ Additional: 1. Ashbourn J., Biometrics - Advanced Identity Verification, Springer-Verlag, UK, 2000. 2. Humphreys E.J, Moses R.H., Plate A.E., Guide to Risk Estimation and Risk Management, BSI, UK, 1998. 3. Scheiner B., Applied Cryptography, John Wiley & Sons Inc., USA, 1996Thorenson J.D., Blankenship J.H., Information Secrets, Valuable Information Ltd, USA, 1996. Exercises: 1. Various textbooks and on-line documentation for program tools used in exercises course.