University of Zagreb
Faculty of Graphic Arts

CATALOGUE OF COURSES IN ENGLISH – exchange students

SHORT SUMMARY

A course catalogue of 42 courses taught in English opened for incoming students in the scope of international exchange / mobility. A list of courses for undergraduate and graduate studies offered in English as well as course descriptions and contact email of teacher is listed in this document.

University of Zagreb
Faculty of Graphic Arts

Contents

About Us

The **Faculty of Graphic Arts of the University of Zagreb** is a public institution of higher education which organizes and conducts study courses and is engaged in scientific and expert work in the area of engineering sciences, field of graphic engineering. The Faculty is a constituent unit of the University of Zagreb, which, under the provisions of the Science and Higher Education Act and the Statute of the University, is the bearer of founding rights over the Faculty.

The study program based on the Bologna process covers three levels:

1. Undergraduate study course
2. Graduate study course
3. Postgraduate study course

The **Undergraduate Study Course of Graphic Engineering** trains students for professional and creative tasks, scientific research and qualifies them to work independently in all segments of graphic industry. Accordingly, the students are trained to run and manage any printing system, as well as optimising costs and implement quality control within these systems.

The students who enrol into the **Undergraduate Study program of Graphic Product Design** are trained in designing graphic products, in developing communication criteria of graphic design and examining and optimizing graphic materials.

The **Graduate Study Course of Graphic Engineering** offers students further professional development and qualifies them to work independently in all segments of graphic industry. Accordingly, they are trained to run and manage any printing system, as well as optimising costs and implement quality control within these systems. Graduate M.A.s in graphic engineering engage independently in scientific research and development of all forms of graphic technology.

The Graduate Study Course of Graphic Product Design primarily encourages permanent research and supports the creative component of graphic design in the synthesis with graphic engineering. The students thus receive education in designing graphic products, examining and selecting optimal materials and developing and improving the work of designers, which can only be realised by means of enhancing the students' awareness of the value of communication criteria of graphic design.

Address:

University of Zagreb Faculty of Graphic Arts
Getaldićeva 2, 10000 Zagreb, Croatia

Contact:

International Relations Office
Ms. Ivana Žganjar, PhD
Phone: + 385 1 23 71 080 /206
E-mail: ivana.zganjar@grf.unizg.hr

ECTS coordinator/Vice Dean for Science and International Relations
asst. prof. Marina Vukoje, PhD
Phone: + 385 1 23 71 080 /120
E-mail: marina.vukoje@grf.unizg.hr

Summary of undergraduate courses and contact information of teachers

COURSE CODE	COURSE TITLE	SEMESTER Winter / Summer	ECTS Credits	STUDY LEVEL BSc (Bachelor's)	Course Teacher	contact email
254254	WAVES, SOUND AND LIGHT	W	4	BSc	asst.prof. Katarina Itrić Ivanda, PhD	katarina.itric.ivanda@grf.unizg.hr
32894	INFORMATICS 1	W	3	BSc	assoc. prof. Tibor Skala, PhD asst.prof. Marko Maričević, PhD	tibor.skala@grf.unizg.hr marko.maricevic@grf.unizg.hr
254260	OPTICS, ELECTROSTATICS, AND FLUID MECHANICS	S	5	BSc	asst.prof. Katarina Itrić Ivanda, PhD	katarina.itric.ivanda@grf.unizg.hr
19535	PHOTOGRAPHIC PROCESSES	S	4	BSc	assoc. prof. Rahela Kulčar, PhD	rahela.kulcar@grf.unizg.hr
19529	DIGITAL MULTIMEDIA 1	S	5	BSc	prof. Klaudio Pap, PhD assoc. prof. Maja Rudlof, PhD	klaudio.pap@grf.unizg.hr maja.rudolf@grf.unizg.hr
32895	INFORMATICS 2	S	3	BSc	assoc. prof. Tibor Skala, PhD asst. prof. Marko Maričević, PhD	tibor.skala@grf.unizg.hr marko.maricevic@grf.unizg.hr
19537	PRINTING FORMS 1	W	5	BSc	prof. Sanja Mahović Poljaček, PhD assoc. prof. Tomislav Cigula, PhD	sanja.mahovic.poljacek@grf.unizg.hr tomislav.cigula@grf.unizg.hr
19549	REPRODUCTION PHOTOGRAPHY 1	W	4	BSc	prof. Lidija Mandić, PhD	lidija.mandic@grf.unizg.hr
19543	MULTIMEDIA COMMUNICATIONS 1	W	5	BSc	assoc. prof. Tajana Koren Ivančević, PhD	tajana.koren.ivancevic@grf.unizg.hr

19558	PRINTING FORMS 2	W	4	BSc	prof. Sanja Mahović Poljaček, PhD asst.prof. Tamara Tomašegović, PhD	sanja.mahovic.poljacek@grf.unizg.hr tamara.tomasegovic@grf.unizg.hr
19528	DESIGN OF GRAPHIC MEDIA 1	S	4	BSc	prof. Jesenka Pibernik, PhD	jesenka.pibernik@grf.unizg.hr
98042	INDUSTRY AND ENVIRONMENT	W	4	BSc	prof. Ivana Bolanča Mirković, PhD	ivana.bolanca.mirkovic@grf.unizg.hr
19559	GRAPHIC PROGRAMMING LANGUAGES	S	4	BSc	prof. Klaudio Pap, PhD assoc. prof. Maja Rudolf, PhD	klaudio.pap@grf.unizg.hr maja.rudolf@grf.unizg.hr
38011	SCIENCE OF ENVIRONMENT AND DESIGN	W	4	BSc	prof. Ivana Bolanča Mirković, PhD	ivana.bolanca.mirkovic@grf.unizg.hr
19539	PRINTING INKS	W	4	BSc	assoc. prof. Sonja Jamnicki Hanzer, PhD	sonja.jamnicki.hanzer@grf.unizg.hr
32785	GRAPHIC DESIGN 1	W	4	BSc	prof. Maja Brozović, PhD	maja.brozovic@grf.unizg.hr
19548	ORGANIZATION OF GRAPHIC PRODUCTS	W	4	BSc	asst.prof. Diana Bratić, PhD	diana.bratic@grf.unizg.hr
32786	GRAPHIC DESIGN 2	S	4	BSc	prof. Maja Brozović, PhD asst. prof. Dorotea Kovačević, PhD asst. prof. Josip Bota, PhD	maja.brozovic@grf.unizg.hr dorotea.kovacevic@grf.unizg.hr josip.bota@grf.unizg.hr
128242	COMPOSITION	S	4	BSc	assoc. prof. Tajana Koren Ivančević, PhD	tajana.koren.ivancevic@grf.unizg.hr
19561	QUALITATIVE RESEARCH METHODS OF COLOUR REPRODUCTION	S	4	BSc	assoc. prof. Rahela Kulčar, PhD	rahela.kulcar@grf.unizg.hr
19563	APPLICATION AND INVESTIGATION OF PRINTED MATERIALS	S	4	BSc	asst. prof. Maja Strižić Jakovljević, PhD prof. Branka Lozo, PhD	maja.strizic.jakovljevic@grf.unizg.hr
19557	BOOKBINDING 1	S	5	BSc	assoc. prof. Suzana Pasanec Preprotić, PhD	suzana.pasanec.preprotic@grf.unizg.hr

19469	OFFSET PRINTING MANAGEMENT	S	5	BSc	prof. Igor Zjakić, PhD assoc. prof. Irena Bates, PhD	Igor.zjakic@grf.unizg.hr irena.bates@grf.unizg.hr

Summary of graduate courses and contact information of teachers

COURSE CODE	COURSE TITLE	SEMESTER Winter / Summer	ECTS Credits	STUDY LEVEL MSc (Master's)	Course Teacher	contact email
19476	DIGITAL PRINTING FORM	W	6	MSc	Prof. Igor Majnarić, PhD	igor.majnaric@grf.unizg.hr
19438	PACKAGING PRINTING	W	5	MSc	assoc. prof. Irena Bates, PhD	irena.bates@grf.unizg.hr
19473	APPLICATION OF DIGITAL PHOTOGRAPHY IN REPRO. MEDIA	W	4	MSc	Prof. Maja Strgar Kurečić, PhD	maja.strgar.kurecic@grf.unizg.hr
19498	HOLOGRAPHY	W	5	MSc	asst.prof. Katarina Itrić Ivanda, PhD asst.prof. Vladimir Cviljušac, PhD	katarina.itric.ivanda@grf.unizg.hr vladimir.cviljusac@grf.unizg.hr
33072	GRAPHIC DESIGN 3	W	5	MSc	prof. Maja Brozović, PhD	maja.brozovic@grf.unizg.hr
40782	WEB DESIGN 1	W	6	MSc	prof. Jesenka Pibernik, PhD	jesenka.pibernik@grf.unizg.hr
19455	DESIGN AND ENVIRONMENT	S	5	MSc	prof. Ivana Bolanča Mirković, PhD	ivana.bolanca.mirkovic@grf.unizg.hr
19481	CTP TEHNOLOGY	S	6	MSc	prof. Sanja Mahović Poljaček, PhD asst.prof. Tamara Tomašegović, PhD	sanja.mahovic.poljacek@grf.unizg.hr tamara.tomasegovic@grf.unizg.hr
19502	OPTOELECTRONIC SYSTEMS 2	S	6	MSc	prof. Lidija Mandić, PhD	lidija.mandic@grf.unizg.hr
19461	SYSTEM FOR THE ENVIRONMENT MANAGEMENT	S	5	MSc	asst. prof. Marina Vukoje, PhD prof. Ivana Bolanča Mirković, PhD	marina.vukoje@grf.unizg.hr
19490	OPTICAL METHODS OF THE PRINTING SURFACE INVESTIGATIONS	S	5	MSc	asst.prof. Katarina Itrić Ivanda, PhD	katarina.itric.ivanda@grf.unizg.hr

19480	SURFACE PHENOMENA ON PRINTING FORMS	S	5	MSc	assoc. prof. Tomislav Cigula, PhD asst.prof. Tamara Tomašegović, PhD	tomislav.cigula@grf.unizg.hr tamara.tomasegovic@grf.unizg.hr
96536	INK IN DIGITAL ENVIRONMENT	S	3	MSc	prof. Lidija Mandić, PhD	lidija.mandic@grf.unizg.hr
33073	GRAPHIC DESIGN 4	S	5	MSc	prof. Maja Brozović, PhD	maja.brozovic@grf.unizg.hr
53571	MOTION GRAPHICS	W	6	MSc	prof. Jesenka Pibernik, PhD	jesenka.pibernik@grf.unizg.hr
19463	MARKETING COMMUNICATIONS	W	5	MSc	asst.prof. Diana Bratić, PhD	diana.bratic@grf.unizg.hr
19494	INTRODUCTION TO THE THEORY OF EXPERIMENTAL WORK	W	5	MSc	asst.prof. Katarina Itrić Ivanda, PhD	katarina.itric.ivanda@grf.unizg.hr
19441	PACKAGING AND ENVIRONMENT	W	5	Msc	prof. Ivana Bolanča Mirković, PhD	ivana.bolanca.mirkovic@grf.unizg.hr
19504	BROADBAND NETWORK APPLICATIONS	W	6	MSc	assoc. prof. Tibor Skala, PhD	tibor.skala@grf.unizg.hr

Courses from undergraduate study programme

WAVES, SOUND AND LIGHT			
Course teacher	Katarina Itrić Ivanda	Course code	254254
Name of the course	Waves, sound and light	Semester (winter/summer)	winter
Teacher's contact email	katarina.itric.ivanda@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
COURSE DESCRIPTION			
Course objectives	The goal of this course is to introduce students to the fundamentals of waves, sound, and light and their application in various areas of graphic technology. Through instructional units, students will acquire fundamental knowledge of oscillation, waves, and electromagnetic wave properties, as well as the basic parameters that describe sound. In the first part of the course, topics related to sound perception, interference, resonance, modulation, and the application of sound in multimedia, video games, and augmented reality will be covered. In the second part of the course, students will become familiar with the interaction of light and matter, absorption, reflection, transmission, color perception, and the application of Beer-Lambert's law. They will also be introduced to optical components of different image capture systems, as well as light interference, diffraction, and polarization and their application in graphic technology.		
Learning outcomes	1.List the basic characteristics of sound waves. 2.Recognize sources of sound waves and explain how they differ based on intensity and frequency. 3.Classify noise sources and their impact on sound perception. 4.Explain superposition and interference and distinguish between spatial and temporal interference of sound waves. 5.Describe sources of light and understand how they are used in various applications, including spectrometry, holography, and photography. 6.Explain the principles of operation of optical components used in different image capture and reproduction systems. 7.Acquire the concepts of light interference, diffraction, and polarization to apply them in practice (such as hologram creation, manufacturing polarizing filters and 3D models, and quality control of graphic products).		
Course content (syllabus)	1. Waves. General wave formation. Oscillation; force of a harmonic oscillator. Oscillation equation; solution of the equation, frequency and period of oscillation; Wave equation; temporal and spatial components. 2. Sound waves; sources of sound waves; reflection of sound waves; speed of sound waves; propagation of sound in a medium; wave refraction; energy, power, and intensity of sound waves. 3. Sound level; auditory response to intensity and frequency; Doppler effect (relationship between the sound source and receiver); shock waves. 4. Superposition and interference; spatial interference; standing waves; standing waves in an air column (one free end, two free ends, two fixed ends); temporal interference of sound waves: beats.		

	5. Sound perception; human auditory system; audibility threshold; noise; the role of sound in multimedia, video games, and augmented reality. 6. Quiz. 7. Light, the dual nature of light; light sources; spectral radiation density; intensity of light sources. 8. Interaction of light and matter; absorption, reflection, and transmission depending on the type of material; color perception. 9. Interaction of light and matter; Beer-Lambert's law. 10. Optical components of different image capture and reproduction systems; flat and spherical lenses. 11. Optical components of different image capture and reproduction systems; filters and sensors. 12. Interference, diffraction, and polarization of light and their application in graphic technology; photography, holography. 13. Application of optical phenomena in spectrometers, densitometers. 14. Application of optical phenomena in digital communication devices. 15. Quiz.
Required literature (available in the library and/or via other media)	**Title**
	F. A. Everest, K. C. Pohlmann: Master Handbook of Acoustics, 6th Edition, McGraw-Hill Education, 2015.
	S Y Lee: Fundamental Physics of Sound, World Scientific, 2020.
	F. Alton Everest : The Master Handbook of Acoustics, Fourth Edition, McGraw-Hill, 2001.
	H.D. Young i R. A. Freedman: University Physics With Modern Physics,Addison-Wesley, 2012.
	V. Henč-Bartolić i P. Kulišić: Valovi i optika, Školska knjiga, Zagreb, 2004.
	V. Henč-Bartolić i ostali: Riješeni zadaci iz valova i optike, Školska knjiga, Zagreb, 2002.

INFORMATICS 1			
Course teacher	Tibor Skala Marko Maričević	Course code	32894
Name of the course	Informatics 1	Semester (winter/summer)	winter
Teacher's contact email	tibor.skala@grf.unizg.hr marko.maricevic@grf.unizg.hr	ECTS credits	3
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
COURSE DESCRIPTION			
Course objectives	To standardize the level of computer literacy that, along with new knowledge and skills, they will be able to apply in business and continuing studies. Developing the ability of reliable and critical use of information and communication technologies. Developing logical and critical thinking and an algorithmic approach to solving various problems.		
Learning outcomes	Students will be able to: Explain the systematic approach and state definitions of key theories related to with the emergence of informatics. List the basic characteristics of computer generations. Apply basic principles from the field of mathematical and logical basis of computer operation. List the types of computer networks and describe their development. List the basic characteristics of Web 2.0 technology. Give an example of use i present it. Differentiate between the basic terms: multimedia and hypermedia. State the definition of artificial intelligence and state its application. Differentiate basic concepts from the field of IS security. Apply operating system, Internet, computer word processing tools and spreadsheet calculator to basic and advanced level.		
Course content (syllabus)	Introduction to the basic concepts of the course. Development of computers throughout history: ideas and assumptions computers, mechanical devices, more mature ideas. 2. First digital computers, commercial development, microprocessors, personal computers. Concepts architecture and organization of digital computers: von Neumann architecture, parts, connection, logical and circuit foundations. 3. Basic terms of a personal computer: hardware, software, peripheral devices, types of computers according to purpose. 4. The concept of system. Definition of information system. Business system. Systemic approach (term system, system elements, connections in the system). Terms related to the information system. Algorithm. Functions of the information system in the business system. Hardware. Software. 5. Cybernetics. System theory. Information sciences. Informatics. 6. Data and information. Communication system. Information technologies. Informational society. Information system. 7. Development of data processing and computers. Computer system. Choice of computer equipment. 8. Software support for computer operation. Mathematical and logical bases of computer operation. 9. Data organization. Logical organization of data. Physical organization of data. Addresses folder and file. 10. Multimedia and hypermedia. Definitions and general terms. Disadvantages of the hypermedia model and possible solutions. A brief historical overview. Application of multimedia and hypermedia. Multimedia computer systems. Basic multimedia elements.		

	11. Artificial Intelligence. A traditional approach to artificial intelligence. Symbolic representation of knowledge and reasoning as manipulation of symbols. Alternative approaches. Imitation of models found in nature. 12. Computer networks. Internet. Web 2.0 technologies. Development of networks. History of development and basic features. Media. Network equipment. Topology of LANs. OSI reference model. Protocols. Addressing in LAN. MAC addresses. IP addresses. Binary number system. 13. E-business. Information and communication technology in education. 14. Information society - characteristics and consequences: characteristics, state in our country and in the world, impact of IT on business, society, social groups of IT users, IT literacy, dependence of society and economy on IT, globalization and IT. 15. Protection, security and privacy in the application and use of information technology: security risks in the application and use of IT, licenses, open-source, personal security, privacy, legal consequences.
Required literature (available in the library and/or via other media)	**Title**
	Lecture script in digital form. Script of tasks and exercises in digital form.
	Šehanović, J., Hutinski, Ž.; Žugaj, M. Informatics for economists. Faculty of Economics Pula, Pula, 2002.
	Cerić, V., Varga. M., (2004): Information technology in business. Zagreb: Element
	Group of authors, Business computing. Znak, Zagreb, 1998.
	Manuals of programming tools from the program exercises

OPTICS, ELECTROSTATICS, AND FLUID MECHANICS			
Course teacher	Katarina Itrić Ivanda	Course code	254260
Name of the course	Optics, electrostatics, and fluid mechanics	Semester (winter/summer)	summer
Teacher's contact email	katarina.itric.ivanda@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
COURSE DESCRIPTION			
Course objectives	The aim of the course is the application of fundamental knowledge in fluid mechanics, electrostatics, as well as geometric and physical optics in the analysis of technical and technological processes in graphic reproduction. In the first part of the course, students will become familiar with fluid mechanics, where, within the scope of hydrostatics and hydrodynamics, they will address topics related to fluid viscosity, the characteristics of ideal fluids, and their application in graphic technology. Topics covered in the course will also include light interference and diffraction on devices used in quality control during graphic processes. Students will acquire knowledge related to the phenomenon of electron emission from materials under the influence of electromagnetic radiation and become acquainted with photometric quantities describing light sources. The goal is also to understand the optical interaction of light with materials, distinguish between incoherent and coherent radiation, and apply the theory of electromagnetic radiation polarization in graphic reproduction.		
Learning outcomes	1. Acquire knowledge about the rheological properties of fluids. 2. Understand and apply the laws of geometric and physical optics. 3. Describe various types of electrical phenomena in graphic technology. 4. Apply acquired knowledge from electrostatics in explaining the principles of digital printing. 5. Define the fundamental forms of electromagnetic radiation interaction with matter: reflection, transmission, and absorption, and specify systems that absorb and scatter light. 6. Analyze the interaction of light and printing substrates based on simple physical models. 7. List the basic characteristics of the physics of color.		
Course content (syllabus)	1. Introductory Lecture 2. Fluid Mechanics I – Hydrostatics - Hydrostatic pressure; buoyancy; surface tension; the influence of cohesive and adhesive forces on molecules in a fluid; wetting and non-wetting surfaces; wetting angle and its significance in the graphic industry; capillary effect; explaining the difference between real and ideal fluids; humidity. 3. Fluid Mechanics II – Hydrodynamics - Laminar flow, deformation of fluids; turbulent flow; viscosity of fluids and graphic inks; characteristics of ideal fluids, continuity equation, Bernoulli's equation. 4. Electrostatics and Electrodynamics - Electric charges; charge distribution on real bodies; surface charge density; electric force; Coulomb's law; electric field; electric potential; electric current; application of concepts in graphic technology. 5. Photoelectric Effect - Photoelectric effect equation; threshold frequencies; photoelectric current and photocells; application of the photoelectric effect in graphic processes.		

	6. Geometric Optics I - Laws of geometric optics; limitations of the validity of laws, mirror and diffuse reflection, total internal reflection; refraction of light in flat optical systems (plane-parallel plate, prism); light dispersion. 7. Geometric Optics II - Imaging in geometric optics; real and virtual objects, formation of real or virtual images; conditions for unique mapping; Gaussian approximation; conjugate equation; linear magnification; imaging on flat and spherical mirrors. 8. Geometric Optics III - Imaging on thin lenses; lens systems; optical instruments: camera; microscope; microscope magnification, resolution, Rayleigh's criterion. 9. Wave Optics I - Wave nature of light; interference of light; coherent sources and conditions for the formation of bright and dark fringes. Young's experiment; Fresnel mirrors, thin films, Newton's rings; application of interference in graphic phenomena. 10. Wave Optics II - Diffraction at an obstacle; diffraction at a slit; diffraction on an optical grating; conditions for maxima and minima of light; intensities of individual maxima; application of diffraction in graphic processes. 11. Photometry; measurement of the visible part of the electromagnetic waves; energy and photometric quantities of light sources; equivalent; human eye sensitivity in the visible light spectrum; intensity, flux, and quantity of light; Lambert's law; representation of functional relationships and finding extreme values; optimal values of illumination of certain surfaces. 12. Polarization of Light - Methods of light polarization; types of polarization; Fresnel equations; the role of polarizers in quality control devices. 13. Physics of Color - Visible light spectrum and color tone; frequency and energy of visible light; psychophysical perception of color; color representation theory using three stimuli; additive and subtractive color mixing; color of opaque and transparent objects. 14. Interaction of Light with the Printing Substrate; resonant and non-resonant interaction; reflection, transmission (refraction), absorption; systems that absorb and scatter light. Beer-Lambert system. Kubelka-Munk system. 15. Models for Describing Reflection from a Halftone Image: Murray-Davies and Yule-Nielsen models; optical and mechanical dot gain.
Required literature (available in the library and/or via other media)	**Title**
	P. Kulišić i V. Lopac: Elektromagnetske pojave i struktura tvari, Školska knjiga, Zagreb, 2003.
	V. Henč-Bartolić i P. Kulišić: Valovi i optika, Školska knjiga, Zagreb, 2004.
	V. Henč-Bartolić i ostali: Riješeni zadaci iz valova i optike, Školska knjiga, Zagreb, 2002.
	V. Lopac i ostali: Riješeni zadaci iz elektromagnetskih pojava i strukture tvari, Školska knjiga, Zagreb, 2003.
	P.Kulišić: Mehanika i toplina, Školska knjiga, 2005.

PHOTOGRAPHIC PROCESSES			
Course teacher	Rahela Kulčar	Course code	19535
Name of the course	Photographic processes	Semester (winter/summer)	Summer
Teacher's contact email	rahela.kulcar@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Tutorial class, lectures
COURSE DESCRIPTION			
Course objectives	The course introduces students to the fundamental photochemical reactions and principles, and the structure and composition of photographic materials based on silver salts as the photosensitive substance. It covers the processes and chemistries involved in the creation of a photographic image. Photographic properties and characteristics of the photographic image are examined. The characteristics of negative and positive materials, as well as finished images, are discussed. Alternative photographic techniques and photosensitive emulsions required for various processes that produce a photographic image without the use of a camera are analyzed.		
Learning outcomes	The student will be able to practically apply the basic laws of photochemistry. After passing the course, the student will be able to independently, based on their knowledge of the structure and image formation, carry out the classical photographic process and select suitable materials for the desired result of the final photographic image. Additionally, they will be able to independently create a photographic image using an alternative photographic technique without the use of a camera on various surfaces.		
Course content (syllabus)	1. Photochemical reactions and basic photochemical laws. Grotthus's law, Lambert-Beer's law, Einstein's law, Reciprocity law, Schwarzschild's law. Application of these laws in photography. 2. Structure and production of photographic materials. Types of substrates and their properties. Photographic layers and their components. Preparation of photographic emulsions. 3. Precoating additives to enhance the photographic properties of photomaterials. Optical sensitizers and stabilizers. Additives to improve physical and mechanical properties. Coating of emulsion. Confectioning of photographic materials. 4. Camera. Lens. Illumination of photographic materials. Mechanism of latent image formation. 5. Processing of photographic layers in solutions. Developer and its components. Utilization and regeneration of the developer. Developer induction period. 6. Types of developers. Chemistry of development. Factors influencing development. Physical development. Development termination. Composition of fixing solution. 7. Chemistry of fixation. Types of fixers. Fixer regeneration. Washing and drying. 8. Characteristics of photographic layers. Sensitometry and its parameters. Photographic exposure. Opacity. Transparency. Reflection. Density of darkening. 9. Characteristic densities of darkening. Sensitometric testing of photomaterials. 10. Gradation. Factors affecting gradation. 11. General sensitivity DIN, ASA, ISO values. Spectral sensitivity.		

	12. Ability to resolve photomaterials. MTF function. Graininess and granularity. 13. Methods of obtaining a photographic image. Direct method. Indirect method. Negative-positive process. Negative image, negative film, positive image, positive film. 14. Photographic paper, structure, and properties. Application of different gradations of photographic paper. Variable gradation photographic papers. 15. Alternative photographic techniques. Photosensitive emulsions.
Required literature (available in the library and/or via other media)	**Title**
	M. Langford; Advanced Photography, Focal Press, Oxford, 1999.
	London, Stone, Upton; Photography, Pearson Education, 2008.
	James C., The book of alternative photographic processes, Cengage Learning, 2015.

DIGITAL MULTIMEDIA 1			
Course teacher	Klaudio Pap, Maja Rudlof	Course code	19529
Name of the course	Digital multimedia 1	Semester (winter/summer)	summer
Teacher's contact email	klaudio.pap@grf.unizg.hr maja.rudolf@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
COURSE DESCRIPTION			
Course objectives	Acquiring fundamental knowledge about digital multimedia components and their potential use. This subject studies digital multimedia with all its basic components. Basic knowledge is provided on digital text, digital image, sound, video, and animation. The basics of the em square, digital writing lines, and font are defined as an organized set of digital squares. The definition of vector, pixel, and raster images is explained. The mathematical definition of the Bezier curve and types of connections in vector graphics are also discussed. The digital vector path and its attributes for use, as well as the digital image element, its multichannel coding of gray levels, and organized grouping into a digital image, are defined. Basic digital transformations and filtering over digital images are studied. The histogram of the digital image is introduced, along with its use for redistributing n-channel coded gray levels. The basics of digital rasterization, color digitization in different color systems, and the basic integration of text, image, sound, video, and animation into multimedia content are covered. The definition of basic HTML elements and attributes, as well as the CSS basic command set and fundamentals of usage for multimedia content presentation on the web medium, are also included.		
Learning outcomes	Evaluation of the characteristics of prepress, printing, finishing, and multimedia devices. Classification of different media and identification of their main features depending on the type of communication. Defining the type and purpose of the message based on the user, form, and type of graphic media. Using tools and knowledge of technological processes and materials in designing, reproducing, and distributing visual messages. Classifying the basic components of digital multimedia. Differentiating between vector, pixel, and raster image formats. Using different types of encoding of digital information in different digital media. Using graphic tools for basic processing and integration of digital multimedia content. Differentiating between different color digitization systems in the digital multimedia environment. Using software tools for basic digital transformations and filtering of digital images. Applying the basics of HTML and CSS technology for simple multimedia presentations on a website.		
Course content (syllabus)	1. Lecture: Basic definitions of digital text, digital image, sound, video, and animation; Exercises: Basic font operations, editing, generating, and installation 2. Lecture: Definition of em square, digital writing line, and font as an ordered set of em squares; Exercises: Basics of vector graphics and typography application in vector programs 3. Lecture: Definition of vector, pixel, and raster images; Exercises: Complex shapes in vector graphics and color systems		

	4. Lecture: Mathematical definition of Bezier curve and types of connections in vector graphics; Exercises: Introduction of pixel graphics into vector environments 5. Lecture: Definition of digital vector path and its attributes for use; Exercises: Basics of 3D simulation in vector program, Colloquium 6. Lecture: Digital image element, its multichannel coding of grayscale and organized grouping into a digital image; Exercises: Basics of coloring monochromatic images, working with selections and channels 7. Lecture: Basic digital transformations and filtering on digital images; Exercises: Basics of digital retouching 8. Lecture: Histogram of digital image and its use for redistribution of n-channel coded grayscales; Exercises: Basics of photomontage 9. Lecture: Introduction to the basics of digital rasterization; Exercises: Automation of digital content processing: Actions 10. Lecture: Basics of digitizing color in different color systems; Exercises: Basics of multi-page layout, master, styles, wrapping text around image (free forms), colloquium 11. Lecture: Basics of integrating text and images; Exercises: Basics of multi-page layout, master, styles, wrapping text around image (free forms) 12. Lecture: Basics of integrating sound and video into multimedia content; Exercises: Introduction to video, basics of cutting sequences, merging sequences, and adding sound 13. Lecture: Basics of animation in multimedia content; Exercises: Basic animations - frames, tweening 14. Lecture: Definition of basic HTML elements and attributes and CSS basic set of commands; Exercises: HTML: forms and lists 15. Lecture: Basics of multimedia content presentation on the web medium; Exercises: Introduction of multimedia content into web documents, colloquium
Required literature (available in the library and/or via other media)	**Title**
	K. Pap: Osnovna HTML pravila http://www.klaudiopap.com/pretraznici-i-navigacija-na-webu/
	ed. John G. Webster, Multimedia Encyclopedia of Electrical and Electronics Engineering, V37, 1999,
	Multimedia, 1999.
	Jesse S. Jin, Changsheng Xu, Min Xu, The Era of Interactive Media, ISBN 978-1-4614-3500-6, 2013.,Springer
	Optional: V. Žiljak, K. Pap, POSTSCRIPT PROGRAMIRANJE GRAFIKE, FS, Zagreb,1998. /2004. Tiskovno izdanje: ISBN: 953 - 199 – 000, Elektr. izdanje: http://free-zg.htnet.hr/kpap

INFORMATICS 2			
Course teacher	Tibor Skala Marko Maričević	Course code	32895
Name of the course	Informatics 2	Semester (winter/summer)	summer
Teacher's contact email	tibor.skala@grf.unizg.hr marko.maricevic@grf.unig.hr	ECTS credits	3
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g., tutorial class, lectures, seminar)	Lectures, laboratory
COURSE DESCRIPTION			
Course objectives	Acquiring knowledge about the principles of computer system operation, the principles of design, construction and maintenance of the information system, and with areas of application and trends in information development technologies. The aim of the course is to introduce students to models of information system construction and its use in the business environment. Various aspects of computer application will be pointed out optimization of business processes and implementation of electronic business systems. It will also be defined describe the ways of presentation of processing results with an emphasis on the application of multimedia, and the development and application of virtual reality. Students will learn about the types of computer networks, and the basic one's devices necessary for their realization. The concept of the network will be expanded with knowledge from the field Internet and its technologies, internet services, the way to find data on the Internet, and the necessary infrastructure. Security and protection of information systems are the foundation uter applications in corporate conditions. Awareness of the existence of threats and importance will develop protection of data content. Data protection measures will be defined and explained, as well as specific possibilities of their application. At the pragmatic level, students will be trained to work in open-source systems.		
Learning outcomes	Students will be able to: understand and explain the principles of computer system operation, analyze and explain trends in the development of information technology, create and adapt presentations and use basic network services based on acquired IT literacy.		
Course content (syllabus)	1. Introductory lecture. Introduction to the subject and explanation of the way of work. Referral to teaching contents presented on the Internet and within the LMS system Types of information systems, models of building information systems. 2. Information systems in certain business areas, information system in the area finance and accounting, production information systems, procurement information systems, sales information systems, personnel information systems. Elements of the system software support, the concept of an operating system, types and functions of an operating system. 3. Approach to the construction of an information system, life cycle of an information system, stages of construction information system, information system development planning, business analysis system, information system design, information system development, implementation new system, system maintenance. 4. Electronic business is a condition for modern business and organization in under modern conditions, stages of development of electronic business, company-to- company business (B2B), business of the company with the end user (B2C),		

	business of the end user s company (C2B), end user to end user (C2C) business. Block diagrams and data flow diagrams, numerical coding. 5. Textual presentation of content, inclusion of sound in the description and presentation of content, graphically display, multimedia in the display of content. The concept of multimedia, multimedia as a technology, multimedia as a communication phenomenon, development of multimedia communication systems, hypertext and hypermedia for non-linear content movement, IT concept multimedia, virtual reality, elements for building virtual reality. 6. Multimedia in the presentation and connection of facts in the function of learning, virtual reality step according to kinetic memory, multimedia as a condition for efficient realization of lifelong learning, multimedia description of the real system in exchange for a conceptual image of the description of the real system. Spreadsheets, simple databases. 7. Elements of the digital communication system, data transfer in a computer network, technological computer network aspects, necessary elements for building a computer network, computers, communication channels, communication adapters, communication protocols, operating system for network management. Constituent parts, the role of computers in communication. 8. Types of computer networks, local networks, regional networks, wide area networks, topologies computer networks, connection of topology and organizational solutions in the business system, telematic services. User interface, technological aspects of computer networks. 9. The concept of Internet communication, the origin and development of the Internet, the working principle of the Internet, characteristics of the Internet, elements and topology of the Internet, Internet services and their application in business. Internet services, electronic mail, discussion groups, distribution lists, transmission remote data. Web infrastructure, areas of application, further development of the Internet. Conditions Internet business, development and areas of application. Principles of data transmission in the network computers. 10. Systems and methods for finding information on the Internet, thematic catalogs, search engines, methods querying using search engines, basic logical operators, setting phrases to search engines, substitution operators, structured search, search by file type, metasearch engines, intelligent agents, alternative search methods, search strategies, evaluation of found content, according to institution, according to a well- known and recognized author, recognition of reference literature. 11. Application of Internet technology in the function of learning, hypertext, hypermedia, application of ICT in teaching, distance learning, mixed teaching systems. Areas of application information technologies. 12. The concept of information system protection, the concept of information system security, reasons construction of the information system protection system, the concept of computer crime, sources and forms of threats to the information system, nature as a source of threat, man with attribution intentionality, man with the attribution of unintentionality, technical means as a source of threats. 13. Steps in building a business information system security system, policy definition information system security, selection of security system building strategies information system, selection of the bearer of responsibility for the construction of the security system, selection of approaches in the way of implementation of the security system. 14. Assessment of the importance of the data content of the business system, external factors of importance data content, internal factors of data content significance, assessment of form and intensity of threats to data content with regard to the estimated significance, risk assessment o individual content, quantitative assessment measures and qualitative assessment measures. Selection protection measure.

	15. Protection measures of information systems, material carrier as a protection measure, programmatic protection measures, protection at the level of the operating system, protection at the level of application software support, backup with change of material carrier as a protection measure, protection cryptographic protection measures, symmetric crypto systems, asymmetric encryption systems, function of a digital signature, ways to create a digital signature, virus protection, technical protection measures, physical protection measures, organizational protection measures, protection measures from the area rights. Verification of the validity of the protection measures taken.
Required literature (available in the library and/or via other media)	**Title**
	Vlatko Čerić … et al. Informacijska tehnologija u poslovanju.
	Dobrinić, D. et al. Izravni marketing. TIVA Tiskara, Varaždin, 2005.
	Stair, R.M.; Reynolds, G.W. Principles of Information Systems. 8th ed. Thomson, Boston, 2008.
	Rainer, R.K.Jr.; Turban, E.; Potter, R.E. Introduction to Information Systems: Supporting and Transforming Business. Wiley, Hoboken, 2006.

PRINTING FORMS 1			
Course teacher	Sanja Mahović Poljaček, Tomislav Cigula	Course code	19537
Name of the course	Printing forms 1	Semester (winter/summer)	winter
Teacher's contact email	sanja.mahovic.poljacek@grf.unizg.hr tomislav.cigula@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g., tutorial class, lectures, seminar)	tutorial class, laboratory
COURSE DESCRIPTION			
Course objectives	To become familiar with the types of printing plates used for different printing techniques. Define and distinguish the processing materials used for the production of different types of printing plates. Create images and transfer them on printing plates using analogue processes. Define and quantify the parameters of specific materials used to make printing plates, i.e., the requirements for creating images on the surface of printing plates.		
Learning outcomes	Students will have the knowledge and ability to identify the technological segments in graphic production, classify and explain the actions and processes within graphic prepress, and plan the sequence of process procedures in graphic technology. Upon completion of the course, students will be able to describe the printing plates workflow in the analogue process; identify and explain the functional properties of printing plates; enumerate and classify the materials used in production of printing plates; describe and evaluate the types of printing plates within a printing technology; analyse the functional properties of printing plates; explain and differentiate copying processes in production of printing plates; select materials and processes for making printing plates within a printing technology; enumerate and describe surface phenomena on printing plates. They will be able to research the literature on materials and printing plates in conventional workflow.		
Course content (syllabus)	1. Definition of printing plates and production workflow 2. Types of printing plates 3. Analogue processes, basic features of photosensitive layers and copying process 4. Digital processes, computer-controlled production of printing plates 5. Materials for production of printing plates, basic properties 6. Production of polymer printing plates 7. Production of printing plates for letterpress printing techniques 8. Production of printing plates for flexography printing 9. Production of printing plates for flexography printing 10. Production of printing plates for conventional offset printing 11. Production of printing plates for conventional intaglio printing 12. Production of printing plates for pad printing		

	13. Production of printing plates for screen printing 14. Surface phenomena on the printing plate surfaces 15. Surface phenomena on the printing plate surfaces, interaction with inks
Required literature (available in the library and/or via other media)	**Title**
	M. Gojo, S. Mahović Poljaček, Osnove tiskovnih formi, Sveučilište u Zagrebu Grafički fakultet, Zagreb, 2013.
	H. Kipphan, Handbook of Print Media, Springer Verlag Berlin Heidelberg New York, Heidelberg, 2001.
	K. Johansson, P. Lundberg, R. Ryberg, A Guide to Graphic Print Production, 3rd Edition, Wiley, New York, 2011.
	J. Deemer, Glossary of Graphic Communications, 4th edition, GATFPress, Pittsburg, 2008.

REPRODUCTION PHOTOGRAPHY 1			
Course teacher	Lidija Mandić	Course code	19549
Name of the course	Reproduction photography 1	Semester (winter/summer)	winter
Teacher's contact email	lidija.mandic@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	tutorial class, laboratory
COURSE DESCRIPTION			
Course objectives	Identifying and understanding the basic stages of the reproduction process with an emphasis on the preparation stage. Acquiring knowledge about input processes and the principle of operation of input devices. Acquiring knowledge about factors which affect the quality of reproduction (resolution, bit depth, tonal range, color space, format records ...). Differences in preparation depending on the purpose. Identifying and understanding screen systems, amplitude and frequency modulation, hybrid screen. Knowledge of objective measurements for control reproduction quality. Ability to recognize and correct errors that occurred in the preparatory work phase.		
Learning outcomes	Describe the basic stages of the reproduction process and explain the role of graphic prepress. List and describe factors affecting the quality of reproduction. Distinguish the basic types of screen systems. Use appropriate measuring devices to control the quality of reproduction. Identify and associate errors in reproduction with possible causes in graphic preparation.		
Course content (syllabus)	1. The role of preparation in the reproduction chain, Defining student obligations and scoring. Exercises: digital image processing: levels 2. Classification of image types and their characteristics. Exercises: Digital image processing: histogram 3. Recording of originals, light sources and their spectrophotometric curve. Exercises: Digital image processing: corrections using curves 4. Why screening is carried out and the role of the screen element, which makes up the screen system. Exercises: Digital image processing: image correction 5. Characteristics of different types of screening. Exercises: Digital image processing: image correction 6. Densitometric measurements and what is expressed through densitometric measurements Exercises: Digital image processing: image correction. 7. Tone reproduction curves and their correction. Exercises: Digital image processing: image correction 8. Steps covered by RIP (raster image processor). Exercises: Digital image processing: image correction 9. Analog to digital signal conversion. Exercises: Digital image processing: image correction 10. Digital image. Exercises: Digital image processing: image correction 11. Image compression. Exercises: Digital image processing: layers 12. Image record formats. Exercises: Digital image processing: actions 13. Methods for control of black separation. Exercises: Digital image processing: profiles 14. What must be included in the preparation and which parameters should be checked in the PDF. Exercises: Digital image processing: image correction		

	15. Getting to know the most common mistakes in preparation. Preliminary exam.
Required literature (available in the library and/or via other media)	**Title**
	teaching material on MERLIN
	H. Kipphan et al., Handbook of Print Media, Springer, Berlin, 2001.
	R. S. Berns, Billmeyer and Saltzman's Principles of Color Technology - 3rd ed. John Wiley & Sons, New York, 2000.;
	R. C. Gonzalez & R. E. Woods, Digital Image Processing - 3rd ed., Upper Saddle River, NJ, USA: Prentice Hall, 2007

MULTIMEDIA COMMUNICATIONS 1			
Course teacher	Tajana Koren Ivančević	Course code	19543
Name of the course	Multimedia communications 1	Semester (winter/summer)	winter
Teacher's contact email	tajana.koren.ivancevic@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	tutorial class, laboratory
COURSE DESCRIPTION			
Course objectives	Students will learn the basics of HTML and CSS. They will be able to distinguish individual HTML elements and attributes. Students will learn how to implement multimedia content on a website through HTML and CSS and how to be position elements in precisely defined positions. They will learn transformations, transitions and animations on to the web.		
Learning outcomes	The student will be able to distinguish and compare HTML elements. By applying styles, the student will be able to define appearance and positioning of elements. The student will be able to classify multimedia content on the web. The student will be able to use multimedia content when creating a website. The student will be able to connect multiple web hubs and create basic navigation. The student will be able to manipulate HTML elements in terms of transitions, transformations and animation. The student will be able to adjust the web content pages to all the most popular browsers and devices.		
Course content (syllabus)	1. Getting to know the basic HTML elements related to text and tabular display. Use of basic HTML elements and checking the appearance of the HTML document in the browser. 2. Introduction of forms, surveys, interactivity, links. Possibility of comparison and selection form for the desired survey. Setting up navigation and determining where the content will appear. 3. Getting to know CSS. Ability to influence the appearance of the website by changing styles. 4. Selectors and grouping of elements through CSS. Understanding the benefits of grouping elements through styles 5. Introducing multimedia elements. Introducing an image into an HTML document. Image processing and preparation for posting on a website. Exercises - Colloquium 6. Image mapping. Determining the coordinates of a part of the image as a link to another element. 7. Introduction of audio and video material into HTML. 8. Nesting of external multimedia elements in the page. Distinguishing individual audio and video format. Differentiation of HTML elements for the introduction of multimedia content on the web. 9. Absolute positioning of elements. Understanding the coordinate system. The possibility of stacking elements to precisely defined positions. 10. Absolute and relative positioning of elements. Differences, advantages and disadvantages. Exercises - Colloquium (0.9 ECTS) 11. Adapting content to different screen sizes and devices. 12. Manipulation with HTML elements by mouse movement. The possibility of changing the appearance of elements by mouse-over. 13. Transitions. The concept of time. Transition from one state to another in a period of time.		

	14. 2D and 3D transformation of HTML elements. Manipulating HTML elements through 2D and 3D transformations. Differentiation of 2D and 3D space. 15. Animation of HTML elements. Animating various HTML elements. Flow programming animations. Animation management. Exercises - Colloquium
Required literature (available in the library and/or via other media)	**Title**
	http://www.w3schools.com; http://www.w3.org

PRINTING FORMS 2			
Course teacher	Sanja Mahović Poljaček, Tamara Tomašegović	Course code	19558
Name of the course	Printing forms 2	Semester (winter/summer)	summer
Teacher's contact email	sanja.mahovic.poljacek@grf.unizg.hr tamara.tomasegovic@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	tutorial class, laboratory
COURSE DESCRIPTION			
Course objectives	Become familiar with the digital workflow of printing plates and forms. Define and compare different CtP systems for the production of printing plates according to printing techniques, technical solutions of printing units and construction of imaging devices. Ability to plan the stages of the reproduction process in the context of graphic prepress. Definition of various production methods depending on the type and material of CtP printing plates and related calculated process conditions. Calculation of process parameters in the production of printing plates for various graphic products.		
Learning outcomes	Students will have the knowledge and be able to identify the technological phases in graphic arts prepress; be able to classify and explain the operations and processes in digital prepress; be able to plan the sequence of process operations in digital (CtP) plate making processes. After completing the course, students will be able to define the CtP system for imaging plates for different printing technologies, classify and compare units for image setting on the printing plates, compare and analyse different CtP plate types within a printing technology, apply different tools to optimise processes in plate making, calculate and select the printing plate type considering the process parameters, analyse and evaluate the development of CtP technologies. Students will be able to work in a team, apply their knowledge in literature research.		
Course content (syllabus)	1. Digital workflow - the position of printing plates/forms in the reproduction process 2. Computer to… technologies 3. Digital prepress 4. Digital (CtP) processes for production of printing plates 5. Types of CtP printing plates 6. Formation of the digital image on printing plate 7. Computer processing of information and procedures for imaging of printing plates 8. CtP processes for production of flexographic printing plates 9. CtP process for production of flexographic printing plates 10. CtP process for production of printing plates for offset printing 11. CtP process for production of printing plates for intaglio printing 12. CtP process for production of printing plates for screen printing 13. CtP process for production of printing plates for pad printing		

	14. Measuring the quality level of printing plates 15. Instrumental and visual methods of monitoring the quality level of printing plates
Required literature (available in the library and/or via other media)	**Title**
	S. Mahović Poljaček, CtP tehnologije, Sveučilište u Zagrebu Grafički fakultet, Zagreb, 2021.
	H. Kipphan, Handbook of Print Media, Springer Verlag Berlin Heidelberg New York, Heidelberg, 2001.
	K. Johansson, P. Lundberg, R. Ryberg, A Guide to Graphic Print Production, 3rd Edition, Wiley, New York, 2011.
	R. M. Adams, , F. J. Romano, Computer to Plate: Automating the Printing Industry, GATFPress, Pittsburg, 1999.
	J. T. Lind, G. M. Radencic, GATF Computer-To-Plate Performance Study,Vol. 31, Gatf Research & Technology Reports, Printing Industries Press, 2002.
	J. Deemer, Glossary of Graphic Communications, 4th edition, GATFPress, Pittsburg, 2008.

DESIGN OF GRAPHIC MEDIA 1			
Course teacher	Jesenka Pibernik	Course code	19528
Name of the course	Design of graphic media 1	Semester (winter/summer)	summer
Teacher's contact email	jesenka.pibernik@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	
COURSE DESCRIPTION			
Course objectives	The objectives of the course are to train students in creating and shaping visual messages across various media using basic principles of graphic design, to understand fundamental concepts of image and text design, and to acquire skills in using graphic design software in the design process.		
Learning outcomes	• Plan visual communication design according to the audience's needs and the context for which visual communication is intended. • Create a visual message using principles of visual organization/composition, information hierarchy, symbolic representation, typographic forms, virtual texture, layout, etc. • Advanced skills in using Adobe graphic programs. • Classify analog and digital technologies as means of creating visual form, interaction, and the context in which communication takes place. • Evaluate the design of visual forms that address a given communication problem—devise methods and steps in the design process as a system for solving systemic problems.		
Course content (syllabus)	1. Introductory Lecture (definition of students' rights and duties, seminar definition, literature definition). Introductory Seminar (presentation of student works from previous years, definition of necessary equipment) 2. Positive and negative space. Form/Gestalt. Creating a company/product name, Designing a logo for a product and/or company. Defining general stylistic guidelines. 3. Relationship between image and text: font as an image 4. Text design in layout. Determining a typographic form that functions with the sign. Determining a typographic form that functions within relevant visual compositions. 5. Establishing hierarchy on the page 6. Design tools. Creating textures and patterns using abstract construction elements related to developed identity. 7. Photo manipulations: photomontage and collage. Transparency and layering - creating illustrations and photomontages according to previously defined visual guidelines. 8. Universal design principles 9. Composition with color. Creating infographics, illustrations, or icon systems consistent with previously established visual guidelines. 10. Graphic design of brochures/magazines. 11. Construction and deconstruction: network system.		

	12. Construction and deconstruction: tearing the net. Designing innovative and interactive elements of the brochure and planning their implementation. 13. Interaction design 14. Design of aesthetic experience. Specification and preparation of photographic material and brochure content, brochure format, and network construction. 15. Final presentation/guest designer. Brochure layout design
Required literature (available in the library and/or via other media)	**Title**
	White J. V. : Editing by design, Allworth Press, 2011.
	Martin, B., Universal methods of design : 100 ways to research complex problems, develop innovative ideas, and design effective solutions, Beverly, MA : Rockport Publishers, 2012.
	Cabarga, L., Logo, font & lettering bible, HOW Design Books, F+W Publications, 2004.
	Holtzschue, L., Understanding color : an introduction for designers,3rd ed., Hoboken : Wiley, 2006.

INDUSTRY AND ENVIRONMENT			
Course teacher	Ivana Bolanča Mirković	Course code	98042
Name of the course	Industry and environment	Semester (winter/summer)	winter
Teacher's contact email	ivana.bolanca.mirkovic@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Tutorial class, laboratory
COURSE DESCRIPTION			
Course objectives	The aim of the course is to familiarize students with the impact of graphic technology processes on the environment, and to transfer theoretical knowledge in the field of environmental engineering and its practical application. The further goal of the course is to introduce students to the ecological aspect of cellulose and paper production, paper recycling in relation to other methods of disposal of used graphic products. Students are trained to understand and make sound conclusions in the field of the ecological aspect of conventional printing techniques (offset printing, flexo printing, gravure printing, and screen printing) as well as digital printing techniques (electrophotography and inkjet printing). Students are introduced to the best available techniques in the field of graphic reproduction, as well as the development of printing substrates and inks, including nanotechnology and nanomaterials. The aim is to acquire theoretical knowledge that can be improved through practical work in the laboratory. In the laboratory, units originally related to environmental issues are processed. The goal is for students to achieve information recognition and understanding, as well as to develop generic skills, presentation skills, and teamwork.		
Learning outcomes	Students will be able to analyze the ecological aspect of energy sources and assess the environmental suitability of renewable energy sources. Students will be able to describe and evaluate the ecological aspect of cellulose, paper, recycled paper, and printing inks production. Students will be able to evaluate the environmental impact and health risks of conventional and digital printing techniques. Students will be able to describe the best available techniques in the field of printing substrates, inks, and printing.		
Course content (syllabus)	1. Lectures: Major causes of environmental devastation. Principles of environmental protection. Legal regulations in the field of environmental protection. Exercises: Introduction. Laboratory work rules. 2. Lecture: Composition and properties of the atmosphere. Air pollution. Exercises: Carbon footprint. 3. Lecture: Impact of meteorological factors on air pollution. Cycle of discharge of pollutants from the atmosphere. Exercises: Air quality in the graphic industry. 4. Lecture: Ecological aspect of conventional printing techniques (offset printing, gravure printing, flexo printing, and screen printing) impact on the environment, health, and safety risks. Exercises: Chemical deinking flotation, principles, and influencing factors. 5. Lecture: Ecological aspect of digital printing techniques, impact on the environment, health risks. Exercises: Disposal of composite materials: composite recycling process. 6. Lecture: Ecological aspect of the production and application of printing inks. Biodegradability of inks. exercises: Recycling of prints using ultrasound. 7. Lecture: Knowledge check through a colloquium. Exercises: Durability of inks in defined environmental conditions.		

	8. Lecture: Production of pulp and paper and its impact on air quality. Methods for air purification. Exercises: Durability of printing substrates in defined environmental conditions. 9. Lecture: Process and wastewater. Physical, chemical, and biological indicators of water pollution. Exercises: Determination of effective concentration of residual ink on laboratory sheets and application of other spectrophotometric methods of analysis. 10. Lecture: Wastewater from conventional printing techniques. Ecological aspect of CTP technology. Exercises: Principle of the method and application of image analysis. 11. Lecture: Wastewater from the production of pulp, paper, and recycled paper. Exercises: Determination of organic matter in process waters. 12. Lecture: Wastewater from the production of pulp, paper, and recycled paper. Exercises: Determination of organic matter in process waters. 13. Lecture: Major determinants of environmental management in printing houses. Exercises: Principle and application of membrane filtration method. 14. Lecture: Characteristics of waste from the graphic and related industries. Methods of disposal - landfilling, incineration, recycling. Exercises: Composting of prints. 15. Knowledge check through a colloquium. Final colloquium on laboratory
Required literature (available in the library and/or via other media)	**Title**
	M. London, Environment, Health and Sustainable Development, Open University Press, Berksire, 2011
	F. Shapiro, Environmental Regulation for Printers, Jelmar Pablishing Co., New York, 2003.
	M. K. Hill, Understanding Environmental Pollution, 2nd Ed. Cambridge University Press, Camridge, 2004.

GRAPHIC PROGRAMMING LANGUAGES			
Course teacher	Klaudio Pap, Maja Rudolf	Course code	19559
Name of the course	Graphic programming languages	Semester (winter/summer)	winter
Teacher's contact email	klaudio.pap@grf.unizg.hr maja.rudolf@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Tutorial class, laboratory
COURSE DESCRIPTION			
Course objectives	Training for performing programming tasks using graphical programming languages in graphic engineering. Graphical coordinate space, output coordinate space, and programming of the coordinate grid. Rules for writing commands and parameters in stack-oriented graphical language. Concept of graphic pages and corresponding measuring units. Absolute and relative programming of lines and paths, closing paths and filling them. Creating graphic shapes in multiple layers. Control of line endings, line joining, and line discontinuity. Programming circular and tangential shapes and circular arcs. Bezier curve and its mathematical definition. Types of Bezier curve joining. Joining Bezier curve with tangent curve. Saving and restoring graphic state. Rotations, translations, horizontal and vertical transformations of the coordinate system. Control of object fill and "holes" by programming the orientation of the path clockwise and counterclockwise. Multiple transparencies of objects by even-odd rule of origin ray crossings. Stack memory management. Arithmetic and logical operators in PostScript language (representative of PDL languages). Programming loops in graphical programming languages. Repetition and transformation of graphic shapes. Programming tonal transitions in RGB, CMYK, and HSB color spaces. Grouping graphic shapes. Individual programming manipulation of a letter and converting an envelope to a vector path. Functions of textual strings and data arrays. Program control of font and text in PostScript language. Optimization of memory usage by program stack control.		
Learning outcomes	Evaluation of features of prepress, printing, finishing, and multimedia devices. Defining the type and purpose of a message based on the user, form, and type of graphic media. Applying high-level structured programming languages Using tools and knowledge of technological processes and materials in the design, reproduction, and distribution of visual messages Applying techniques for processing and designing different media (images, sound, video, photography, animation) Differentiating coordinate system transformations from graphic shape deformations. Constructing programs for lines, curves, arcs, and other types of vector paths. Using programming branching, loops, arrays, and functions in a graphic programming Language. Designing programmable graphic elements in different color systems and graphic states. Creating user procedures for later independent use. Applying optimization of memory usage through programmatic control of stack memory in printing devices. Applying programmatic manipulation of individual characters. Applying programmatic control of fonts and text Expanding the capabilities of standard market programs with custom programs for specific purposes.		
Course content (syllabus)	1. Lecture: Graphic coordinate space, print coordinate space, and programming coordinate grid; Exercises: Programmatic positioning in graphic coordinate space and defining straight paths in it.		

	2. Lecture: Rules for writing commands and parameters in stack-oriented graphic language, concept of graphic page and associated measurement units; Exercises: Programming control of projected measures and multiple variations of stack writing of graphic command parameters. 3. Lecture: Absolute and relative programming of lines and paths, closing paths and filling them; Exercises: Absolute and relative programming of lines and paths, creating polygons and filling them. 4. Lecture: Control of the final shape of lines, joining lines, and line breaks; Exercises: Programming the final shape of lines, joining lines, and line breaks. 5. Lecture: Programming circular and tangent shapes and circular segments; Exercise: Programmatic implementation of given circular and tangent shapes and circular segments. 6. Lecture: Programming Bezier curves in vector paths; Exercise: Programmatic implementation of a given path using Bezier curves. 7. Lecture: Rotations, translations, horizontal and vertical transformations of the coordinate system; Exercise: Programmatic implementation of object rotation, translation, and reflection, midterm. 8. Lecture: Control of object fill and "holes" with programming of path orientation and control of multiple object transparencies; Exercise: Programmatic implementation of objects with "holes" in multiple possible ways. 9. Lecture: Stack memory management, arithmetic and logical operators in stack-oriented language; Exercise: Use of arithmetic and logical operators with current output of stack memory state. 10. Lecture: Loops in graphic programming languages, repetition and transformation of graphic shapes; Exercise: Repetition, cloning, and transformation of graphic objects. 11. Lecture: Programming tonal transitions in RGB, CMYK, and HSB color spaces;Exercise: Programming color in various color systems and their use on graphic entities. 12. Lecture: Grouping graphic shapes; Exercise: Defining program procedures for groups of graphic shapes and basic manipulations with them. 13. Lecture: Individual program manipulation of a letter character and converting envelope into a vector path; Exercise: Program manipulation of a letter character and converting the envelope into a vector path. 14. Lecture: Functions of text strings and data arrays; Exercise: Programming with a basic set of commands for text strings 15. Lecture: Programmatic control of fonts and text; Exercise: Programmatic control of fonts and text, final exam.
Required literature (available in the library and/or via other media)	**Title**
	Žiljak, K. Pap, POSTSCRIPT PROGRAMIRANJE GRAFIKE, FS, Zagreb, 1998. /2004. Tiskovno izdanje: ISBN: 953 - 199 – 000, Elektr. izdanje: http://free-zg.htnet.hr/kpap/
	I. Adobe Systems: „PostScript Language Reference Manual”, Addison-Wesley, 1985 -
	I. Adobe Systems: „PostScript Language Tutorial and Cookbook”, Addison-Wesley, 1985
	H. McGilton, M. Campione: „PostScript by Example”, Addison-Wesley, 1992

SCIENCE OF ENVIRONMENT AND DESIGN			
Course teacher	Ivana Bolanča Mirković	Course code	38011
Name of the course	Science of environment and design	Semester (winter/summer)	winter
Teacher's contact email	ivana.bolanca.mirkovic@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Tutorial class, seminar
COURSE DESCRIPTION			
Course objectives	The students are introduced to the global environmental issues, such as air pollution, greenhouse effect, stratospheric ozone depletion, winter and summer smog, water pollution, soil pollution, solid waste, hazardous waste, emission sources, direct and indirect causes of emissions, and design approach in product creation context with the aim of reducing anthropogenic impact on environmental quality. The course content covers the specificities of emissions from the production processes of graphic and related industries, working and user activities with the goal of implementing measures through product design towards the preservation or improvement of environmental quality.		
Learning outcomes	Students will be able to recognize and describe global environmental issues and explain the principles of graphic design in the context of creating products with a lower environmental impact. They will be able to explain the impact of solid waste on the environment and the principles of design in the context of waste reduction. They will be able to explain the principles of design for preventing pollutant emissions. They will be able to list and explain the ecological principles of graphic product design. They will be able to apply design tools in the context of ecological efficiency and differentiate their limitations.		
Course content (syllabus)	1.Lecture: Introduction, importance of environmental science, general concepts of environmental protection related to design. Seminar: Introduction, individual assignments. 2. Lecture: Design and global environmental issues. Air pollution. Greenhouse effect: emission sources, mechanism of formation, impact on the environment. Seminar: Alternative product design using global warming indicators. 3. Lecture: Design and global environmental issues II. Winter smog: emission sources, mechanism of formation, impact on the environment, prevention measures. Seminar: Product design and prevention of pollutant emissions causing winter smog. 4. Lecture: Design and global environmental issues III. Summer smog: emission sources, mechanism of formation, impact on the environment, prevention measures. Seminar: Design and prevention of primary pollutant emissions causing summer smog. 5. Lecture: Design and global environmental issues IV. Destruction of the ozone layer in the stratosphere: mechanism of the destruction process, impact on the environment. Seminar: Design and measures for protecting graphic products from global radiation. 6. Lecture: Design and global environmental issues V. Pollutants in water: sources of pollution primarily in the domain of graphic materials, impact on the environment. Seminar: Design of graphic products and prevention of water pollution. 7. Lecture: Design and Global Environmental Issues VI: Solid Waste. Hierarchy of Waste Disposal Methods. Seminar: Graphic Product Design Settings in the Context of Waste Reduction.		

	8. Knowledge Assessment through a Colloquium. Seminar: Designer's Impact on Reducing Pollutants during Production and Use of Products. 9. Lecture: Toxic Substances in Air and Water, Environmental Impact. Seminar: Design and Prevention of Emission of Toxic Substances. 10. Lectures: Ecological Aspects of Non-Renewable Energy Sources. Seminar: Product Design with Low Energy consumption through Production and Consumption. 11. Lectures: Ecological Aspects of Renewable Energy Sources. Seminar: Energy Efficiency in the Workplace - Ecological Aspect. 12. Lecture: Ecological Aspect of Transportation. (ECTS 0.21) Seminar: Product Design in the Context of Pollution Reduction during Transportation. 13. Lecture: Design Support Tools that Increase Environmental Impact Reduction Efficiency. Seminar: Solving Examples in the Domain of Graphic Product Design. 14. Lecture: Design Tools in the Context of Ecological Efficiency. Seminar: Solving Examples in the Domain of Graphic Product Design. 15. Knowledge Assessment through a Colloquium. Compensation for Justifiably Unheld Student Presentations of Seminar Papers
Required literature (available in the library and/or via other media)	**Title**
	L. Pepper, C.P. Gerba, M.L. Brusseau, Environmental and Pollution Science, Springer Verlag, London, 2008.
	G.T. Miller, S. E. Spoolman, Environmental Science, Brooks/Cole, Canada 2013.
	A.Chick, P. Micklethwaite, Design for Sustainability Change, AVA Publishing S, 2011
	C. Vezzoli, E.Manzini, Design for Environmental Sustainabilility, Springer Verlag,London, 2008

PRINTING INKS			
Course teacher	Sonja Jamnicki Hanzer	Course code	19539
Name of the course	Printing Inks	Semester (winter/summer)	Winter
Teacher's contact email	sonja.jamnicki.hanzer@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	Undergraduate BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Tutorial class
COURSE DESCRIPTION			
Course objectives	The goal of the course is to acquaint students with the production, composition, and basic properties of printing inks as well as their proper application in graphic technology. Within the course, students acquire knowledge of the properties and special features of printing inks for various printing techniques. Students will acquire basic and practical skills necessary for the selection of printing inks for printing on various substrates to achieve the desired printing quality. Students will also acquire competencies for conducting specific laboratory testing of printing inks.		
Learning outcomes	• Explain the chemical and physical properties and the role of each component of printing inks. • Explain the rheological properties of printing inks and how they affect print quality. • Classify and explain different drying mechanisms of printing inks. • Relate the influence of the properties of the substrate, the chemical composition of the printing ink, its viscosity, layer thickness, printing speed and other parameters on the quality of the final print. • Determine the optimal combination of ink and printing substrate to avoid printing problems. • Explain the properties and composition of inks for various printing techniques. • Identify potential printing problems caused by inadequate ink properties. • Identify the possible problems that can occur when printing on food packaging.		
Course content (syllabus)	TEACHING UNITS (topics covered): 1. Components of printing inks • Use of pigments and dyes • Ink Vehicles (oils, resins, solvents) • Additives and their types, uses and properties 2. Drying mechanisms and ink formulations • Absorption drying • Oxidation-polymerisation drying • Evaporation drying • Quickset drying • Coldset drying • Heatset drying • Ultraviolet curing, EB curing		

	• Other methods of ink drying and specialty inks 3. Rheology of printing inks (ink tack, ink flow, viscosity, thixotropy) 4. Letterpress inks 5. Lithographic inks 6. Flexographic Inks 7. Gravure Inks 8. Screen Inks 9. Ultraviolet and Electron Beam Curing Systems 10. Ink jet inks 11. Manufacture of printing inks 12. The use of printing inks for food packaging
Required literature (available in the library and/or via other media)	**Title**
	The Printing Ink Manual, Fifth Edition, R. H. Leach, R. J. Pierce (Eds.), Springer, Dordrecht, 2008.
	C. H. Williams, The Printer's Ink Handbook, Mclean Hunter Ltd, Hertfordshire, 1992.
	N. R. Eldred and T. Scarlett, What the Printer Should Know about Ink, GATF, Pittsburgh, 1990.
	Ronald E Todd, Printing inks: Formulation principles, manufacture and quality control testing procedures, Pira International, 1994
	Teaching materials prepared by the teacher.

GRAPHIC DESIGN 1			
Course teacher	Maja Brozović	Course code	32785
Name of the course	Graphic design 1	Semester (winter/summer)	Winter
Teacher's contact email	maja.brozovic@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
COURSE DESCRIPTION			
Course objectives	To obtain the knowledge and acquire the skillset needed in visual design mindful of the user, form and graphic media type. The course is based on the study of the basic elements of the visual structure and their organization into functional optical systems. The analysis of graphic structure comprises of identifying the elementary meanings and data organisation models which follow from the appearance of the text and the readability of the message in accordance to the choice of the shape and size of letterforms as abstract forms and the choice of content and position of pictorial elements as figurative forms. By way of systematic analysis of graphic structure, students will become capable of organizing information in accordance to the type and intent of the message. Structural analysis is considered and conducted on the basis of every graphic media's twofold functionality: operative and persuasive communication. The message can be interpreted according to the goal and users by choosing the appropriate types of sign.		
Learning outcomes	- interpretation and reinterpretation of visual systems - adjusting readability of graphic composition - analysing visual message with regard to objectivity level - apply an appropriate visual structure considering the purpose of the visual message - show the principles of composing elements of visual form - sketch the redesigned unit structure of the graphic media - solve the optically harmonising newspaper page layout		
Course content (syllabus)	1. Visual structure analysis. Sketch and analyse a newspaper article from the point of view of visual structure 2. Visual structure analysis. Reinterpret a newspaper article based on the obtained data about its structure 3. Increasing the readability of the visual message Increase the readability of a newspaper article by intervention in typography 4. Increasing the readability of the visual message. Increase the readability of a newspaper article by emphasizing the hierarchy of data 5. Informational values of the message. Emphasize informative parts of the message compared to redundant ones 6. Informational values of the message Define the styles of titles, sub-titles, super-titles, text by applying letter scales and selecting illustrative systems 7. Measuring the meaning of the message in levels of objectivity. Present the article in operative and persuasive communication		

	8. Order and disorder system Present the topic of the article from another aspect in relation to the target group 9. Animation of a visual message. Animate the obtained content of the article using image information 10. Stylization of the visual message. Stylize the content of the article using rational, conventional signs 11. Principles of composing. Show the static composition of the article in the dynamic relationship of elements 12. Color system. Stratify the hierarchy of information using pairs of contrasting colors 13. Message redesign. Redesigning a newspaper article 14. Optical balance of the graphic media page. On the newspaper page, achieve an optical balance from the obtained number of articles 15. Optical balance of the graphic media page. On the newspaper page, achieve an optical balance from the obtained number of article
Required literature (available in the library and/or via other media)	**Title**
	Arnheim, R.: Art and Visual Perception - A Psychology of the Creative Eye, University of California Press, 2004.
	Ware, C.: Information Visualization, Third Edition: Perception for Design (Interactive Technologies), Elsevier Inc, 2013.
	Bringhurst, R.: The Elements of Typographic Design: Form and Communication, John Wiley and Sons Inc., New Jersey, 2007.
	Mesaroš, F.: Tipografsko oblikovanje, Viša grafička škola u Zagrebu, Zagreb, 1981.
	Malamed, C.: Visual Language for Designers: Principles for Creating Graphics That People Understand, Rockport Publishers, 2009
	Pettersson, R.: It Depends - Principles and Guidelines, International Institute for Information Design, Tullinge, 2012

ORGANIZATION OF GRAPHIC PRODUCTS			
Course teacher	Diana Bratić	Course code	19548
Name of the course	Organization of graphic products	Semester (winter/summer)	winter
Teacher's contact email	diana.bratic@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Lectures + seminars
COURSE DESCRIPTION			
Course objectives	The main objective of the course is to familiarize students with the fundamentals of organizational theory and the factors that influence the organization, design, planning and management of graphic production to enable them to acquire skills for successful management of production, logistics and warehousing.		
Learning outcomes	1. Identify, analyse, and evaluate the key elements that influence the planning process and the preparation of a business plan. 2. Apply mathematical procedures in the preparation of a unified aggregate and operational production plan. 3. Propose an organizational chart of work units and a productive workplace. 4. Plan capacities. 5. Prepare a cost estimate for a graphic product. 6. Make technological preparations for production. 7. Evaluate, select, and apply database management techniques and tools. 8. Create a project plan.		
Course content (syllabus)	Course content (Syllabus) on a weekly basis: 1. Organization 2. Planning 3. Production 4. Capacity planning 5. Calculation 6. Preparation and monitoring of work documentation 7. Technological preparation of work 8. Technological preparation of production 9. Production monitoring 10. Production management software 11. Logistics and internal transport management 12. Inventory management 13. Database management 14. Planning, implementation and control of projects 15. Business plan		
Required literature (available in the library	**Title**		
	1. Kiran, D. R. (2019), Production Planning and Control: A Comprehensive Approach		

and/or via other media)	2. Rushton, A., Croucher, P., Baker, P. (2004), The Handbook of Logistic&Distribution Management
	3. Lectures from the course

GRAPHIC DESIGN 2			
Course teacher	Maja Brozović, Dorotea Kovačević, Josip Bota	Course code	32786
Name of the course	Graphic design 2	Semester (winter/summer)	Summer
Teacher's contact email	maja.brozovic@grf.unizg.hr dorotea.kovacevic@grf.unizg.hr Josip.bota@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
COURSE DESCRIPTION			
Course objectives	To obtain the knowledge and acquire the know-how in designing a visual message with respect to specific features of particular graphic media and the corresponding graphic-editorial practice. In the framework of the course students will learn how to organize visual forms into functional visual systems of particular graphic media. Students will analyse specific features of each graphic media in regard to the type and intent of the message, its character/nature and form, as well as technical and technological limitations of each media type in presenting messages. Students are requested to offer the best solutions for presenting this information through various types of graphic media based on the given input. Through active participation in the course lectures and practical application of the presented principles students will get acquainted with characteristics of newspapers and magazines as key representatives of periodical graphic media, picture books as specific educational and entertainment type of media whose visual structure is adjusted to a particular age group, and posters as a representative of outdoor advertisement media.		
Learning outcomes	- create a conceptual sketch of the hierarchy of optical values of the relationship between the structural elements of the newspaper page - organise visual hierarchy of information on predefined newspaper format - planning a coherent system of magazine layout design - organising grid systems for various magazine content - suggesting design solutions for effective advertisement communication - ability of combining aesthetic and technological factors in presenting visual messages by means of outdoor advertisement media - illustrating and designing picture-book as an educational graphic media form		
Course content (syllabus)	1. Organization of the visual structure of the newspaper page. Sketching the visual structure of the newspaper page with regard to the defined number of articles - raster page 2. Organization of the visual hierarchy of information of the newspaper page. Design a visual hierarchy of articles on a newspaper page based on a sketched raster 3. Designing another newspaper page while maintaining defined parameters (margins, number of columns, text styles, etc.)		

	Design the left/right newspaper pages that will form a single entity with the page from the previous exercise 4. Monochrome newspaper printing: possibilities and limitations in creating information hierarchies Design a monochrome newspaper page in relation to the obtained number and importance of articles using the defined parameters from the previous exercise 5. Newspaper cover page - persuasive communication. Design the cover page of the newspaper from the obtained number of information with a focus on persuasive communication 6. Magazine as a graphic media: definition, types of magazines, design specifics. Present the visual structure of one thematic unit of the magazine through a certain number of pages 7. Types and application of grid system in thematic unit design of magazines Sketch grid system for the journal according to different thematic units. 8. Consistency of the visual hierarchy of individual thematic units with a grid system Design two pages of different thematic units and apply different grids while maintaining the visual recognition of the magazine 9. Introductory pages of the magazine, specifics in the design and presentation of information. Design the introductory pages of a certain thematic unit of the magazine 10. Magazine cover page - design aimed at the target group. Design a magazine cover page in relation to a defined target group 11. Advertising messages in magazines. Illustrate the solution of an advertisement in a magazine on a given topic and target group 12. Outdoor advertising media - lapidary solutions. Illustrate a lapidary poster solution on a given topic and target group 13. Outdoor advertising media - temporal solutions. Illustrate the temporal solution of the poster on the given topic and target group 14. Picture book - specifics, suitability for the child's age. Sketch the main characters of a picture book for a certain age of the child 15. Aesthetic, pedagogical, technological parameters of the picture book. Design and present an art-graphic solution for the cover and two inside pages of the picture book using sketches of the main characters throughout the story
Required literature (available in the library and/or via other media)	**Title**
	R.D. Zakia: Perception and Imaging, Focal Press, New York, 2001.
	G. Ambrose, P. Harns: The Fundamental of Graphic Design, Ava Publishin, Lausanne, Switzerland, 2009.
	A. Twelow: What is Graphic Design for?, RotoVision SA, Mies, Switzerland, 2006.

COMPOSITION			
Course teacher	Tajana Koren Ivančević	Course code	128242
Name of the course	Composition	Semester (winter/summer)	Summer
Teacher's contact email	tajana.koren.ivančević @grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
COURSE DESCRIPTION			
Course objectives	Students will learn to program text display for print and digital media. Text programming for printed media is performed through PostScript. Character envelope programming. Programming repeating text with the introduction of variables that change their values through a loop. Text programming by given path. Changes on each letter character. Positioning and alignment of text. Filling letters with other elements. Text programming for the web. Introduction of individualized fonts on web pages. Text styling, alignment and positioning. Animation text through HTML and CSS. Character display programming through ActionScript. Possibility of manipulation of the appearance of letters by introducing random numbers. Text input in SVG. Text animation in SVG technology. The possibility of choosing a medium for displaying typography.		
Learning outcomes	The student will be able to distinguish the media in which typography appears. The student will be able to program the way the typography will be displayed in the print medium. The student will be able to program a way to which typography will be displayed on the web. The student will be able to distinguish and define individual webs technologies for displaying typography. The student will be able to implement typography in animation.		
Course content (syllabus)	1. Programming text appearance for print media through PostScript. Checking the programmed text through the GS View browser 2. Programming text repetition using loops. Introduction of variables. 3. Filling the letter characters with other elements. Filling the letter path with other elements 4. Programming the path along which the text is displayed. Manipulation of each character separately. 5. Text manipulation through random numbers. Exercises - colloquium 6. Programming text for display on the web using HTML and CSS 7. Text styling through CSS. 8. Transforming text on the web. 9. Animating text on the web using HTML and CSS 10. Animating text through ActionScript. Exercises - colloquium 11. Text manipulation through ActionScript and random numbers. 12. Displaying text on the web through SVG. 13. Text animation through SVG. 14. Interactivity in SVG by mouse over and click 15. Programming text in SVG using gradients and filters. Exercises - colloquium		
Required literature	**Title**		

(available in the library and/or via other media)	Pap, Klaudio; Žiljak, Vilko. Digitalni udžbenik PostScript grafike . Zagreb : FS, 2002. (priručnik).
	Žiljak, Vilko; Pap, Klaudio. Postscript programiranje. Zagreb : FS d.o.o., 1999. (priručnik).
	http://www.w3schools.com/ http://www.w3.org

QUALITATIVE RESEARCH METHODS OF COLOUR REPRODUCTION			
Course teacher	Rahela Kulčar	Course code	19561
Name of the course	Qualitative research methods of colour reproduction	Semester (winter/summer)	Summer
Teacher's contact email	rahela.kulcar@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Tutorial class, lectures
COURSE DESCRIPTION			
Course objectives	This course aims to provide students with theoretical and practical knowledge of colour, enabling them to develop independent ideas and solutions related to the assessment of colour reproduction quality. Students will gain a fundamental understanding of the science of colour and its perception. Throughout the course, students will learn to communicate through colour and become acquainted with some intuitive colour systems. They will also become familiar with the characteristics of light sources, their impacts on observed colours and substrates, and how to leverage their advantages and disadvantages. Emphasis will be placed on independently determining colour characteristics based on instrumental measurements. With the knowledge acquired, students will be able to choose colour systems, and measurement techniques, and interpret results effectively.		
Learning outcomes	1. The student will be able to connect fundamental knowledge in the field of colour with its multidisciplinary aspects in the field of colorimetry. 2. Categorize colour measurement devices, propose the most suitable measurement method based on the substrate type, justify the choice of the device, and critically assess differences in reproduced colours compared to standards.		
Course content (syllabus)	1. Fundamentals of the Science of Color and its Perception 2. Characteristics of Light Sources 3. Characteristics of the Sample Under Examination 4. Colour Perception (Psychophysical Experience of the Observer) 5. Theories of Color Vision 6. Simultaneous Contrast, Color Vision Deficiency 7. Psychophysical Aspects of Color 8. Determination of Tristimulus (X, Y, Z) Values 9. CIE Chromaticity Diagram 10. Limitations of the CIE Chromaticity Diagram 11. CIELAB Color Representation System 12. Determining Total Color Difference 13. Colour Measurement Standards (Ostwald System, Munsell System, NCS System) 14. Metamerism 15. Standard Measurement Geometries, Color Measurement Devices, Device Selection for Color Measurement		

	Title
Required literature (available in the library and/or via other media)	R.S. Berns; Principles of Color Technology. John Wiley and Sons, Fourth Edition,2019
	R.W.G. Hunt; The Reproduction of Colour, John Wiley and Sons, Chichester, England,2004.
	M. Langford; Advanced Photography, Focal Press, Oxford, 1999;
	N. Ohta, A.R.Robertson; Colorimetry.Fundamentals and Applications, John Wiley and Sons, England, 2005.

APPLICATION AND INVESTIGATION OF PRINTED MATERIALS			
Course teacher	Maja Strižić Jakovljević, Branka Lozo	Course code	19563
Name of the course	Application and investigation of printed materials	Semester (winter/summer)	summer
Teacher's contact email	maja.strizic.jakovljevic@grf.unizg.hr branka.lozo@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	lectures, seminar, laboratory
COURSE DESCRIPTION			
Course objectives	The aim of the course is to familiarize students with various aspects of functional applications that are achieved by printing, especially ink-jet technology, with an explanation of its advantages as a non-impact technique, to point out the variety of functions that can be achieved through the choice and combination of materials, to introduce students to upcoming trends, to direct them towards own creative ideas.		
Learning outcomes	Students will be able to list and describe different types of 2D codes; Explain the technology of 3D ink-jet printing; List the materials used in 3D printing; Be able to explain what chromogenic inks are and the mechanism of the colour change; Be able to list and explain different types of chromogenic inks; Explain which part of the RFID system is printable; Explain the differences between electronic paper and other screen products and explain the principle of electrophoresis; Find out about other functional applications and development and application possibilities.		
Course content (syllabus)	1. Review of content, presentation of various aspects of printed functional applications; definitions of basic terms. 2. Explanation of function and principles of 2D code generation, types, explanation of interactivity. 3. Limits of reading 2D codes and error correction system, intentional design errors as a function of creativity. 4. Electronic book, principle of e-paper screen operation, differences compared to other screen products. 5. The working principle of the e-paper screen, electrophoresis. 6. Explanation of 3D printing technique, types and principles of AM, 3D InkJet printing, development of color printing, differences. 7. The purpose of 3D printing by areas, development and perspectives, examples, 3D scanning, use of 3D printing records. 8. Materials for 3D printing, types of powder, binder function, color function, infiltrators, role and differences by type. 9. The first written intermediate knowledge test. 10. Explanation RFID, parts, printed parts, antennas, other printed electronics, examples. 11. Explanation of the concept of chromogenic inks, types, division according to different criteria, purpose of inks. 12. Thermochromic inks, types and mechanisms of color change, biochromic inks, indicators, types. 13. Bio-paper, explanation of different uses, biocides in/on paper, application. 14. Other examples of functional applications, advantages of InkJet technique, microscreen printing and other examples. 15. Second written knowledge test.		
Required literature (available in the library and/or via other media)	**Title**		
	1. Teacher's lectures on the department's website		
	2. Developments in Printing Technology, Pira International, Leatherhead, 2007		

	3. Lozo, Branka; Stanić, Maja, 3D Ink Jet Printing, Ed: Stasiak W, James, Sprinfield: Society for Imaging Science and Technology, USA, 2010
	4. Thompson, B., Printing materials: science and technology, Pira International, Leatherhead, 2004
	5. Z Corporation, 3D Printing Technology Whitepaper, Z Corporation, Burlington, USA, 2005 Gebhardt, A., Short Course on Rapid Prototyping, Aachen University of Applied Sciences, Aachen, Germany, 2005

BOOKBINDING 1			
Course teacher	Suzana Pasanec Preprotić	Course code	19557
Name of the course	Bookbinding 1	Semester (winter/summer)	summer
Teacher's contact email	suzana.pasanec.preprotic@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Tutorial class
COURSE DESCRIPTION			
Course objectives	The course follows finishing processes throughout publishing and craft bookbinding. It studies the bookbinding and binding block system types. It focuses on establishing the characteristics of bookbinding regarding bookshelf system, binding unit, adhesive and paper types. The aim of the course is to find the best solutions within the frame of bookbinding engineering. Practical work focuses on specific details including individual handmade book. It allows the students to understand a complex network of binding technology. Students are asked to write seminar paper on the course topics during the semester. Also, student needs to create handmade book of his choice. The oral speech is also included to the students give explanations about binding design. The final grade (with marks 2, 3, 4, or 5) is the average of the grades obtained through seminar papers and work practice.		
Learning outcomes	Students understand how to properly choose engineering book concepts which leads binding efficiency. Students can correctly identify binding standardized procedure within Standards Framework ISO/TC 130. Students are able to give examples how to cope with technological bindery style processes. Students can reliably demonstrate how to tailor paper features in order to optimize the visual-tactile book appearance. Students can correctly present comprehensive binding knowledge by constructing a handmaking prototypes.		
Course content (syllabus)	• Bookshelf classification system • Bookbinding types (paperback, hardback, mechanical) • Binding block systems (adhesive, thread and wire stitching, comb) • Binding units' type (individual sheets/leaf, folded sheets) • Adhesive binding methods (double-fan and rough spine) • Differences between Craft bookbinding and Book publishing • Finishing process steps (cutting, folding, gathering, binding block systems, trimming) • Technological principle of binding block system • Classification and type of folded sheet • Basic gathering principles (collating, inserting) • Craft binding block variants (side wire stitching, thread-stitching with linen tape) • Perfect binding diagram (block spine processing and gluing) • Adhesive type applications (PVAc, hot-melt, PUR) in bookbinding • Perfect binding strength rating (pull test, FOGRA standard) • Paper suitability for perfect binding (high grades papers, recycle and wood-contained papers)		

	• Book covers in craft bookbinding • Bookbinding materials and equipment • Creating handmade book (design bindings to suit specific projects)
Required literature (available in the library and/or via other media)	**Title**
	[1] Pasanec Preprotić, Suzana; Vukoje, Marina; Petković, Gorana; Rožić, Mirela: Novel Approaches to Enhancing Sustainable Adhesive System Solutions in Contemporary Book Binding: An Overview // Heritage (Basel), 6 (2023.), 1; 628-646. doi:10.3390/heritage6010033 [2] Pasanec Preprotić, Suzana; Petković, Gorana; Bracić, Mario; Marošević Dolovski, Ana: Comprehensive Principles for Enhancing the Adhesive Bound Book Performances // Tehnički glasnik, 2023 (2023.), 17(4); 543-553. doi:10.31803/tg-20230127170218 [3] Pasanec Preprotić, Suzana; Dijana Stančin; Gorana, Petković: Projektiranje procesa u nakladničkom uvezu knjiga - Analiza radnog procesa // Polytechnic and design, 10 (2022.), 4; 222-232. doi:10.19279/TVZ.PD.2022-10-4-01 [4] Dasović, Eva; Petković, Gorana; Pasanec Preprotić, Suzana: Oblikovanje i budućnost knjižnog uveza u svijetu e-knjige // Tehnički glasnik, 9 (2015.), 4; 440-445 [5] Pasanec Preprotić, Suzana; Vukoje, Marina; Petković, Gorana; Rožić, Mirela: Sustainable approach to book designing concepts in bindery sector: An overview // Proceedings - 11th International Symposium on Graphic Engineering and Design GRID 2022 / Vlaidić, Gojko (ur.). Novi Sad, 2022. str. 629-645. doi:10.24867/GRID-2022-p69
	<u>Additional literature:</u> [1] Weston, H., Bookcraft, Technique for Binding, Folding and Decorating to Create Books and More, Quarry Books, London, 2008. [2] Kipphan, H., Handbook of printmedia: technologies and production methods, Springer Verlag Heidelberg, New York, 2001. [3] Southworth, M., Southwourth, D.: Quality and Productivity in the Graphic Arts: Quality Control in the Bindery-Werner Rebsamen, Graphic Arts Publishing Co, New York, 1989. [4] Clark, T., Bookbinding with adhesives, McGRAW-HILL Book Company Europe, England, 1994.

OFFSET PRINTING MANAGEMENT			
Course teacher	Igor Zjakić, Irena Bates	Course code	19469
Name of the course	Offset printing management	Semester (winter/summer)	summer
Teacher's contact email	igor.zjakic@grf.unizg.hr irena.bates@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	BSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Tutorial class
COURSE DESCRIPTION			
Course objectives	To teach students how to obtain and standardize a printing quality in different printing techniques.		
Learning outcomes	The course provides students with basic knowledge about standardization and quality management of various printing techniques. The subject teaches the principles of reproduction of raster elements, how their deformation affects the reduction of print quality, how print quality is managed with the help of measuring fields, how visual control is used to identify and solve printing problems, then, the subject teaches how to standardizes the printing process and how modern computer systems achieve uniform and high-quality printing. In addition to the above, students learn about hi-fi printing techniques and ways to increase quality in reproduction, as well as ways and methods of varnishing in printing, which achieves a higher quality graphic product.		
Course content (syllabus)	1. Introduction to the subject. The importance of quality in printing. The link between technology and design. Expectations and global quality trends. Separation of products by quality. Defining the quality of different printing techniques. 2. Colour in printing, importance of color in commercial purposes, problems of defining quality with customers, principles of multi-color reproduction in printing with technological process. 3. Raster systems and error assumptions. Advantages and disadvantages of different types of rasterization, deformation of raster elements. 4. Errors in printing, causes, methods of detection, sequence of printing and connection with machines, Geometrical deformation of raster elements, examples. Optical deformation of raster elements, examples, realistic and optimal reproduction. 5. Printing methods, control strips, signal and measurement strips. Shearing, duplicating, smearing, color density, color density range, reproduction of microlines, examples. 6. Methods of establishing the geometric deformation of raster elements. Colour density range. 7. Methods of establishing the geometric deformation of raster elements. Colour density range. 8. Calibration and characterization procedures, Fogra principles, GATF, field D, K/S fields. Transfer of tonal values, Hartmann system of programmed printing, control system Felix-Brunner, measuring microelements, degrees of coloring, control system Gretag.		

	9. Proper definition of print quality, tone error in print, grayness of color in print, color efficiency in print, relative print contrast, color acceptance. Print order. 10. Mixed color printing. Color difference control methods. Quantitative detection of missing colors in mixing, color gamut and print behavior. Pantone, HKS etc. 11. The difference between mixed and CMYK color printing. Defining colors. The link between design and reproduction of the final product. 12. Printing errors. Toning, excess wetting solution, wiping, damaged TF, damaged rubber cover, deformations of the printing material affecting the quality, scraping, improper powdering, appearance of unwanted lines in the print. 13. Reduction and methods of increasing color reproduction in printing. Hi-Fi printing methods - Hexachrome, Opaltone, MaxCYM, highly pigmented printing, printing with additional mixed colors. Increasing color reproduction, methods of achieving greater commercial effect, advantages of Hi-Fi printing. 14. Printing management - CPC 1, 2, 3, 4, PRINECT, PECOM, MaxNet, DoNet, etc. Possibilities and quality improvements, speeding up work, importance of the link between management and apparatus production management. Varnishing in printing - classic oil varnishes, water-dispersive varnishing, UV varnishing on prints with classic colors, UV colors and hybrid colors, methods, advantages and disadvantages, inducing different commercial effects, examples. 15. Colloquium
Required literature (available in the library and/or via other media)	**Title**
	I. Zjakić: upravljanje kvalitetom ofsetnog tiska. HSN, 2007.
	I. Zjakić: tehničko uređivanje u procesu izrade knjige, HSN, 2013.;
	H. Kiphan:Handbook of Print media, Springer, 2001.

Courses from graduate study programme

DIGITAL PRINTING FORM			
Course teacher	Igor Majnarić	Course code	19476
Name of the course	Digital printing form	Semester (winter/summer)	winter
Teacher's contact email	igor.majnaric@grf.unizg.hr	ECTS credits	6
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
2. COURSE DESCRIPTION			
Course objectives	Students deepen the theoretical foundations based on Computer to Press and Computer to Print technologies. All relevant NIP printing technologies will be analyzed in more detail, including their basic working principles. They learn about the design features of digital printing machines that can print from rolls and sheets, whose role is crucial for creating a quality print. During the course, problems caused by the interaction of printing substrates, printing inks (toners), and other factors that can be found in the working environment (digital printing press) are identified. During the class, students will create computer templates and print prints using different digital techniques, after which they will compare them with each other, applying various measurement methods to evaluate the quality of reproduction. The evaluation will be performed using advanced methods of image analysis, with a standard comparison based on densitometric, colorimetric and spectrophotometric measurement methods.		
Learning outcomes	Students will be able to list all digital printing techniques and determine their direct application with regard to productivity and print quality. After passing the course, students will be able to explain in detail all construction variants of digital printing machines (Electrography, Inkjet, Magnetography, Ionography, Electrography, Photography, Thermography, X-graphy) together with the basic processes that take place during the generation of a print. This alone will allow for quantitative and qualitative evaluation. For the two most dominant digital printing techniques (Inkjet and Electrophotography), students will be able to prepare hand-made digital files, and print them with the desired adjustment of adequate settings on the printer (using linearization and appropriate ICC profiles). For the needs of digital printing, students will be able to critically select adequate consumables (printing substrates and inks) and in accordance with them in order to achieve adequate print quality. On the basis of theory and practice obtained during lectures and exercises (performed by densitometric and colorimetric measurements), the student will be able to independently evaluate conventionally printed and digitally printed prints and assess which of them is more applicable for the realization of different graphic products.		
Course content (syllabus)	1. Introductory lecture (def. rights and responsibilities of students, def. seminars in Digital Printing, def. literature). Introductory exercise (def. rights and duties of students, def. necessary equipment and literature).		

	2. Digital printing systems, the difference between individual and mass. Personalization and printing on the claim. Presentation of Non-Impact Printing (NIP) technologies, Applications in digital printing, and development trends. Creating your one-page digital product in the Adobe Illustrator application (print 4/0). Production of P.S. file, creating a PDF file suitable for digital printing on known machines (known PPD and precisely defined driver) 3. Part I: basics of the electrostatic process. Photosensitive materials and properties of photoconductors. Powder and liquid toners. Chronological development of EP printing machines. Stages of formation of black and white EPs. of imprints Drum photoreceptor impingement processes. Creating your own double-sided printed digital product in the Adobe Illustrator application (print 4/4). Production of P.S. file, which is printed in margo, creation of a PDF file suitable for digital printing on an HP Indigo machine (known PPD and precisely defined driver) 4. II. part: the basis of the electrophotographic process. Lighting modes ROS and LED. Principle of laser operation. Modulation of laser radiation. Laser beam directors. The principle of image formation in photocopiers. Presentation of the creation of digital products in Adobe Acrobat applications with the help of a plug-in for digital imposition (standard book sheets and non-standard book sheets). Printing examples on the Laserjet 9050 dn printer, defining sheet rotation, activation of digital finishing. 5. III. part: The the basis of the electrophotographic process. Principles of development in electrophotographic machines. Principles of possible transfers in electrophotography. Creating your multi-page digital product in Adobe Acrobat applications with the help of a plug-in for digital imposition (standard book sheets and non-standard book sheets) 6. III. part: The the basis of the electrostatic process. Principles of fusion of electrophotographic prints. Fusing with rollers, non-contact fusing, fusing with solvents. Principles of photoreceptor cleaning. Creating your digital product that contains special effects. Generating files for automatic cutting, Generating special spot colors, Activation of achromatic and metallic colors, and Generating files for in-line varnishing (segment varnishing and varnishing of certain samples). Creation of files for personalized printing. 7. Constructions of multi-colored EPs. machines. Transport systems for guiding paper. Finishing options for electrophotographic machines. Possible special effects 8. COLLOQUIUM. Description of the basic structure of the HP Indigo printing machine. Disassembly of basic machine components, description of their structure and purpose. 9. Working principle of the ionographic printing process. Ionographic machine constructions. Postulates of magnetism, the principle of magnetography, construction of magnetographic machines of the coloring system, and carrying out the calibration procedure of the machine. Paper transport adjustment and duplex unit adjustment. 10. Principle of operation of electrographic printing machines. Principle of operation of thermographic machines. The working principle of photographic machines. Types of printing substrates for photographic printing. Working with HP Indigo RIP. Sending performed files to RIP. Adjustment of separations, printing, and correction of prints (colors, positions). 11. Principle of formation of droplets. Continuous InkJet printing. Principle and operation of binary InkJet printing. The principle and operation of guided IRIS printing. Working principle of thermal Inkjet, Variants of construction of the basic cell and tank. Achieving photo quality printing. Test printing in the Inkjet technique. Performing linearization within color management software (EFI RiP). Generating the ICC profile of the production footprint. Test printing with the application of the desired profile.

	12. The working principle of piezoelectric InkJet printing. Variants of the structure of the basic cell. Principle of operation of the Electrostatic InkJet. Cell structure. Achieving higher resolution in print. Ultrasonic Inkjet. Dyes for InkJet printing techniques. Presentation of basic machine components of UV LED Inkjet, description of their structure and purpose. Working with Roland's RIP. Printing specially created files. (Cutting and printing, varnishing, spot color, and white color printing) 13. Working principle of X-graphic printing systems. Direct imaging, Electrography, TonerJet printing, Nanography. The working principle of hybrid digital printing. Making a print using the principle of indirect thermal transfer. Preparation of the transfer medium and its transfer to the shirt. Creating a doom effect as a possibility to create a special relief pattern. 14. Machines for digital printing with permanent printing form. The principle of creating a permanent form with a laser in offset printing machines. Construction of digital machines with permanent printing form. Satellite machines based on Computer to Press technology. Changing the shape without removing it from the machine. Tandem Computer to Press machines. Change of printing form. Dyes and printing media. Other Computer to Press printing technologies. Visit (excursion) a Croatian digital printing house. 15. COLLOQUIUM
Required literature (available in the library and/or via other media)	**Title**
	B. Baumler, C. Senff, Laserdruck, Polygraph Verlag GmBH, Frankfurt am Main, 1988.
	G. A.Nathmann, Nonimpact Printing, Graphic Arts Technical Fundation, Pittsburgh, 1989.
	F. J. Romano, H. M. Feuton, On Demand Printing, Graphic Arts, Technical Fundation, Pittsburgh,1998.
	H. Kipphan et al., Handbook of Print Media, Springer, Berlin, 2001.
	G.Goldman, The World of Printers, Piong, OCE Printing Systems, 2004.
	I. Manarić, Studija indirektne elektrofotografije, Grafički fakultet, Zagreb, 2007.

PACKAGING PRINTING			
Course teacher	Irena Bates	Course code	19438
Name of the course	Packaging printing	Semester (winter/summer)	winter
Teacher's contact email	Irena.bates@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	Lectures,
2. COURSE DESCRIPTION			
Course objectives	1)The possibility of applying knowledge of packaging and label printing methods. 2) The possibility of applying knowledge of quality management in offset printing. 3) The possibility of applying knowledge of quality management in flexographic printing. 4) The possibility of applying knowledge of quality management in gravure printing. 5) The possibility of applying knowledge of quality management in screen printing. 6) The possibility of applying knowledge in the quality management of digital printing. 7) The possibility of applying knowledge of decoration, protection and coding methods. 8) the possibility of applying knowledge in the use of packaging materials. 9) The possibility of applying knowledge of standardization of printing quality in packaging printing. 10) The possibility of analyzing and synthesizing the reproducibility parameters of the packaging and label printing process.		
Learning outcomes	1) Categorize the history of packaging and label printing 2) Categorize the printing materials 3) Evaluate and categorize packaging printing technologies 4) Analyze trends and standards that describe the quality of packaging and label printing. 5) Categorize and propose an environmentally friendly way of packaging printing 6) Categorize and propose decoration and protection and categorize codes. 7) Evaluate the quality of packaging and label printing 8) Suggest how to improve the quality of flexographic, offset and gravure printing.		
Course content (syllabus)	History of packaging and label printing. Methods and possibilities of packaging printing with letterpress printing. Advantages and disadvantages of packaging printing with letterpress printing technique. Types of printing substrate and methods of packaging printing. Printing on flexible and rigid substrates. Methods and possibilities of packaging printing using offset printing. Advantages and disadvantages of packaging printing with offset printing technique. International trends and quality standards in offset printing. Methods and possibilities of packaging and label printing with gravure printing technique. Advantages and disadvantages of packaging printing with gravure printing technique. International trends and quality standards in gravure printing. Methods and possibilities of packaging and label printing with flexographic printing technique. Advantages and disadvantages of packaging printing using flexographic printing technique. International trends and quality standards in flexographic printing. Methods and possibilities of packaging printing with screen printing technique. Advantages and disadvantages of packaging printing using screen printing technique. International trends and quality standards in screen printing. Processes and possibilities of packaging printing with digital printing technique. Advantages and disadvantages of packaging printing using digital printing technique. International trends and quality standards in digital printing. Environmental awareness in packaging and label printing (types of printing substrate, types of inks, recycling of packaging, etc.). Types of decoration and protection. Types of codes and labels used to transmit stored information.		

	Title
Required literature (available in the library and/or via other media)	1. Bolanča S., (2013), Tisak ambalaže, Hrvatska sveučilišna naklada, Zagreb
	2. Vujković, I., Galić, K., Vereš, M. (2007), Ambalaža za prehrambene namirnice, Tectus, Zagreb
	3. Kiphhan, H., (2001), Handbook of Print Media, Springer, Berlin
	4. Brody, A. L., Marsh, K. S., (1997.), The Wiley Encyclopedia of packaging technology, 2ed. John Wiley & Sons, Inc., New York, Chichester, Weinheim, Brisbane, Singapore, Toronto
	5. Flexography: Principles and Practices, 5th edition, Foundation of Flexographic Technical Association Inc. (1999), Ronkonkoma; New York,
	6. Fairley, M., (2004), Encyclopedia of Labels and Label Technology, London, England

APPLICATION OF DIGITAL PHOTOGRAPHY IN REPRO. MEDIA			
Course teacher	Maja Strgar Kurečić	Course code	19473
Name of the course	Application of digital photography in repro. media	Semester (winter/summer)	winter
Teacher's contact email	maja.strgar.kurečić@grf.unizg.hr	ECTS credits	4
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
2. COURSE DESCRIPTION			
Course objectives	Teach the basics of digital photography with a balanced emphasis on technical, aesthetic and conceptual skills. Provide students with creative and technical assignments to make personal work. Provide students with the skills to analyse and critique images in a global context.		
Learning outcomes	Use practical image capture and editing skills in digital photography. Understand exposure techniques in manual mode. Classify image capture equipment and judge suitability of the equipment for a given photography project. Evaluate and interpret aesthetics and concept of a photography project. Demonstrate creative and critical communication through the visual medium of photography. Create a portfolio of work.		
Course content (syllabus)	1. Anatomy of a DSLR camera 2. Camera Lens 3. Understanding exposure (ISO / aperture / shutter) 4. Image size and quality 5. ISO sensitivity and image quality 6. File format - RAW vs. JPEG 7. Image editing in Adobe Photoshop 8. Visual design concept 9. Composition 10. Basic principles of lighting 11. Studio portrait / outdoor portrait 12. Creative photographic techniques 13. Photo essay 14. Context in Photography 15. Final Project Presentation		
Required literature (available in the library and/or via other media)	**Title**		
	Langford, M., Fox, A., & Smith, R. S. (2015). Langford's Basic Photography: The Guide for Serious Photographers.		
	Focal Press. Kelby, S. (2020). The Digital Photography Book. Rocky Nook, Inc.		
	London, B., Stone, J., & Upton, J. (2017). Photography. Pearson.		
	Terry Barrett, P. (2011). Criticizing Photographs. McGraw-Hill Education		

HOLOGRAPHY			
Course teacher	Katarina Itrić Ivanda Vladimir Cviljušac	Course code	19498
Name of the course	Holography	Semester (winter/summer)	winter
Teacher's contact email	katarina.itric.ivanda@grf.unizg.hr vladimir.cviljusac@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	Lectures,
2. COURSE DESCRIPTION			
Course objectives	The aim of the course is to acquire fundamental and specialized knowledge in holography and it's implementations in graphic technology.		
Learning outcomes	he aim of the course is to acquire fundamental and specialized knowledge for implementation of holography in graphic technology. Students will be able to define the basic physical principles that must be followed in the design, production, and application of holograms. Identify the basic physical assumptions related to the relationships between the finished graphic product, printing technology, design solutions, and holograms. Recognize the potential applications of holograms in graphic technology. Identify different possibilities for realizing holograms within a graphic product with respect to different design solutions. Identify the optimal method for producing holograms used in the graphic industry. Recognize different types of holograms and their specific applications in graphic technology. Select optimal solutions for designing holograms as a graphic product. Define and apply protective elements of holograms and the level of protection required for a specific graphic product. Acquire basic knowledge for creating computer-generated holograms.		
Course content (syllabus)	n ight Optics I 3. Coherent Light Optics II 4. Simple transmission holograms I 5. Simple transmission holograms II 6. White-Light Transmission Holograms 7. Reflective holograms 8. Synthetic and computer-generated holograms 9. Holographic interferometry 10. Holographic materials 11. Hologram printing I 12. Printing holograms II 13. Holography and information technologies 14. Holographic Imaging technology		

	15. Art and Holography
Required literature (available in the library and/or via other media)	**Title**
	HOLOGRAPHIC IMAGING: Stephen A. Benton, V. Michael Bove, Jr., John Wiley & Sons, Inc., Hoboken, New Jersey, 2008
	PRACTICAL HOLOGRAPHY, Third Edition, Graham Saxby, IOP Publishing Ltd., 2004
	LECTRO-OPTICS HANDBOOK 2nd ed. , The McGraw-Hill, 2000
	HOLOGRAMS & HOLOGRAPHY: DESIGN, TECHNIQUES, & COMMERCIAL APPLICATIONS, Vacca, John R., CHARLES RIVER MEDIA, INC. Hingham, Massachusetts, 2001

GRAPHIC DESIGN 3			
Course teacher	Maja Brozović	Course code	33072
Name of the course	Graphic design 3	Semester (winter/summer)	winter
Teacher's contact email	maja.brozovic@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
2. COURSE DESCRIPTION			
Course objectives	To obtain the knowledge and acquire the skills in design of a sign as a carrier of a message with regard to the functions that the message should convey. Course is focused on systematic analysis of symbols and the concept of creating meaning through visual communication. Form, in the context of visual communication, is thought of as a mean s for information transmission through graphic media communication systems. Symbols (signifiers) are not analysed on the basis of case studies, but rather as integral parts of an organised information system. Particular attention is given to notions and definitions of sign and meaning, as given by various influential authors. Through lectures and practical exercises, students study visual forms from the standpoint of their structure, as highly or scarcely structured symbols, and their respective formal appearance. The development of the tendency towards reduction of figurative shapes to wholly abstract signs is being considered. Pictorial systems and their practical application are studied, including standardised systems of pictograms in everyday use. Semantic analysis is carried out concerning general functions of symbols and their application in shaping visual messages through: relations between symbol and referent, author and message, parts and whole of the message, assessment of appropriateness of a symbol structure regarding target audience, accessibility of the visual message and the contribution of the graphic structure in clarifying the message's content. Through practical work, students will obtain knowledge and acquire skills for designing signs on the basis of content, attitude, inventiveness, context, non-content factors and style.		
Learning outcomes	- create different signs with respect to structuredness - analyse signs and their meanings - integrate signs into a unique formal system - propose a suitable illustrative system for the presentation of information - design a sign in accordance with the focus on a particular function in the communication process		
Course content (syllabus)	1. A highly structured sign. Concept and solution of a highly structured sign on a given topic 2. A low-structured sign. Concept and solution of a low-structured sign on a given topic 3. Pictograms. Design the defined number of signs as a unique system of pictograms 4. Analysis of sign and meaning. Reduce the given figurative form to a completely abstract sign through a certain number of phase - sketching 5. Illustrative systems. Reduce the given figurative form to a completely abstract sign through a certain number of phase - realization 6. Illustrative systems. Illustrate a specific location with independent signs 7. Illustrative systems – examples. Corrections of the selected illustrative system according to the information hierarchy		

	8. General sign functions. Design a certain product with regard to the level of quality 9. Referential function of the sign. Present the animation of a stylized form through a certain number of phase 10. Emotional function of the sign. Present personal view of a certain concept in the form of a sign 11. Aesthetic function of the sign. Form sign for concepts characterized by symmetry and rhythm 12. Conative function of the sign. Show signs for different target groups 13. Contact function of the sign. Design sign with an emphasized contact function 14. Metalinguistic function of the sign. Present sign with an emphasized metalinguistic function 15. Representation of individual sign functions. Analyse the obtained sign through the representation of individual functions
Required literature (available in the library and/or via other media)	**Title**
	van der Vlught, R.: Logo life: Life Histories of 100 Famous Logos, BIS Publishers, Amsterdam, 2012.
	Abdullah, R.; Hübner, R.: Pictograms, icons & signs: a guide to information graphics,Thames & Hudson, 2006.
	Robbins, N.B.: Creating More Effective Graphs, John Wiley & Sons, Hoboken NJ, 2005.
	Ware, C.: Information Visualization: Perception for Design, San Francisco CA, Morgan Kaufmann Publishers, 2004.
	Harris, R.L.: Information Graphics, Oxford University, New York and Oxford Press, 2000.
	Bertin, J.: Semiology of Graphics: Diagrams Networks Maps, University of Wisconsin Press, Madison Wis., 1983.

WEB DESIGN 1			
Course teacher	Jesenka Pibernik	Course code	40782
Name of the course	WEB design 1	Semester (winter/summer)	winter
Teacher's contact email	jesenka.pibernik@grf.unizg.hr	ECTS credits	6
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
2. COURSE DESCRIPTION			
Course objectives	Students are being trained in the design and testing of websites using user-centered design methods.		
Learning outcomes	• Plan goals, purpose, content structure, and interface • Design user interaction with the interface • Devise target audience, personas, customer journey mapping, task analysis, flow modeling • Identify and apply user-centered design process methods: user interviews, card sorting, tree testing, guerrilla usability testing, creating and annotating wireframes and prototypes, writing micro-copy for the website • Integrate typography, images, icons, and video into a cohesive web design of a specific style • Design websites that are functional, attractive, useful, and user-friendly • Create a design specification for websites (design-spec) • Use typography and color in web design • Define principles of accessibility and inclusivity in web design • Use basic HTML, CSS technologies		
Course content (syllabus)	1. Introduction, fundamentals of information architecture. Definition of rights and duties of students, definition of exercises, definition of literature, presentation of students' work from previous years, definition of necessary equipment. 2. Website development process using user-centered design methods. Application to SILK / setting up a group blog - students are required to actively participate and track their progress on SILK throughout the semester. 3. Defining the target audience. Depending on prior knowledge, slice PSD to HTML (convert a given PSD file into an HTML page) or design and code a small HTML page with multiple subpages, menu, tables, video, and images. 4. Defining purpose and goals. Initiation of website documentation - defining goals, researching future users (conducting surveys, interviews), and shaping research results. 5. User scenarios and task analysis. Group/individual work: beginning the design of the first individual page in exercises, creating sketches/LOFI wireframes. 6. Design principles. Group work: card sorting and tree testing for the final website. Incorporating testing into project documentation. 7. Conceptual sketches. Creating flowcharts, user journey, and CX maps. 8. Prototyping. Group/individual work: creating HIFI wireframes, a fully functional prototype of the page.		

	9. Hierarchical organization, networks. Group/individual work: Testing prototypes on a real target user group - documenting and presenting test results, making wireframe adjustments based on test results. 10. Navigation organization. Designing an individual website according to wireframes in software of choice. 11. Web colors. Adjustments to documentation/design/wireframes. 12. Web typography. Commenting on individual pages, voice and tone according to personas (addressing users, writing micro-copy, "human interface"). 13. Form design. Complete specification of individual web page. 14. Icon design. Website evaluation, user testing. 15. Final presentation. Preparation for the final presentation.
Required literature (available in the library and/or via other media)	**Title**
	Caddick R., Cable S., Communicationg the User Eyperience, Wiley 2011.
	Garrett J. J., The Elements of User Experience, New Riders, 2011.
	Barnum C. M., Usability Testing Essentials, Elsevier, 2011.

GRAPHIC DESIGN 4			
Course teacher	Maja Brozović	Course code	33073
Name of the course	Graphic design 4	Semester (winter/summer)	winter
Teacher's contact email	maja.brozovic@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
2. COURSE DESCRIPTION			
Course objectives	To obtain the knowledge and acquire the know-how in presenting design concept for a visual identity and its application in form of a book of graphic standards. Course focuses on finding and realizing design concepts for visual identity of a company (or a product) through trademark/logotype design, elaboration of all aspects of visual identity and presentation of its intended applications in form of a book of graphic standards. Through lectures and practical work on project assignments, students obtain knowledge and practical skills needed to present design concepts for visual identity, in accordance to the requirements of public competitions. Theme units of the course encompass examples of client's requirements, analysis of the affinity of different job-types/companies, selecting the best solutions, development of design concepts or models, delivering proposals for trademark/logotype design, its presentation and assessment, as well as implementation of the final draft. Student research activities on the project assignment consist in elaborating all aspects of visual identity and materializing it in the form of a book of graphic standards. These include the following: description of the objectives, SWOT analysis in regard to competition, construction of a trademark, appropriate typographic customization and colour pallet definition, listing of authorized and prohibited implementations, creating previews of application on corporate communication, promotional materials and other aspects of its intended use.		
Learning outcomes	- analysis and critical assessment of marks functioning as visual identity - evaluate existing, competitive and own author's logo solutions - designing various concepts for trademark/logotype while respecting the specific needs of the client - presentation of proposed design concepts for trademark/logotype according to the given framework - conducting a development project aimed at shaping visual identity - producing a book of graphic standards according to the client's requests - autonomous completion of project assignments in simulated conditions of public competition		
Course content (syllabus)	1. Visual identity - definition, purpose, goals, examples Analyze graphic solutions of existing signs and company's logos of various activities 2. A set of guidelines for creating a visual identity Compilation of guidelines for designing the company's visual identity according to the student's choice 3. Examples of visual identities of related activities, analysis of signs and logos Analyze the visual identities of competing companies in relation to the selected company for which the student drew up guidelines in the previous exercise		

	4. Examples of different proposals for sign and logo solutions Design five proposals for a conceptual design of a sign, logo, or its combination in relation to the set of guidelines for creating a visual identity 5. Successfulness evaluation of selected solutions in real circumstances of the sign Select the best solution from the five proposed solutions within a group of students 6. Construction of signs, logos, slogans in the coordinate system, determination of empty space Construct the sign, logo, and slogan of the chosen solution in the coordinate system, define the empty space 7. Sign/logo application in different sizes, determination of the minimum allowed size, correction needs in small sizes Determine the minimum size of the sign/logo, correct the conceptual solution due to the possible loss of certain parts 8. Defining the basic and extended color palette, applying systems Define the number and types of colors of the sign/logo through different applying systems 9. Defining official typography: primary and secondary Analyze examples, select primary and secondary typography, selection justification 10. Obligatory performance forms of the sign/logo and their application Perform the sign/logo in the following forms: monochrome, negative, grayscale, line version 11. Permitted and forbidden application forms of the sign/logo Recommend other permitted forms of sign/logo and define forbidden applications 12. Sign/logo application on different substrates (monochrome, multicolor, photos) Anticipate the need to apply the sign/logo on different substrates and define the appearance of the sign/logo on grayscale, monochrome, and multi-colored substrates, photographs 13. Examples of business documentation, advantages, and disadvantages Design business documentation that reflects the recognizability of the subject's visual identity 14. Examples and purpose of sign/logo application for the purpose of promotional activities Apply the sign/logo on small promotional materials and signage 15. Examples analysis of different books of standards Organize visual identity items in the form of a book of standards
Required literature (available in the library and/or via other media)	**Title**
	J. Murphy, M. Rowe: How to Design Trademarks and Logos (Graphic Designers Library),F&W Pubns, 1991.
	B.M. Pederson (Editor): Graphic Corporate Identity, Graphic Press, 1994.
	Manual of graphic standards

DESIGN AND ENVIRONMENT			
Course teacher	Ivana Bolanča Mirković	Course code	19455
Name of the course	Design and environment	Semester (winter/summer)	summer
Teacher's contact email	ivana.bolanca.mirkovic@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Tutorial class, seminar
COURSE DESCRIPTION			
Course objectives	The main goal of the course is to train students to apply graphic design principles for environmental sustainability. Within the sustainability approach framework, industrial ecology and life cycle assessment settings are used primarily from "cradle to cradle". Students are explained the ecological principles of selecting and saving raw materials and materials, ways to save energy, and the best available printing techniques (BAT), then design for reuse, recycling, and develop a logical conclusion of the right path of choice. Students are introduced to quantitative methods and tools, and the further goal is the development of group work skills and the development of presentation skills.		
Learning outcomes	Students will be able to describe and apply design principles for environmental sustainability. Students will be able to explain the settings of industrial ecology. Students will be able to assess the life cycle of a graphic product "from cradle to cradle" and apply it when creating a graphic product. Students will be able to explain the carbon footprint and other ways of determining the impact of products, materials or processes on the quality of the environment and apply them in design. Students will be able to create a graphic product by choosing materials in accordance with environmental sustainability. Students will be able to choose the best available reproduction techniques when creating products. Students will be able to describe and evaluate the results of the application of eco indicators and apply them in solving the task. Students will be able to choose which design eco tools to use in the given examples. Students will be able to evaluate the advantages of reusing and/or recycling products.		
Course content (syllabus)	1. Lecture: Introduction, the importance of product creation in the context of environmental quality, generally about the concepts of environmental protection related to design Seminar: Introduction, individual assignments 2. Lecture: Sustainable development, environmental sustainability and design. Seminar: Design and concept of ecological sustainability, examples of good practice. 3. Lecture: Design for the environment. Design for X. Seminar: Design and optimization of ecological characteristics of products including phases of production. 4. Lecture: Design and ecological efficiency. Seminar: Production and service strategy aimed at increased economic profit. 5. Lecture: Industrial ecology. Historical development. Key settings Seminar: Design for production with sustainable use of resources and energy. 6. Lecture: Industrial metabolism. Seminar: Flows of materials and energy in industrial production systems viewed from a biological point of view. 7. Lectures: Industrial symbiosis. Seminars: Examples of good practice: examples of symbiosis in the graphic industry.		

	8. Knowledge verification through a colloquium Seminar: Design and pollution prevention. 9. Lecture: Product life cycle assessment. ISO standards. Seminars: Case studies: life cycle assessment for book and e-book. 10. Lecture: Assessment of the life cycle of a graphic product. Phases of analysis. Seminar: Evaluation of the impact of the graphic product according to the impact factors. Design and database. 11. Lecture: Analysis and comparison of environmental load. Methods: EI, EDIP, CML and others Seminars: Calculation methodology: EI, EDIP. Examples from practice in the domain of materials and printing. 12. Lecture: Tools of eco-friendly design: Tools that include the product life cycle at all stages. Seminars: Examples of the use of ecological design tools that include the life cycle 13. Lecture: Environmentally friendly design tools that have a qualitative approach. Seminars: Examples of using ecological tools for design with a qualitative approach. 14. Lecture: Tools for environmentally friendly design with a quantitative approach. Seminars: Examples of the use of tools for ecologically acceptable design with a quantitative approach. 15. Knowledge verification through a colloquium.
Required literature (available in the library and/or via other media)	**Title**
	Fiksel, Design for Enviroment, Mc Graw Hill, New York 2012
	W.Jadlička, Suistainable Graphic Design, J. Wiley &Sons, 2009
	J. Ehrenfeld, Sustainability by Design, Yale University Press,New Haven, 2008

CTP TEHNOLOGY			
Course teacher	Sanja Mahović Poljaček	Course code	19481
Name of the course	CtP tehnology	Semester (winter/summer)	summer
Teacher's contact email	sanja.mahovic.poljacek@grf.unizg.hr	ECTS credits	6
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	tutorial class, seminar
2. COURSE DESCRIPTION			
Course objectives	Definition of CtP processes and digital workflow in the production of printing plates. Definition of the elements of the Computer to Plate (CtP) system for creating an image on the surface of printing plates. Analysis of devices for imaging printing plates and classification according to architecture, radiation sources and printing techniques. Definition and comparison of different systems for the production of printing plates depending on the technical solutions of the printing units and the structure of the printing plates. Differentiation and evaluation of the technologies available on the market and the possibility of their application in the different workflows.		
Learning outcomes	Students will have the knowledge and ability to define the digital workflow in graphic arts prepress, classify and explain various CtP processes; plan the workflow of processes in graphic arts technology. After completing the course, students will be able to define the CtP system for imaging plates, classify and compare devices for imaging plates, compare and analyze different types of CtP plates, calculate the parameters of imaging plates for different printing techniques, apply different tools for creating imposition templates and optimizing the printing process, calculate and select the type of printing plate taking into account the process parameters, analyze and evaluate the development of CtP technologies, work in a team, apply foreign language skills in literature research.		
Course content (syllabus)	1. Computer to … technologies (0.25 ECTS) 2. CtP - Computer to Plate (0.25 ECTS) 3. Optimization of digital information for imaging process (0.25 ECTS) 4. Imaging devices - architecture, radiation sources (0.25 ECTS) 5. Adjustable imaging devices (0.25 ECTS) 6. CtP printing plates for intaglio printing (0.25 ECTS) 7. CtP printing plates for intaglio printing - electro gravure (0.25 ECTS) 8. CtP printing plates for flexographic printing (0.25 ECTS) 9. CtP printing plates for flexographic printing (0.25 ECTS) 10. CtP printing plates for offset printing (0.25 ECTS) 11. CtP printing plates for offset printing (0.25 ECTS) 12. CtP printing plates for screen printing (0.25 ECTS) 13. CtP printing plates for pad printing (0.25 ECTS) 14. Trends in CtP, non-process printing plates (0.25 ECTS) 15. Trends in CtP, non-process printing plates (0.25 ECTS)		

	Title
Required literature (available in the library and/or via other media)	S. Mahović Poljaček, CtP tehnologije, Sveučilište u Zagrebu Grafički fakultet, Zagreb, 2021.
	H. Kipphan, Handbook of Print Media, Springer Verlag Berlin Heidelberg New York, Heidelberg, 2001.
	K. Johansson, P. Lundberg, R. Ryberg, A Guide to Graphic Print Production, 3rd Edition, Wiley, New York, 2011.
	R. M. Adams, , F. J. Romano, Computer to Plate: Automating the Printing Industry, GATFPress, Pittsburg, 1999.
	J. T. Lind, G. M. Radencic, GATF Computer-To-Plate Performance Study,Vol. 31, Gatf Research & Technology Reports, Printing Industries Press, 2002.
	J. Deemer, Glossary of Graphic Communications, 4th edition, GATFPress, Pittsburg, 2008.

OPTOELECTRONIC SYSTEMS 2			
Course teacher	Lidija Mandić	Course code	19502
Name of the course	Optoelectronic systems 2	Semester (winter/summer)	summer
Teacher's contact email	lidija.mandic@grf.unizg.hr	ECTS credits	6
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	tutorial class, laboratory
2. COURSE DESCRIPTION			
Course objectives	Learn about new technologies, know the principle of operation and application, distinguish between technologies and recognize their application.		
Learning outcomes	Explain the principle of device operation, evaluate devices of the same type according to characteristics, choose devices according to the purpose, to independently research with the aim of lifelong learning.		
Course content (syllabus)	1. Various LED technologies 2. New screen technologies 3. Principle of 3D monitor operation 4. Touch screens 5. Touch screen technologies 6. Touch screen technologies 7. Wireless technologies 8. Working principle of RFID 9. Application of RFID 10. NFC and application 11. Motion sensors 12. Comparison of different motion sensors 13. Printed electronics 14. Printed electronics 15. New technologies		
Required literature (available in the library and/or via other media)	**Title**		
	Miles, Sarma and Williams: RFID Technology and Applications Cambridge University Press, 2010; Saleh, Teich, Fundamentals of photonics, Wiley, 2007		

SYSTEM FOR THE ENVIRONMENT MANAGEMENT			
Course teacher	Marina Vukoje Ivana Bolanča Mirković	Course code	19461
Name of the course	System for the environment management	Semester (winter/summer)	summer
Teacher's contact email	marina.vukoje@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	tutorial class, seminar
2. COURSE DESCRIPTION			
Course objectives	The aim of the course is to train students to participate in the implementation of the environmental management system in the company. Students get to know the reasons for environmental protection and the advantages that they achieve by introducing ecologically sustainable production management. The goal is to acquaint students through the contents of the course with how to achieve competitive advantages through environmental protection. A further goal is to train students to carry out environmental management through life cycle assessment "from cradle to cradle", eco-balancing and ecological labeling. One of the goals of the course is to train students to participate in solving the specifics of environmental management for small businesses.		
Learning outcomes	Students will be able to evaluate the advantages achieved by introducing ecologically sustainable production management. Students will be able to participate in planning the modernization of the company based on the principles of sustainability. Students will be able to apply environmental management as a fundamental factor of a successful company. Students will be able to participate in the application of the environmental management system. Students will be able to recognize and evaluate the impact on the environment in the area of emissions of pollutants, process and waste water, consumption of materials and energy for a specific production process. Students will be able to evaluate the eco-balance in order to optimize the ecological suitability of production and products.		
Course content (syllabus)	1: Defining basic concepts in environmental protection. 2: Reasons for preserving the environment in production. Connection between production and the environment. 3: Principles of sustainable development. Socio-economic foundations of ecological sustainability. 4: Monitoring environmental changes and selecting ecological sustainability policy. 5: Important determinants of ecological management. Seven rules of the 7Rs management system. 6: Relationship between development, environmental protection, and economic growth. 7: Environmental management system: scope, definitions, system requirements. 8: Knowledge check through colloquium. 9: Environmental management system model, planning, implementation, and operation. 10: Description of the production process - environmental protection and technological process. 11: Environmental management through the product life cycle, definitions, division, assessment methodology, functional unit, system boundary. Generic elements of life cycle assessment.		

	12: Environmental management through eco-balancing. 13: Environmental management through ecological labeling. 14: Ecological settings for small entrepreneurship and specificities of environmental management. 15: Knowledge check through colloquium.
Required literature (available in the library and/or via other media)	**Title**
	J.Kausek, Environmental Management Quick and Easy, Quality Press, Milwaukee,2007;
	J.Kaplan,Greening your Small Business, Prentice Hall Press, Nev York, 2009,
	M. Common, S Stagl, Ecological Economics, Cambrige University Press, Cambrige, 2005.

OPTICAL METHODS OF THE PRINTING SURFACE INVESTIGATIONS			
Course teacher	Katarina Itrić Ivanda	Course code	19490
Name of the course	Optical methods of the printing surface investigations	Semester (winter/summer)	summer
Teacher's contact email	katarina.itric.ivanda@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
COURSE DESCRIPTION			
Course objectives	The course provides students with knowledge of methods for examining the optical properties of various types of printing surfaces, both unprinted and printed. It enables them to plan research methodologies and use measuring devices to demonstrate formulated hypotheses. In laboratory exercises, students apply the knowledge acquired through the curriculum, which is continuously connected to the foundational courses throughout all forms of instruction.		
Learning outcomes	1. Describe the correlation between mutually dependent physical quantities and apply them to real situations in graphic reproduction; 2. Use computer programs for statistical processing and graphical presentation of data; 3. Observe, record, and analyze data obtained from laboratory tests; 4. Create measurement conditions to assess the stability of printing surfaces; 5. Utilize relevant standards for assessing the quality of printing surfaces based on their optical characteristics 6. Interpret the reflection spectra of printing surfaces and colorants; 7. Apply the Kubelka-Munk model to calculate the absorption and scattering coefficients on measured printing surfaces, whether recycled or non-recycled; 8. Describe spectrophotometers and recognize when/how to use them in graphic reproduction; 9. Analyze the interaction of light and printing substrate based on physical models, understanding the optical/physical enlargement of the raster element; 10. Explain the interaction of light with the printed substrate using simple physical models (Murray-Daveis and Yule-Nielsen); 11. Define accelerated aging (degradation of the printing surface under controlled conditions) and natural aging.		
Course content (syllabus)	1. Introduction. Electromagnetic radiation, spectrum. Energy of radiation. Radiation sources. Impact of electromagnetic radiation on the environment. Visible radiation. Perception of visible radiation. Thermal radiation. Ultraviolet radiation. Microwaves. Radio waves. X-ray radiation. Gamma radiation and cosmic rays. 2. Emission and absorption spectra. Characteristics of spectra. Spectra of gases, liquids, and solids. Operation principle of spectrometers. Types of spectrometers; prism and optical grating. Standard light sources. 3. Reflection of electromagnetic radiation on a completely opaque surface; surface, mirror, reflection. Printing substrates and surface reflection. Layered and unlayered surfaces. Reflectance curves in the visible spectrum and the structure of the printing surface.		

	4. Light scattering within bound particles; turbid media, cloudy systems. Kubelka-Munk scattering theory and its application in investigating the optical properties of printing surfaces. Reflectance, scattering, and absorption spectra. Relationship between scattering and structure, types, substrates. 5. Murray–Davies and Yule-Nielsen improved scattering theory. 6. Scattering on non-recycled and recycled substrates. Analysis of particle impurities in printing substrates. 7. Scattering and colored substrates, papers. Reflectance curves and factors of scattering and absorption. Limitations of applying the Kubelka–Munk scattering theory to recycled and fully colored substrates. 8. Scattering and types of printing substrates (transparent/opaque). 9. Scattering and related optical properties of printing surfaces. Brightness, transparency, opacity. Familiarization with optical measurement standards; ISO, TAPPI. 10. Fluorescence; explanation of the phenomenon. Detection of the phenomenon in reflectance measurements. Fluorescent materials. 11. Aging and stability of printing surfaces. Visible and UV radiation. Selection of specific radiation sources and measurement of radiation energy. 12. Stability of printing surfaces and the influence of moisture and temperature. Effect of substrate acidity on stability. Accelerated and natural aging. 13. Physical changes within the substrate caused by aging. 14. Overview of selected testing methods. Analysis of all student results in the group. 15. Familiarization with literature data on proposed methods and suggestions for new content for testing printing surfaces.
Required literature (available in the library and/or via other media)	**Title**
	P. Kulišić i V. Lopac : Elektromagnetske pojave i struktura tvari, Školska knjiga, Zagreb, 2003.
	H. Kipphan: Handbook of Print Media: Technologies and production methods, Berlin, Springer,2001
	N. Pauler: Paper optics, AB Lorentzen & Wettre, Sweden, 2001.

SURFACE PHENOMENA ON PRINTING FORMS			
Course teacher	Tomislav Cigula Tamara Tomašegović	Course code	19480
Name of the course	Surface phenomena on printing forms	Semester (winter/summer)	summer
Teacher's contact email	tomislav.cigula@grf.unizg.hr tamara.tomasegovic@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	tutorial class, seminar
2. COURSE DESCRIPTION			
Course objectives	To define and analyse surface phenomena which are specific for printing forms. To choose measurement methods which enable characterization of materials and processes in printing forms production. To evaluate influence of the processing parameters. To optimize printing forms production. To determine composition of fluids in the printing processes for the highest functionality.		
Learning outcomes	Proposing new and functional solutions for graphic products having in mind used materials and production processes of printing forms; evaluation and characterization of advanced imaging processes in graphic industry; implementation of the eco-system in graphic processes; optimization of processing steps in graphic reproduction. After finishing the course, the student can: define and classify surface phenomena in the graphic industry; analyse and evaluate the influence of the material and its surface treatment on functionality in graphic reproduction processes; explain and evaluate physicochemical properties of fluids and the parameters that affects them; choose and apply measurement methods in surface properties analysis, evaluate the material processing and propose optimization solutions, propose additives ratio in liquids to increase functionality; evaluate and elaborate modification of material processing; literature search related to materials for the production of printing forms.		
Course content (syllabus)	1. Definition of surfaces, surface phenomena on printing forms 2. Adsorption in graphic reproduction processes 3. Wetting in graphic reproduction processes 4. Methods of determining the wetting degree on the surfaces of the printing form 5. Capillarity in graphic reproduction processes 6. Mechanical properties of surfaces, structure related topography of solids 7. Surface roughness, roughness parameters 8. Methods for determining roughness parameters 9. Processes of printing forms production that affect the change in the roughness of the material 10. Physico-chemical properties of liquids in the graphic industry 11. The role and composition of the wetting solution 12. Surfactants 13. Methods for determining the surface properties of liquids		

	14. Methods for determining the free surface energy of materials 15. Parameters affecting solid-liquid interaction
Required literature (available in the library and/or via other media)	**Title**
	K. L. Mittal, Contact Angle, Wettability and Adhesion, Volume 5, VSP, Leiden, 2008;
	S. Hartland, Surface and Interfacial Tension: Measurement, Theory and Applications, Marcel Dekker, 2004;
	H. Kipphan, Handbook of Print Media, Springer Verlag Berlin Heidelberg New York, Heidelberg, 2001
	. C. Hiemenz. R. Rajagopalan, Principles of Colloid and Surface Chemistry, Third Edition, Marcel Dekker, New York, 1997;
	P. Atkins, J. de Paula, Atkin\'s Physical Chemistry, 8th edition, Oxford University Press, Oxford 2006.

INK IN DIGITAL ENVIRONMENT			
Course teacher	Lidija Mandić	Course code	96536
Name of the course	Ink in digital environment	Semester (winter/summer)	summer
Teacher's contact email	lidija.mandic@grf.unizg.hr	ECTS credits	3
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	tutorial class, seminar
2. COURSE DESCRIPTION			
Course objectives	Classification of parameters affecting color appearance. Explain the importance of modeling the chromatic model adaptations. Connect chromatic adaptation models with color appearance models. Explain models for image appearance.		
Learning outcomes	Evaluation of the characteristics of prepress, printing, finishing and multimedia devices Expected learning outcomes at the subject level explain the parameters that affect the appearance of colors compare the different ones chromatic adaptation models connect models for color appearance with application differentiate models for colors appearance from the image appearance model.		
Course content (syllabus)	1. Experience of color and parameters that influence the experience of color; 2. Color characteristics that are included in the color appearance model, 3. Human visual system and adaptation 4. Parameters affecting color appearance 5. Parameters affecting color appearance 6. Color spaces 7. Device characterization 8. Device characterization 9. Models of chromatic adaptation 10. Models of chromatic adaptation 11. Models of chromatic adaptation 12. Color appearance model 13. Color appearance model 14. Model for image appearance 15. Image appearance model		
Required literature (available in the library and/or via other media)	**Title**		
	MD Fairchild. Color Appearance Models, Second edition. Chichester, UK: John Wiley and Sons, Ltd., 2005;		
	Reinhard, Khan, Akyuz, Johnson, Color Imaging: fundamentals and Applications, A.K. Peters, 2008.		

MOTION GRAPHICS			
Course teacher	Jesenka Pibernik	Course code	53571
Name of the course	Motion graphics	Semester (winter/summer)	winter
Teacher's contact email	jesenka.pibernik@grf.unizg.hr	ECTS credits	6
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching : (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
2. COURSE DESCRIPTION			
Course objectives	The aim of the course is to explore the narrative possibilities of motion graphics as a new medium that combines text and graphics in motion. Students will acquire basic knowledge of progressively solving complex visual problems from the design perspective (motion choreography, dramatic structure) and technology (Adobe suite).		
Learning outcomes	• Integrate visual vocabulary (typography, images, icons, and video) into a cohesive project • Interpret meanings and emotions conveyed through composition, movement, pace, sound, form, and image depending on the target audience • Apply advanced techniques of Adobe graphic programs • Evaluate the properties of motion (info) graphics in relation to graphic design, web design, information design, and film • Apply basic principles of animation • Apply appropriate creative techniques (effects within the composition) and technical standards in the process of creating motion graphics • Ability to work effectively in a team and successfully manage workload and time		
Course content (syllabus)	1. Introductory lecture - definition of student rights and duties, definition of exercises, definition of literature, presentation of student works from previous years, definition of necessary equipment 2. History and development of motion graphics • Animation techniques • Task: Creating a stop motion animation 3. Traditional and computer-generated motion graphics • Basics of animation in Adobe After Effects • Task: Creating motion graphics in After Effects 4. Individual contributions to the development of motion graphics • Motion design – design for space and time (elements of spatial structuring and framing) • Task: Simulating the spatial relationship of elements and framing using motion graphics 5. Film credits and trailers (subtitling) • Kinetic typography • Task: Representing connotative meanings of words using motion graphics		

	6. Motion graphics concepts: Book announcement • Kinetic typography – sentence animation (animated poster) • Task: Conveying a message in a temporal medium using typographic elements and simple geometric shapes 7. Motion graphics concepts: Digital book 8. Moving typography: Conveying meaning and emotions through motion (word) • Real - virtual: Combination of real footage and motion graphics elements • Task: Using keying technique to create motion graphics emphasizing the interaction between video footage and virtual elements of motion graphics 9. Moving typography (sentence) • Project task: presentation of project tasks • Task: Selecting a project task theme and conducting an analysis of motion graphics of competitive products 10. Movement choreography: Interpretation of space and time • Project task: personas • Task: Defining the target audience and creating a minimum of 3 persona examples 11. Concept articulation: conclusion • Project task: brainstorming • Task: Conducting brainstorming related to the project task theme and creating a mental map 12. Concept articulation: construction of space • Project task: storyboard • Task: Creating a storyboard for the project task 13. Styles and editing techniques: Sequence composition • Project task: storyboard – Part 2 (task: Correction of the storyboard) 14. Styles and editing techniques: Transitions • Project task: realization • Task: Implementation of the project task – motion graphics in Adobe After Effects 15. Final presentation • Project task: realization • Task: Implementation of the project task – motion graphics in Adobe After Effect
Required literature (available in the library and/or via other media)	**Title**
	Krasner J., Motion Graphic Design, Routledge, 2013.,
	Braha Y., Bryne B.,Creative Motion Graphic, Titling for Film, Video and the Web, Routledge, 2013.,
	Taylor, A., Design Essentials for the Motion Media Artist, Focal Press, 2010.
	Laurel, B., Design research, methods and perspectives; Cambridge, Massachusetts : MIT Press, 2003

MARKETING COMMUNICATIONS			
Course teacher	Diana Bratić	Course code	19463
Name of the course	Marketing communications	Semester (winter/summer)	Winter
Teacher's contact email	diana.bratic@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Lectures + seminars
2. COURSE DESCRIPTION			
Course objectives	The main objective of the course is to familiarise students with the role and importance of marketing techniques and tools in modern business. Students will be provided with the necessary theoretical and practical knowledge to understand marketing concepts in specific business environments and acquire the necessary skills to develop marketing strategies by combining and integrating different elements of the marketing mix in synergy with the principles of graphic design, and to carry out marketing activities.		
Learning outcomes	1. Proposals for the optimal design of the communication mix. 2. Proposing the structure of an integrated communication plan and drafting a communication strategy and tactics. 3. Selecting the most appropriate media for conveying specific messages. 4. Select appropriate forms of advertising for a product, service, brand or company. 5. Prepare an advertising plan and an advertising budget plan. 6. Evaluate the advertising campaign in terms of communication efficiency standards. 7. Strategically integrate promotional activities, institutional advertising and sponsorship into marketing communications. 8. Strategically integrate sales promotion, personal selling, and direct marketing into marketing communications. 9. Measure the effectiveness of marketing communications. 10. Establish a long-term relationship plan with customers.		
Course content (syllabus)	Course content (Syllabus) on a weekly basis: 1. Communication and marketing 2. Integrated marketing communication 3. Elements of communication and visual identity 4. Marketing mix configuration 5. Promotion mix configuration 6. Advertising and advertising plan 7. Institutional advertising, publicity, sponsorship, and PR 8. Personal selling, direct and interactive marketing 9. Branding and image 10. Packaging and marketing communication		

	11. Digital marketing 12. Social networks marketing 13. Integrated communication plan 14. Consumer behavior and influence on purchase 15. Measuring the effectiveness of marketing communication
Required literature (available in the library and/or via other media)	**Title**
	1. Kotler, P., Armstrong, G. (2020), Principles of Marketing
	2. Kotler, P., Kartajaya, H., Setiawan, I. (2021), Marketing 5.0: Technology for Humanity
	3. Blakeman, R. (2018), Integrated Marketing Communication: Creative Strategy from Idea to Implementation
	4. Belch, G., Belch, M. (2017), Advertising and Promotion: An Integrated Marketing Communications Perspective
	5. Lectures from the course

INTRODUCTION TO THE THEORY OF EXPERIMENTAL WORK			
Course teacher	Katarina Itrić Ivanda	Course code	19494
Name of the course	Introduction to the theory of experimental work	Semester (winter/summer)	winter
Teacher's contact email	katarina.itric.ivanda@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
COURSE DESCRIPTION			
Course objectives	The aim of the course is to acquire basic and professional knowledge, skills and abilities to implement experimental design techniques to improve the production process in graphic technology.		
Learning outcomes	Becoming familiar with experimental design. Preparatory actions (collecting literature, selecting collaborators, etc.). Observation and experimentation. Resolution and propagation of errors. Testing hypotheses. Hypotheses, models, theories, and laws. Defining and analysing measured quantities. The possibility of designing and analysing comparative experiments. Experimental noise (error) and its sources. Types, propagation and elimination of noise. Data acquisition. The existence and treatment of possible alternative hypotheses. Uncertainty (measurement inaccuracy) and experimental design. Building models. Assessing and deciding which factors to use in modelling. Monitoring experiments. Reviewing sampling methods. Deciding when computer simulation can replace experimentation. Statistical processing. Interpretation of measured data. Characteristics of instruments and sensors. Instrument and sensor noise. Standards and common measurements of some quantities. Calibration of instruments and sensors. Determining instrumental function. The course applies fundamental and general knowledge in the analysis of technical and technological processes, classification and explanation of actions and processes within technological units, and applies knowledge from mathematics, chemistry, physics, and modern computer tools to scientific and engineering problems. Also, it enables students to use appropriate mathematical techniques and concepts to obtain quantitative solutions to problems in the graphic industry. This course aims to enable students to understand the logic behind experimental design, understand the factors that promote better experimental design, understand the logic behind inferential statistical testing, present statistical analysis results accurately, concisely and coherently. To apply their understanding of experimental design and statistics, and critically evaluatepublished research. Furthermore, students will learn to design experiments in the field of graphic technology (both technology and design) and report the results in the necessary scope and structure. (Variations of this objective could be used in traditional lectures and courses, as well as in laboratory courses), conduct (or simulate) an experiment in the field of graphic technology (e.g. paper aging) and report the results, develop a mathematical model or computer simulations to correlate or interpret the results of the experiment, interpret data, that is, state and discuss several possible reasons for deviations between predicted and measured results in the experiment, choose the most likely reason and justify the choice, and formulate methods to confirm the explanation.		
Course content (syllabus)	Introduction and objectives. Science and Scientific Method.		

	Experimental design in different fields. Experimental Design in Different Fields - NOISE. Visit to the laboratories at the Faculty of Graphic Arts. Foundations of Experimental Design (I): Causality, Variables, Control, Sampling. Basics of experimental design (II): Validity, reliability, types of experimental projects. Measurement in Experiment: Methods and Methodology. Introduction to descriptive statistics. Error analysis (uncertainty analysis) I. Error analysis (uncertainty analysis) II. Induction and Pattern Recognition. Information Manipulation. Presentation of research proposal; conclusions on experimental research I. Presentation of research proposal; conclusions on experimental research I
Required literature (available in the library and/or via other media)	**Title**
	SCIENTIFIC METHODS, Richard D. Jarrard, (online book), Dept. of Geology and Geophysics, University of Utah, jarrard@mines.utah.edu, 2001;
	How to Lie with Statistics, Darrell Huff, W.W. Norton & Company Inc, 1954;
	The Design of Experiments (9th ed.). Fisher, Ronald A., Macmillan (1971)

PACKAGING AND ENVIRONMENT			
Course teacher	Ivana Bolanča Mirković	Course code	19441
Name of the course	Packaging and environment	Semester (winter/summer)	winter
Teacher's contact email	ivana.bolanca.mirkovic@grf.unizg.hr	ECTS credits	5
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Tutorial class, seminar
COURSE DESCRIPTION			
Course objectives	Students identify and recognize ecological symbols on packaging with many examples in order to recognize them. Introducing students to the impact of packaging materials and packaging products on the environment. Students learn about the importance of different types of packaging materials and their contribution to the environment in terms of energy consumption and pollution. They learn about new nano and smart materials and find out their balance in relation to environmental pollution. Students identify possible problems in the healthiness of the packaging product (especially food). Possible ways of recycling or disposing of the packaging product as the end of one life cycle of the packaging product and the opening of a new life cycle, all with the aim of increasing sustainability.		
Learning outcomes	Students will be able to recognize the ecological symbols on the packaging and know their meaning. Students will know the ecological impact on the environment through all phases of the packaging product's life cycle. Students will be able to compare the amount of energy required to produce packaging materials and packaging. Students will be able to evaluate the impact of the production of packaging materials (cellulose, paper, PE-LD, PE-HD, PVC, PET, glass, and metal) on the environment. Students will be able to recognize the possible impact on the health of a packaging product. Students will be able to list new packaging materials and their impact on the environment. Students will be able to classify legal legislation. Students will be able to propose a way to recycle or dispose of the packaging product.		
Course content (syllabus)	1. Lecture: Introduction. Seminar: Introduction, individual assignments. 2. Lecture: The role of packaging. Location of packaging for promotional purposes. Seminar: Packaging design as a carrier of packaging product promotion. 3. Lecture. The role of packaging. Location of packaging for promotional purposes. Seminar: Packaging design as a carrier of packaging product promotion. 4. Lecture: Impact on air and water quality by pulp and paper production. Seminar: Gradation of pollutants from the pulp and paper industry. 5. Lecture: Ecological aspect of the production of PE-LD, PELLD, PE-HD, PVC, PET. The ecological aspect of the production of glass and metal packaging. Seminar: Polymerization. Properties of polymers. 6. Lecture: Printing on the packaging and the environment. Packaging security in the context of migration. Seminar: Impact of packaging on human health. Diseases. 7. Lecture: Nanotechnology and paper, cardboard and plastic packaging. Seminar: Nanotechnology - new materials. The impact of nanomaterials on the environment and human health. 8. Lectures: Colloquium Seminar: Smart packaging and the environment.		

	9. Lecture: Complete waste management system. Ordinance on packaging waste. Seminar: Legal acts in the Republic of Croatia and the EU. 10. Lecture: Disposal of used paper and cardboard packaging. Composting, landfilling, and burning. Seminar: Ecological approach to the end of life of a packaging product. 11. Lecture: Methods of recycling paper and cardboard packaging. Seminar: Problems in the recycling of multilayer paper packaging. Sticky particles. 12. Lecture: Influence of printing technique, type of dye, and printing substrate on the quality of recycled fibers. The ecological aspect of the recycling process: CO2 balance, heavy metals, and organochlorine compounds. Seminar: Ecological valorization of the quality of recycled fibers. 13. Lectures: Methods of plastic recovery. Seminar: Material recovery. 14. Lectures: Ecological aspects of glass packaging recycling and recovery of metal packaging. Seminar: Energy recovery. 15. Lecture: Colloquium Seminar: Compensation for missed seminars.
Required literature (available in the library and/or via other media)	**Title**
	Lox, Packaging and Ecology, PIRA International, Leatherhead,1999
	S. E. Selke, Packaging and the Environment, CRC Press, Rev.Ed., Portland, 1999.
	Göttsching, H. Pakarinen, Recycled Fiber and Deinking, FPEA and TAPPI, Helsinki, 2000.

BROADBAND NETWORK APPLICATIONS			
Course teacher	Tibor Skala	Course code	19504
Name of the course	Broadband network applications	Semester (winter/summer)	winter
Teacher's contact email	tibor.skala@grf.unizg.hr	ECTS credits	6
Study programme (undergraduate BSc, graduate MSc)	MSc	Forms of teaching (e.g. tutorial class, lectures, seminar)	Lectures, laboratory
COURSE DESCRIPTION			
Course objectives	nowledge of broadband technologies and training for independent broadband design applications for mobile technologies and optimization of multimedia content for broadband applications. Electromagnetic spectrum and digital communications. Information transfer media: copper wire, optical fiber, radio transmission, satellite transmission, microwave, infrared and laser. Definition throughput, bandwidth and long distance communication. Broadband networks. The basics digital telephony, ISDN and development towards broadband connectivity. Types of broadband access: xDSL technologies, optical technologies, electric power network lines (PLC), satellite technology and wireless connections. Interactive broadband multimedia communications. Application of XML language for describing data content and filtered projected rendering via XSLT and SVG technology for different types of display technologies and operating systems in broadband network devices. The use of HTML5 and CSS3 technology in multimedia applications in broadband networks applications.		
Learning outcomes	Students will know: Preparation of complex design tasks for the design and realization of a graphic product in accordance with resources. Valorization of the elements of a particular phase of the implementation of the plan in relation to the set task (plan research, production, design). Planning and evaluation of processes and necessary resources in accordance with the development of graphic technology. Application of graphic engineering knowledge in the field of functional applications (printed electronics, prototyping, bioprinting, mobile applications). Modeling of the graphic process with highly structured programming languages. Optimization of process procedures in graphic reproduction. Developing ideas for shaping and communicating visual messages in the form of new media. Analyze the electromagnetic spectrum and types of media for information transmission. To compare bandwidths, bandwidths and the impact of noise on communications over long distances. Distinguish types of broadband access. Design broadband applications for mobile technologies. Optimizing multimedia content for broadband applications.		
Course content (syllabus)	1. Lecture: Electromagnetic spectrum and digital communications; Exercises: Creating short programs using HTML5 technology. 2. Lecture: Information transmission media: copper wire, optical fiber; Exercises: Creating short programs using HTML5 technology. 3. Lecture: Information transmission media: radio transmission, satellite transmission, microwave, infrared, and laser; Exercises: Creating short programs using HTML5 technology. 4. Lecture: Definition of Bandwidth, Bandwidth and Long Distance Communications; Exercises: Creating programs using HTML5 technology.		

	5. Lecture: Broadband networks; Exercises: Creating programs using HTML5 and CSS3 technology. 6. Lecture: Basics of digital telephony, ISDN and development towards broadband connectivity; Exercises: Creating programs using HTML5 and CSS3 technology. 7. Lecture: Types of broadband access: xDSL technologies; Exercises: Creating a program using HTML5 and CSS3 technology, colloquium. 8. Lecture: Types of broadband access: optical technologies, lines power networks (PLC); Exercises: Creating programs using XML, HTML5, and CSS3 technologies. 9. Lecture: Types of broadband access: satellite technologies; Exercises: Creating programs using XML, HTML5, CSS3, and Javascript technologies. 10. Lecture: Types of broadband access: wireless connections; Exercises: Creating programs using XML, HTML5, CSS3, and Javascript technologies. 11. Lecture: Interactive broadband multimedia communications; Exercises: Creating an interactive application for broadband use. 12. Lecture: Application of XML language for the description of data content and filtered design display for different types of display technologies and operating systems in broadband network devices; Exercises: Creating an interactive application for broadband use. 13. Lecture: Application of XML language for the description of data content and filtered design display for different types of display technologies and operating systems in broadband network devices; Exercises: Creating an interactive application for broadband use. 14. Lecture: HTML5 and CSS3 technologies in multimedia applications in broadband network applications; Exercises: Creating an interactive application for broadband use. 15. Lecture: HTML5 and CSS3 technologies in multimedia applications in broadband network applications; Exercises: Creating an interactive application for broadband use, colloquium.
Required literature (available in the library and/or via other media)	**Title**
	Marlyn Kemper Littman, Building Broadband Networks CRC Press, Jun 3, 2002
	Technology & Engineering A.Salminen, F. Tompa , Communicating with XML, ISBN 978-1-4614-0991-5, e-ISBN 978-1-4614-0992- 2, Springer, 2011
	Pap, Klaudio. Razvoj grafičkih jezika baziranih na XML-u // Tiskarstvo 03 / Lovreček, Mladen (ur.). Zagreb : FS, 2003. 141-143
	Craig Cook, Jason Garber, Foundation HTML5 with CSS3, ISBN 978-1-43 02-3876-8, 2012, Springer
	Gavin Williams, Learn HTML5 and JavaScript for Android, ISBN 978-1-4302-4347-2, 2012, Springer