UNIVERZITET U ZENICI

NASTAVNI PLAN I PROGRAM
II (drugog) CIKLUSA STUDIJA
SOFTVERSKO INŽENJERSTVO

POLITEHNIČKOG FAKULTETA
UNIVERZITETA U ZENICI

Zenica, oktobar 2017. godine

UNIVERZITET U ZENICI

POLITEHNIČKI FAKULTET
ODSJEK SOFTVERSKO INŽENJERSTVO

<table>
<tr><th colspan="3">II (drugi) CIKLUS STUDIJA</th></tr>
<tr><td>Godina studija</td><td colspan="2">Nastavni predmeti obavezni/izborni</td></tr>
<tr><td>I godina

(I + II) semestar</td><td colspan="2">Obavezni
3 + 3

Izborni
1+1 (biraju se iz grupe od 8 izbornih predmeta)</td></tr>
<tr><td>II godina

(III + IV) semestar</td><td colspan="2">Obavezni
3 + 0

Izborni
1+1 (biraju se iz grupe od 8 izbornih predmeta)</td></tr>
<tr><td>Ukupno</td><td>Obavezni: 9</td><td>Izborni: 4 + Magistarski rad</td></tr>
</table>

PREDMETNO-PLANSKA STRUKTURA

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

NASTAVNI PLAN STUDIJSKOG PROGRAMA SOFTVERSKO INŽENJERSTVO – II CIKLUS

Šifra predmeta	R. br.	Naziv predmeta	I semestar (zimski)						Nastavnik/saradnik
			P	V	br. st.	LV	br. st.	ECTS	
	1.	Statistika	3	3				8,0	
	2.	Primjena numeričkih metoda u softverskom inženjerstvu	2	3				8,0	
	3.	Vještačka inteligencija	2	3				7,0	
	4.	Izborni predmet I	3	3				7,0	
		Broj sati u sedmici P/V/LV	**10**	**12**					
		Ukupan broj sati u sedmici	**22**						
		Ukupan broj kreditnih bodova						**30,00**	

Šifra predmeta	R. br.	Naziv predmeta	II semestar (ljetni)						Nastavnik/saradnik
			P	V	br. st.	LV	br. st.	ECTS	
	1.	Optimizacija baza podataka	2	4				8,0	
	2.	Automati i formalni jezici	2	4				8,0	
	3.	Rudarenje podataka	2	3				7,0	
	4.	Izborni predmet II	3	3				7,0	
		Broj sati u sedmici P/V/LV	**9**	**14**					
		Ukupan broj sati u sedmici	**23**						
		Ukupan broj kreditnih bodova						**30,00**	

Legenda: P-predavanja; V-vježbe; LV- laboratorijske vježbe; Br. st. - broj studenata u grupama prema optimalnoj nastavnoj grupi studenata za vježbe i rad u seminaru (čl. 12. Odluke o standardima i normativima za obavljanje djelatnosti visokog obrazovanja na području ZDK)

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

NASTAVNI PLAN STUDIJSKOG PROGRAMA SOFTVERSKO INŽENJERSTVO – II CIKLUS

Šifra predmeta	R. br.	Naziv predmeta	III semestar (zimski)						Nastavnik/saradnik
			P	V	br. st.	LV	br. st.	ECTS	
	1.	Multimedijalni sistemi i aplikacije	2	4				7,0	
	2.	Paralelni računarski sistemi	2	3				8,0	
	3.	Softversko inženjerstvo velikih baza podataka	2	3				8,0	
	4.	Izborni predmet III	3	3				7,0	
		Broj sati u sedmici P/V/LV	**9**	**13**					
		Ukupan broj sati u sedmici	**22**						
		Ukupan broj kreditnih bodova						**30,00**	
Šifra predmeta	**R. br.**	**Naziv predmeta**	**IV semestar (ljetni)**						**Nastavnik/saradnik**
			P	**V**	**br. st.**	**LV**	**br. st.**	**ECTS**	
	1.	Izborni predmet IV	3	3				7,0	
	2.	Master rad						23,0	
		Broj sati u sedmici P/V/LV	**3**	**3**					
		Ukupan broj sati u sedmici	**6**						
		Ukupan broj kreditnih bodova						**30,00**	

Legenda: P-predavanja; V-vježbe; LV- laboratorijske vježbe; Br. st. - broj studenata u grupama prema optimalnoj nastavnoj grupi studenata za vježbe i rad u seminaru (čl. 12. Odluke o standardima i normativima za obavljanje djelatnosti visokog obrazovanja na području ZDK)

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

NASTAVNI PLAN STUDIJSKOG PROGRAMA SOFTVERSKO INŽENJERSTVO – II CIKLUS IZBORNI PREDMETI

Šifra predmeta	R. br.	Naziv predmeta	I, II, III i VI semestar (zimski i ljetni)						Nastavnik/saradnik
			P	V	br. st.	LV	br. st.	ECTS	
I grupa izbornih predmeta									
	1.	Poslovna inteligencija	3	3				7,0	
	2.	Upravljanje rizicima u softverskom inženjerstvu	3	3				7,0	
	3.	Operaciona istraživanja	3	3				7,0	
	4.	Teorija grafova	3	3				7,0	
II grupa izbornih predmeta									
	1.	Prepoznavanje oblika i obrada slike	3	3				7,0	
	2.	Elektronika i mikrokontroleri	3	3				7,0	
	3.	Računarstvo u oblaku	3	3				7,0	
	4.	Računarsko modeliranje i simulacije	3	3				7,0	

Studenti biraju izborne predmete I-IV iz jedne od dvije grupe izbornih predmeta

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

NASTAVNI PLAN STUDIJSKOG PROGRAMA SOFTVERSKO INŽENJERSTVO – II CIKLUS

Šifra predmeta	*R. br.*	*NAZIV PREDMETA*	**I semestar (zimski)**						
			P	**V**	**S**	**PI**	**UI**	**ECTS**	
	1	Statistika	2,0	2,0	1,0	2,0	1,0	8,0	
	2	Primjena numeričkih metoda u softverskom inženjerstvu	1,5	2,0	1,5	2,0	1,0	8,0	
	3	Vještačka inteligencija	1,0	1,5	1,5	2,0	1,0	7,0	
	4	Izborni predmet I	1,5	1,5	1,5	1,5	1,0	7,0	
		Ukupan broj kreditnih bodova						**30,0**	
Šifra predmeta	*R. br.*	*NAZIV PREDMETA*	**II semestar (ljetni)**						
			P	**V**	**S**	**PI**	**UI**	**ECTS**	
	1	Optimizacija baza podataka	1,0	2,0	2,0	2,0	1,0	8,0	
	2	Automati i formalni jezici	1,0	2,0	2,0	2,0	1,0	8,0	
	3	Rudarenje podataka	1,0	1,5	1,5	2,0	1,0	7,0	
	4	Izborni predmet II	1,5	1,5	1,5	1,5	1,0	7,0	
		Ukupan broj kreditnih bodova						**30,0**	

Legenda: P-predavanja; V-vježbe; S- Seminarski radovi (programi, zadaće); PI-Pismeni ispit; UI-Usmeni ispit ECT(A)S-broj kredita

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

NASTAVNI PLAN STUDIJSKOG PROGRAMA SOFTVERSKO INŽENJERSTVO – II CIKLUS

Šifra predmeta	*R. br.*	*NAZIV PREDMETA*	**III semestar (zimski)**						
			P	**V**	**S**	**PI**	**UI**	**ECTS**	
	1	Multimedijalni sistemi i aplikacije	1,0	2,0	1,5	1,5	1,0	7,0	
	2	Paralelni računarski sistemi	1,5	2,0	1,5	2,0	1,0	8,0	
	3	Softversko inženjerstvo velikih baza podataka	1,5	2,0	1,5	2,0	1,0	8,0	
	4	Izborni predmet III	1,5	1,5	1,5	1,5	1,0	7,0	
		Ukupan broj kreditnih bodova						**30,0**	
Šifra predmeta	*R. br.*	*NAZIV PREDMETA*	**IV semestar (ljetni)**						
			P	**V**	**S**	**PI**	**UI**	**ECTS**	
	1	Izborni predmet IV	1,5	1,5	1,5	1,5	1,0	7,0	
	2	Master rad						23,0	
		Ukupan broj kreditnih bodova						**30,0**	

Legenda: P-predavanja; V-vježbe; S- Seminarski radovi (programi, zadaće); PI-Pismeni ispit; UI-Usmeni ispit ECT(A)S-broj kredita

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

NASTAVNI PLAN STUDIJSKOG PROGRAMA SOFTVERSKO INŽENJERSTVO – II CIKLUS IZBORNI PREDMETI

Šifra predmeta	*R. br.*	*NAZIV PREDMETA*	I, II, III, IV semestar (zimski i ljetni)						
			P	**V**	**S**	**PI**	**UI**	**ECTS**	
I grupa izbornih predmeta									
	1	Poslovna inteligencija	1,5	1,5	1,5	1,5	1,0	7,0	
	2	Upravljanje rizicima u softverskom inženjerstvu	1,5	1,5	1,5	1,5	1,0	7,0	
	3	Operaciona istraživanja	1,5	1,5	1,5	1,5	1,0	7,0	
	4	Teorija grafova							
II grupa izbornih predmeta									
	1	Prepoznavanje oblika i obrada slike	1,5	1,5	1,5	1,5	1,0	7,0	
	2	Elektronika i mikrokontroleri	1,5	1,5	1,5	1,5	1,0	7,0	
	3	Računarstvo u oblaku	1,5	1,5	1,5	1,5	1,0	7,0	
	4	Računarsko modeliranje i simulacije							
		Ukupan broj kreditnih bodova							

Legenda: P-predavanja; V-vježbe; S- Seminarski radovi (programi, zadaće); PI-Pismeni ispit; UI-Usmeni ispit ECT(A)S-broj kredita

PROGRAMSKA STRUKTURA

PRVA GODINA

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **STATISTIKA**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-I	Obavezan	3	3	8	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	
Cilj predmeta	Osposobiti studente za upotrebu temeljnih metoda deskriptivne statistike
Kompetencije (Ishodi učenja)	Student koji uspješno završi predmet će imati sljedeće kompetencije: - Biti u stanju analizirati pojave, procese i njihove međuzavisnosti - Biti u stanju analitički sagledavati praktično – metodološke aspekte pojava u informatičkom okruženju

Program predmeta:
Elementi teorije vjerovatnoće. Diskretne i neprekidne slučajne promjenljive. Značajne raspodjele u statistici. Osnovi teorije uzoraka. Predstavljanje statističkih podataka. Procjena parametara. Intervali povjerenja. Statistički testovi. Regresija i korelacija.

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, seminarskog rada, domaće zadače, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Pismeni ispit	Teoretski ispit	Domaća zadaća	
10%	10%	40%	40%		

Literatura

Obavezna	1. Verovatnoća i statistika, Milan Merkle, Petar Vasić, ETF Beograd, 1998.
Dodatna	- Elementi teorije verovatnoće i matematičke statistike, Svetozar Vukadinović, Privredni pregled, 1988. - Zbirka rešenih zadataka iz matematičke statistike, Svetozar Vukadinović, Jovan Popović, Naučna knjiga, Beograd, 1988.

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **PRIMJENA NUMERIČKIH METODA U SOFTVERSKOM INŽENJERSTVU**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-I	Obavezan	2	3	8	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	Inženjerska matematika
Cilj predmeta	– Razviti razumijevanje o matematičkim principima kod numeričkih metoda. – Obezbijediti praktična znanja u primjeni numeričkih metoda u softverskom inženjerstvu. – Usavršiti primjenu numeričkih metoda u razvoju aplikativnog softvera.
Kompetencije (Ishodi učenja)	Po završetku kursa studenti će biti u stanju: – primijeniti tehnike traženja korijena nelinearnih jednačina u nekom programskom jeziku ili paketu. – riješiti linearni system jednačina numerički, koristeći neki programski jezik ili paket. – sprovesti numeričko diferenciranje i integriranje.

Program predmeta:

Osnovne ideje i koncept u numeričkoj matematici. Iteracija, konvergencija, rekurzivna formula. Tačnost, aproksimacija i numerička nestabilnost. **Rješavanje nelinearnih jednačina.** Metoda polovljenja intervala. Metoda regula falsi. Metoda proste iteracije. Newtonova metoda. **Rješavanje sistema jednačina.** Direktne metode: Gaussova metoda eliminacije, metod greška, matrična metoda. Iterativne metode: metod proste iteracije, Jacobijeva metoda, Gauss-Seidelova metoda. **Aproksimacija funkcije.** Interpolacija: Lagrangeov interpolacioni polinom. Aproksimacija: metod najmanjih kvadrata i ravnomjerna aproksimacija. **Numeričko diferenciranje.** Diferenciranje unaprijed, unazad i cetralno diferenciranje. **Numeričko integriranje.** Newton-Cotesove formule.

Izvođenje nastave:

Nastava se izvodi na predavanjima i vježbama. Svrha predavanja je da obezbijede teorijska znanja vezana za predmet uz primjenu stečenih znanja kroz odgovarajuće primjere. Na vježbama se rješavaju određeni zadaci zadati u zadaćama, te dodatni programi koji su neophodni za uspješno polaganje predmeta.

Provjera znanja:

Provjera znanja se vrši kontinuirano u toku semestra kroz izradu zadaće (seminara) i dva teoretska testa, te završnog pismenog ispita na kraju semestra. Završni ispit se sastoji od nekoliko zadataka koje treba riješiti.

Težinski kriteriji za provjeru znanja

Zadaće	Testovi	Završni ispit			
30%	20%	50%			

Literatura

Obavezna	1. Chapra, SC. Canale, RP, Numerical Methods for Engineers, McGraw-Hill Education, 7th Edition, 2014. 2. Demirdžić I, Numerička matematika, IP «Svjetlost», D. D., Univerzitetska knjiga, Sarajevo, 1997. , 3. Drmač Z i dr., Numerička analiza, Sveučilište u Zagrebu, 2003. 4. Hoffman J, Numerical Methods for engineers and Scientists, Marcel Dekker, Inc., New York, 1992.
Dodatna	1. Kiusalaas J, Numerical Methods in Engineering with MATLAB, Cambridge University Press, 2nd edition, 2010. 2. Press WH i dr. Numerical Recipes in C, Cambridge University Press, Third edition, 2007. 3. Knuth D., The Art of Computer Programming, Vols. 1-4, Addison-Wesley,1968-

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **VJEŠTAČKA INTELIGENCIJA**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-I	Obavezan	2	3	7	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	
Cilj predmeta	Upoznati studente s različitim pristupima te dati pregled metoda za rješavanja problema umjetne inteligencije, uključivo metoda za prikaz znanja, zaključivanje, rješavanje problema pretraživanjem, automatsko zaključivanje, učenje i optimizaciju.
Kompetencije (Ishodi učenja)	Student koji uspješno završi predmet će biti osposobljeni da: - definirati osnovne pojmove vještačke inteligencije - razlikovati simboličke i konektivističke pristupe vještačkoj inteligenciji - primijeniti algoritme pretraživanja prostora stanja i algoritme biološki inspirirane optimizacije na jednostavnije probleme - primijeniti logičko programiranje za rješavanje jednostavnijih logičkih problema - primijeniti postupke automatskog zaključivanja na jednostavnije logičke probleme - usporediti različite pristupe prikazivanju nejasnog znanja - ocijeniti primjenjivost pojedinih pristupa vještačke inteligencije na danom problemu - rezimirati filozofske aspekte vještačke inteligencije

Program predmeta:
Pregled područja vještačke inteligencije. Historijski razvoj. Smjerovi razvoja i najnoviji trendovi. Odnosi s drugim područjima. Pojam inteligencije i Turingov test. Rješavanje problema pretraživanjem prostora stanja. Tehnike slijepog pretraživanja. Tehnike usmjerenog pretraživanja. Algoritam A*. Problem zadovoljavanja uslova. Igranje igara. Algoritam minimaks. Znanje i zaključivanje. Logika prvog reda. Dokazivanje teorema. Unifikacija. Rezolucijsko pravilo. Logičko programiranje. Prolog. Semantičke mreže, okviri i pravila. Ontologije. Ekspertni sistemi. Obrada prirodnog jezika. Nepouzdano znanje i zaključivanje. Modeli temeljeni na teoriji vjerovatnoće. Bayesova shema. Neizrazita logika i neizrazito zaključivanje. Uvod u mašinsko učenje. Naivan Bayesov klasifikator. Stabla odluke. Pojačano učenje. Konektivistički pristup vještačkoj inteligenciji. Neuronske mreže. Algoritam perceptrona. Algoritam propagacije greške unazad. Računarska inteligencija. Genetski algoritam. Algoritam kolonije mrava. Filozofski temelji vještačke inteligencije.

Izvođenje nastave: Nastava se izvodi na predavanjima i vježbama. Svrha predavanja je da obezbijede teorijska znanja vezana za predmet uz primjenu stečenih znanja kroz odgovarajuće primjere. Na vježbama se rješavaju određeni zadaci zadati u zadaćama, te dodatni zadaci koji su neophodni za uspješno polaganje predmeta.

Provjera znanja: Provjera znanja se vrši kontinuirano u toku semestra kroz dvije zadaće i dva teoretska testa, te završnog pismenog ispita na kraju semestra. Završni ispit se sastoji od nekoliko zadataka koje treba riješiti.

Težinski kriteriji za provjeru znanja

Zadaće	Testovi	Završni ispit			
30%	20%	50%			

Literatura

Obavezna	1. Stuart Russel, Peter Norvig. Artificial Intelligence - A Modern Approach. Prentice Hall, 1995. 2. George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving. Addison-Wesley, 2005.
Dodatna	- Elaine Rich. Kevin Night. Artificial Intelligence. McGraw-Hill, 1990. - Blay Whitby. Artificial Intelligence. Oneworld Publications, 2003. - Patrick Henry Winston. Artificial Intelligence. Addison Wesley, 1992.

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **OPTIMIZACIJA BAZA PODATAKA**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-II	Obavezan	2	4	8	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	
Cilj predmeta	Cilj je da studenti ovladaju naprednim tehnikama optimizacije, a sve sa ciljem da se izbjegne dupliranje podataka. Također ovladavanje naprednim konceptima optimizacije sloja baze podataka.
Kompetencije (Ishodi učenja)	Student koji uspješno završi predmet će imati sljedeće kompetencije: - Projektovanje baze podataka. - Modeliranje relacione šeme i njena optimizacija. - Pisanje optimalnog SQL koda. - Refaktorizacija. - Optimizacija postojećeg SQL koda.

Program predmeta:
Uvod. Optimizacija baza podataka. Modeliranje optimalne šeme. Refaktorizacija. Pisanje efikasanog SQL koda. Uočavanje, mjerenje i eliminisanje problematičnog koda. Hadverska topologija baze podataka. Virtuelizacija. In Memory koncepti. VLDB – Very Large Database.

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, seminarskog rada, domaće zadaće, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Praktičan rad	Teoretski ispit	Projektni zadatak	
10%	20%	20%	20%	30%	

Literatura

Obavezna	1. Microsoft SQL Server 2012 Internals (Developer Reference) Paperback by Kalen Delaney, Bob Beauchemin, Conor Cunningham, Jonathan Kehayias, Paul S. Randal, Benjamin Nevarez, 2013 2. SQL Server 2012 Query Performance Tuning (Expert's Voice in SQL Server) By Grant Fritchey, 2012 3. Microsoft SQL Server 2014 Query Tuning & Optimization by Benjamin Nevarez, 2014
Dodatna	- Microsoft SQL Server 2012 High-Performance T-SQL Using Window Functions (Developer Reference) By Itzik Ben-Gan, 2012 - Preporučeni internet izvori

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **AUTOMATI I FORMALNI JEZICI**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-II	Obavezan	2	4	8	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	
Cilj predmeta	Osposobiti studenta za razumijevanje jezika i prevođenja. Cilj je da studenti ovladaju teoretskim znanjem s područja automata, gramatika i jezika kao osnovu jezgre računarstva.
Kompetencije (Ishodi učenja)	Student koji uspješno završi predmet će imati sljedeće kompetencije: - Razumjeti primijenu programa za razlaganje i izraditi interpreter za funkcionalni jezik. - Razumijevanje osnovne terminologije iz teorije računarstva. - Razumijevanje različitih tipova konačnih automata, njihovih formalnih specifikacija i svojstava. - Razumijevanje regularnih izraza i njihove veze sa konačnim automatima. - Sposobnost dizajniranja jednostavnih detreminističkih i nedeterminističkih konačnih automata.

Program predmeta:
Uvod -jezički procesori. Konačni automati. Deterministički konačni automati. Nedeterministički konačni automati. Formalne gramatike i jezici. Regularni izrazi. Regularni jezici i regularna gramatika. Osobine regularnih jezika. Konačni automati sa izlazom. Automati sa stekom. Deterministički i nedeterministički automati sa stekom. Kontekstno neovisni jezici i kontekstno neovisne gramatike. Tehnike parsiranja. Rekurzivno prebrojivi jezici: Turingova mašina. Univerzalna Turingova mašina. Nedeterministička Turingova mašina. Turingova teza. Rekurzivni irekurzivno prebrojivi jezici. Linearno ograničeni automat. Kontekstno ovisni jezici i kontekstno ovisne gramatike. Chomskyjeva hijerarhija jezika. Odlučivi i neodlučivi problemi.

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, seminarskog rada, domaće zadaće, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Praktičan rad	Teoretski ispit		
10%	20%	30%	40%		

Literatura

Obavezna	1. Jezični procesori 1, Srbljić, S., Element, Zagreb, 2002. 2. Introduction to Automata Theory, Languages, and Computation, J. E. Hopcroft, R. Motwani, J. D. Ullman, Addison-Wesley, 2000.
Dodatna	- Introduction to the Theory of Computation, M.Sipser, Course Technology, 2005. - Preporučeni internet izvori

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **RUDARENJE PODATAKA**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-II	Obavezan	2	3	7	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	Statistika
Cilj predmeta	Osposobiti studente da samostalno odaberu i metode i alate, te ih primijene i protumače rezultate. Također, da znaju da u raspoloživim podacima uoče zanimljive trendove, relacije i zakonitosti.
Kompetencije (Ishodi učenja)	Student koji uspješno završi predmet će imati sljedeće kompetencije: - Sagledavanje Data mining-a kao procesa koji se sastoji od faza poslovnog planiranja, manipulacije podacima, eksploratorne analize, modeliranja, evaluacije i primjene modela te tumačenja rezultata. - Nesmetano korištenje softvera i naučnog programiranja u programu R. - Razumijevanje i primjena algoritama: klasterizacija, ocjenjivanje, predviđanje, klasifikacija, logistička i višedimenziona regresija. - Razumijevanje i primjena najnovijih metoda data mining-a, kao što je text mining. - Razumijevanje pojmova matematičke statistike koji su osnova za prethodno navedeno.

Program predmeta:
Uvod. Upoznavanje sa pojmom rudarenja podataka. Faze u procesu rudarenja podataka. Tehnike i metode rudarenja podataka. Utvrđivanje raspodjele frekvencija. Analiza klastera. PCA i faktorska analiza. Link analysis. Klasifikacija. Prediktivni modeli. Supervised learning. Regresija. Logistička regresija. Tehnike za predviđanja. Stablo za odlučivanje. Metoda najbližeg susjeda. Metoda K najbližeg susjeda. Vremenska serija. Neuronske mreže. Fazi logika. Memorijski zasnovano rasuđivanje. Clastering. Analiza potrošačke korpe. Pravilo indukcije. Genetički algoritmi.

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, seminarskog rada, domaće zadaće, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Praktičan rad	Teoretski ispit		
10%	20%	30%	40%		

Literatura

Obavezna	1. Data Mining: Practical Machine Learning Tools and Techniques (Second Edition), Ian H. Witten and Eibe Frank, Morgan Kaufmann, 2005. 2. Computer-Aided Multivariate Analysis, Afifi, A.A., Clark, V., Chapman & Hall, Washington, D.C., 2000. 3. Principles of Data Mining, D. Hand, H. Mannila, and P. Smyth, MIT Press, 2001.
Dodatna	- Data mining: concepts and techniques. Morgan Kaufman, J. Han and M. Kamber, 2000. - The Elements of Statistical Learning: data mining, inference and prediction, T. Hastie, R. Tibshirani, and J. Friedman, Springer Verlag, 2001. - Preporučeni internet izvori

DRUGA GODINA

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **MULTIMEDIJALNI SISTEMI I APLIKACIJE**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-III	Obavezan	2	4	7	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	
Cilj predmeta	Stjecanje osnovnih znanja o multimedijskim signalima i podacima, tehnologijama za njihovu efiksanu reprezentaciju, obradu, prikaz i prijenos, te njihovim primjenama u multimedijskim sustavima.
Kompetencije (Ishodi učenja)	Student koji uspješno završi predmet će imati sljedeće kompetencije: - definirati medijske signale, njihovu reprezentaciju, postupke obradbe i primjene - razlikovati kodiranje izvora i entropijsko kodiranje, te različite postupke kompresije medijskih signala - primijeniti i analizirati postupke prediktivnog i predikcijskog kodiranja na medijske signale - opisati model ljudskog vizualnog sustava i objasniti osobine videosignala - objasniti razlike između analognog i digitalnog prikaza videosignala - koristiti postupke za kompresiju slike i videosignala

Program predmeta:
Multimedijske tehnologije i sistemi, njihova arhitektura i primjena. Pregled medija i izvora podataka. Osnove kodiranja i kompresije. Govorni signal, modeliranje i analiza, parametarski prikaz i kodiranje. Standardi kodiranja govora, osnovi sinteze i prepoznavanja. Audio signal. Psihoakustički model, postupci kodiranja i standardi. Osnove ljudskog vizualnog sustava, principi kompresije slike, standardi. Videosignal, nastanak i osobine. Prostorna, vremenska i subjektivna redundancija. Kompresija video signala i standardi. Pohrana, prijenos i obrada multimedijskih podataka. Sklopovske i programske izvedbe. Integracija multimedijskih sadržaja, sinhronizacija. Multimedijski sistemi i programski alati.

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, seminarskog rada, domaće zadaće, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Seminarski rad	Teoretski ispit		
10%	20%	30%	40%		

Literatura

Obavezna	1. Z. N. Li, M. S. Drew (2004.), Fundamentals of Multimedia, Prentice Hall
Dodatna	- R. Steinmetz, K. Nahrstedt (2002.), Multimedia Fundamentals, Volume I: Media Coding and Content Processing, Prentice Hall - Y. Q. Shi, H. Sun (2008.), Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms, and Standards, CRC Press. - Preporučeni internet izvori

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **PARALELNI RAČUNARSKI SISTEMI**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-III	Obavezan	2	3	8	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	
Cilj predmeta	Upoznavanje studenata s osnovama paralelnog procesiranja i principima rada paralelnih računarskih sistema.
Kompetencije (Ishodi učenja)	Student koji uspješno završi predmet će imati sljedeće kompetencije: - Znanja iz poznavanja arhitektura baziranih na paralelizmu i poznavanja dizajna i performansi paralelnih algoritama da bi mogli razumjeti razne modele paralelizma. - Znanja za pravljenje algoritama na bazi paralelnog programiranja u nekom okruženju.

Program predmeta:
Uvod. Hardver za paralelnu obradu: Paralelizam na nivou instrukcija. Paralelizam na nivou dijeljene memorije. Paralelizam kod distribuirane memorije. Princip neograničenog paralelizma. Superskalarni procesori. Tipologije komunikacijskih mreža i njihov uticaj na performanse. Softerski protokoli za paralelnu obradu: Protokl za prosljeđivanje poruka (MPI) protokol. Paralelna virtuelna mašina (PVM). SIMD procesorska polja. Procesorska polja sa distribuiranom memorijom. Procesorska polja sazajedničkom (djeljivom) memorijom. Komunikacija i sinhronizacija procesa u MIMD sistemima: semafori, monitori, slanje poruka. Primjeri algoritama za MIMD sisteme. Primjeri paralelizacije numeričkih algoritama. Brza Furijeova transformacija uz upotrebu paralelizama. Problem N tijela uz upotrebu paralelizama. Monte Carlo analiza uz upotrebu paralelizama. Efikasnost paralelnog računa: Istorija računskih sistema i razvoj njihovih performansi. Definicija ubrzanja (Amhdalov zakon).

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, seminarskog rada, domaće zadaće, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Praktičan rad	Teoretski ispit		
10%	20%	30%	40%		

Literatura

Obavezna	1. Praktikum za laboratorijske vježbe iz paralelnih računarskih sistema, E. I. Milovanović, V. Ćirić,Elektronski fakultet, Niš, 2003. 2. Advanced computer arhitecture and parallel processing, H. El-Rewini, M. El-Barr, John Wilej and Sons, Inc. 2005.
Dodatna	- Parallel Programming in openMP, R. Chandra, R. Menon, L. Dagum, D. Kohr, D. Maydan, J. McDonald, Morgan Kaufmann, 2001. - Parallel Computer Architecture: A Hardware/Software Approach, David E. Culler and Jaswinder Pal Singh - Preporučeni internet izvori

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **SOFTVERSKO INŽENJERSTVO VELIKIH BAZA PODATAKA**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-III	Obavezan	2	3	8	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	Optimizacija baza podataka
Cilj predmeta	Razumjevanje arhitektura modernih baza podataka za velike baze podataka, upoznavanje sa različitim mogućnostima njihove integracije i evaluacija komercijalnih alata.
Kompetencije (Ishodi učenja)	Student koji uspješno završi predmet će imati sljedeće kompetencije: - Kritički evaluiraju različite DBMS i njihove karakteristike. - Sagledaju različite mogućnosti integracije velikih baza podataka. - Implementiraju odabrane primjere. - Steknu praktično iskustvo sa komercijalnim alatima.

Program predmeta:
Uvod. DB Taksonomija: DBMS modeli i arhitekture. DB pristupi (relacijski, proceduralni, objektno-orjentisani, opisni (XML), deduktivni). XML, XPath, Xquery. Dosljedni objekti. DB integracija. Integracija DB: orjentisani jezici (ugrađeni SQL). Orjentisano upravljanje (ODBC, JDBC) (arhitekture, tipovi upravljanja, aplikacijskaarhitektura). Komponente baze podataka. SOA integracija. Web servisi. Agent-baze. Dokumentovanje razvojnog procesa.

Izvođenje nastave:
Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, seminarskog rada, domaće zadaće, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Seminarski rad	Teoretski ispit		
10%	20%	30%	40%		

Literatura

Obavezna	1. Professional XML (Programer to Programmer), Bill Evjen, at all, 2007. 2. Web Services: Concepts, Architectures and Applications by Gustavo Alonso, Fabio Casati, Harumi Kuno, and Vijay Machiraju, 2010. 3. Modern Database Management (10th Edition) by Jeffrey A. Hoffer, V. Ramesh, and Heikki Topi, 2010.
Dodatna	- Physical Database Design: the database professional's guide to exploiting indexes, views, storage, and more (The Morgan Kaufmann Series in Data Management Systems) by Sam Lightstone, Toby J. Teorey, and Tom Nadeau, 2007. - Preporučeni internet izvori

IZBORNI PREDMETI

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **POSLOVNA INTELIGENCIJA**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-A1	Izborni predmet	3	3	7	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	
Cilj predmeta	Cilj predmeta je da se studenti upoznaju sa sistemima za podršku poslovnom odlučivanju. Predmet proučavanja su skladišta podataka, metode oblikovanja (dimenzijski model), integracija podataka (ETL) i OLAP sistemi. Gradivo prate domaće zadaće u kojima studenti testiraju iznesene koncepte.
Kompetencije (Ishodi učenja)	Student koji uspješno završi predmet će biti u stanju: - definirati osnove koncepte poslovne inteligencije i skladišta podataka - primijeniti principe oblikovanja skladišta podataka - koristiti osnovne ETL postupke - upotrijebiti osnove OLAP tehnologije - koristiti osnovne BI alate - proizvesti prototip BI alata

Program predmeta:
Uvod u poslovnu inteligenciju i skladišta podataka. Definicije osnovnih pojmova. Uvod u dimenzijsko modeliranje. Pristupi izgradnji skladišta podataka. Dimenzijsko modeliranje (konformirane dimenzije, različite uloge). Dimenzijsko modeliranje: surogatni ključevi, indeksi, NULL vrijednosti. Izgradnja GUI klijenta za zvjezdasti spoj. Dimenzijsko modeliranje: tipovi dimenzija, heterogene dimenzije i činjenice, hijerarhije, tipovi činjeničnih tablica, agregati, unakrsno pregledavanje. Dimenzijsko modeliranje: N:N veze, rano/kasno dolazeći zapisi, složeni događaji). Stvarnovremenska skladišta podataka, OLAP. ETL. Sigurnost, metapodaci, dozvole, kvaliteta podataka.

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, domaće zadaće, te finalnog pismenog ispita.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Periodične provjere znanja	Domaće zadaće	Završni ispit	
10%	10%	20%	20%	40%	

Literatura

Obavezna	1. Ralph Kimball, Margy Ross (2002.), The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling, Wiley
Dodatna	- Joe Caserta, Ralph Kimball (2004.), The Data Warehouse Etl Toolkit, Wiley - Christopher Adamson (2010.), Star Schema The Complete Reference, McGraw Hill. - Preporučeni internet izvori

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **UPRAVLJANJE RIZICIMA U SOFTVERSKOM INŽENJERSTVU**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-A2	Izborni predmet	3	3	7	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	
Cilj predmeta	Osposobljavanje studenata za vlastito logičko odlučivanje u procesu procjene mogućeg rizika i njegovim upravljanjem, s posebnim naglaskom na postojanje rizika u razvoju i upotrebi softverskih proizvoda. Važnost ovladavanja spoznajom o mogućem riziku, vjerovatnoći njegovog nastanka i ekonomski štetnim posljedicama.
Kompetencije (Ishodi učenja)	Student koji uspješno završi predmet će biti u stanju: - steći jasnu predstavu o mogućim rizicima neodređenog ishoda po svom značenju s mogućnošću identifikacije barem dvaju mogućih ishoda - napraviti izbor u procesu upravljanja rizicima da bi se spriječilo njegovo nastupanje ili umanjile ekonomski štetne posljedice - ovladavati rizikom, tako da se na njega može utjecati i njime upravljati - provesti interdisciplinarnu procjenu rizika

Program predmeta:
Osnovni koncepti upravljanja rizikom; Priroda i tretman rizika; Funkcija i razvoj upravljanja rizikom; Savremeni pristup upravljanju rizikom; Priroda aktivnosti; Organizacioni status i faze procesa upravljanja rizikom; Prilagođavanje uslovima neizvjesnosti u okruženju; Konceptualni okvir za analizu neizvjesnosti; Organizaciono prilagođavanje uslovima neizvjesnosti; Stilovi upravljanja; Predviđanje i planiranje; Imitacije; Procjena rizika: identifikacija, analiza hazarda, mjerenje rizika; Izloženost riziku: imovine, obaveza; Subjekti izloženi riziku; Metode i tehnike upravljanja rizikom; Program upravljanja rizikom: politike i procedure; Informaciona osnova; Revizija i nadgledanje programa i procedura.

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, seminarskog rada, domaće zadaće, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Periodične provjere znanja	Seminarski rad	Završni ispit	
10%	10%	20%	20%	40%	

Literatura

Obavezna	1. Frenkel, M.; Hommel, U.; Rudolf, M. (2012). Risk Management. 2nd ed. New York: Springer.
Dodatna	- Vaughan, E. (2000). Upravljanje rizicima. University of Iowa; - BAS EN 31010:2012 Upravljanje rizikom – Tehnike za ocjenu rizika - Preporučeni internet izvori

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **OPERACIONA ISTRAŽIVANJA**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-A3	Izborni predmet	3	3	7	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje

Cilj predmeta	Osnovni cilj ovog predmeta je da studenti savladaju neke od osnovnih i za praksu najvažnijih metoda optimizacije, kao i da se osposobe da ih samostalno primjenjuju u kvantitativnoj primjeni postojećih, i po potrebi razvoj novih, matematičkih metoda i modela za rješavanje praktičnih problema.
Kompetencije (Ishodi učenja)	Student koji uspješno završi predmet će imati sljedeće kompetencije: - Odabere tehniku koja najbolje odgovara prirodi datog sistema. - Praktičnih znanja i vještine u kreativnoj upotrebi savremenih alata za razvoj složenih sistema odlučivanja i rješavanje složenih poslovnih problema. - Primjeni optimizacionih programa u praksi. - Rješavanje praktičnih problema operacionih istraživanja na računaru uz pomoć programa WinQSB, LINGO, LINDO i Solver dodatka.

Program predmeta:
Uvod. Predmet i cilj operacionih istraživanja. Novi pravci razvoja i primjene. Uvod u optimizaciju, modele i metode operacionih istraživanja. Metode operacionih istraživanja: - Linearno programiranje, grafička i simplex metoda. Teorija dualnosti. Transportni problem linearnog programiranja, metoda sjeverozapadnog ugla (kornera), metoda skakanja s kamena na kamen, MODI metoda. Mađarska metoda raspoređivanja, Mrežno planiranje, CPM, PERT i PERT-COST metoda. Dinamičko programiranje. Primjena računara: primjena optimizacionih programa u praksi, izbor i glavne karakteristike programa. Rješavanje praktičnih problema operacionih istraživanja na računaru uz pomoć programa WinQSB, LINGO, LINDO Solver dodatka.

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, seminarskog rada, domaće zadaće, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Praktičan rad	Teoretski ispit	Projektni zadatak	Domaća zadaća
10%	20%	30%	40%		

Literatura

Obavezna	1. Operaciona istraživanja i kvantitativne metode investicija, Urošević, B, Božović, M, Ekonomski fakultet, Beograd, 2009. 2. Operaciona istraživanja, S. Krčevinac, M. Čangalović, V. Kovačević-Vujčić, M. Matrić, M. Vujošević, FON, Beograd 2004. 3. Matematički modeli i metode programiranja u gospodarskom društvu, dr. sc. Stiepo Andrijić, Synopsis, Zagreb – Sarajevo, 2002. 4. Operaciona istraživanja 2, zbirka zadataka, Martić M i dr, FON, Beograd, 2007
Dodatna	- Operacijska istraţivanja-drugo neizmijenjeno izdanje, Z. Lukač, L. Neralić, Uđbenici Sveučilišta u Zagrebu, 2013. - Zbirka zadataka iz operacionih istraživanja, J. Petrić, Z. Kojić, L. Šarenac, knjiga I i II, Naučna knjiga, Beograd, 1989. - Preporučeni internet izvori

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **TEORIJA GRAFOVA**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-A4	Izborni predmet	3	3	7	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	
Cilj predmeta	Ciljevi modula su upoznavanje sa osnovnim elementima teorije grafova i njenim primjenama. Jedan od najvažnijih ciljeva je pokazati na koji način modelirati problema pomoću grafova i kako ih onda rješavati ili barem definisati odgovarajući problem.
Kompetencije (Ishodi učenja)	Po završetku predmeta, studenti će imati kompetencije: - Da modeliraju realne probleme matematskim aparatom teorije grafova. - Da primjenjuju klasične grafovske algoritme za one tipove problema za koje su poznata efikasna rješenja.

Program predmeta:
Uvod. Osnovni pojmovi i definicije, graf kao model. Izomorfismi, specijalni grafovi i dekompozicije grafova. Povezanost, bipartitni grafovi, Eulerovi grafovi, grafovi intervala, Stepeni čvorova i prebrojavanje grafova. Orjentisani grafovi i odgovarajući modeli. Osnovne osobine stabla, udaljenost u stablima, prebrojavanje stabala. Matching i pokrivači, matching na bipartitnim grafovima. Matching na grafovima (Tutte teorem). Povezanost (2 i 3 povezanost). Mengerovi teoremi i povezanost. Bojenje grafova, Kromatski polinomi. Perfektni grafovi, Trouglasti grafovi. Planarnost, Planarnost i teorem Kuratowskog. Hamiltonov ciklus. Osnovni algoritmi pretraživanja na grafovima.

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, seminarskog rada, domaće zadaće, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Seminarski rad	Teoretski ispit		
10%	20%	30%	40%		

Literatura

Obavezna	1. Graphs and Digraphs; G. Chartrand and L. Lesniak; Chapman & Hall / CRC; 2005. 2. Modern Graph Theory, Bela Bollobas, Springer-Verlag, 1998 3. Introduction to Graph Theory, D. West, Prentice Hall, Pearson; 2 ed 2000. 4. Jay Yellen Graph theory and its applications, Jonathan Gross, Chapman and Hall; 2 ed., 2005.
Dodatna	- A Beginners Guide to Graph Theory; W. D. Wallis; Birkhäuser; 2000. - Introductory graph theory Dover Publications, Gary Chartrand, 1984 - Preporučeni internet izvori

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **PREPOZNAVANJE OBLIKA I OBRADA SLIKE**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-B1	Izborni predmet	3	3	7	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	
Cilj predmeta	Cilj predmeta je dati pregled osnovnih tehnika obrade i analize slike, od reprezentacije podataka do osnovnih metoda detekcije oblika.
Kompetencije (Ishodi učenja)	Po završetku predmeta, studenti će biti u stanju da: - koriste metode prethodne obrade slike - koriste metode segmentacije slike - odaberu način opisivanja oblika prikladan za problem - koriste klasifikacijske metode primjerene problemu.

Program predmeta:
Uvod. Akvizicija i osobine digitalnih slika. Prethodna obrada: geometrijske transformacije, linearno filtriranje, restauracija slike. Uvod u matematičku morfologiju. Primjeri i primjene. Segmentacija i ekstrakcija objekata. Thresholding, otkrivanje ivica, otkrivanje područja. Segmentiranje aktivnim konturama. Primjena u segmentaciji slike. Prikaz i opis oblika. Prikaz na temelju kontura, reprezentacija na temelju regiona. Morfološki kosturi. Prepoznavanje oblika. Statističko prepoznavanje oblika, Bayesova klasifikacija, linearni i nelinearni klasifikatori, perceptroni, neuronske mreže i klasifikatori bez nadzora. Primjene.

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, seminarskog rada, domaće zadaće, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Seminarski rad	Teoretski ispit		
10%	20%	30%	40%		

Literatura

Obavezna	1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing using MATLAB. 2. William K. Pratt, Digital Image Processing.
Dodatna	- Bernd Jähne: Digital Image Processing: Concepts, Algorithms, and Scientific Applications - Richard Szeliski: Computer Vision - Algorithms and Applications - Preporučeni internet izvori

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: ELEKTRONIKA I MIKROKONTROLERI

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-B2	Izborni	3	3	7	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	
Cilj predmeta	Upoznavanje sa arhitekturom i primjenom mikrokontrolera. Upoznavanje sa postupkom izrade mikrokontrolerskog programa i postupkom programiranja mikrokontrolera.
Kompetencije (Ishodi učenja)	Student koji uspješno završi predmet će imati sljedeće kompetencije: - Poznavanje arhitekture i primjene mikrokontrolera. - Sposobnost izbora i poznavanje uloge komponenti i senzora. - Sposobnost programiranja mikrokontrolera. - Praktična primjena mikrokontrolera u realnim situacijama.

Program predmeta:
Uvod; Arhitektura mikrokontrolera; Nadzornik; Konfiguracije; Portovi, DDR, PIN; Alternativne funkcije; Serijski interfejsi: UART, SPI, TWI; Analogni ulazi; Prekidi: način rada, softverska podrška; Tajmeri - brojači; Analogni izlazi - PWM; Analogni komparator; Kapacitivniblizinskisenzor; LCD modul; LED displeji sa multipleksom; Načini spuštanja programa. (ISP; Bootloader).

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao laboratorijske, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, seminarskog rada, domaće zadaće, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Seminarski rad	Periodične provjere znanja	Domaće zadaće	Završni ispit
10%	10%	20%	20%	10%	30%

Literatura

Obavezna	1. Gunther Gridling, Bettina Weiss (2007):Introduction to Microcontrollers, Vienna University of Technology, https://ti.tuwien.ac.at/ecs/teaching/courses/mclu/theory-material/Microcontroller.pdf
Dodatna	- Vojo Milanović (2007): Programiranje mikrokontrolera Pic Basic-om - Miroslav Kostadinović(2013): Praktikum za auditorne vježbe iz projektovanja digitalnih sistema sa mikrokontrolerom. ISBN 978-99955-36-37-4 - Preporučeni internet izvori

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **RAČUNARSTVO U OBLAKU**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-B3	Izborni predmet	3	3	7	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje	
Cilj predmeta	Osposobiti studente za samostalnu primjenu računarstva u oblaku u poslovnim okruženjima
Kompetencije (Ishodi učenja)	Po završetku predmeta, studenti će imati kompetencije: - Implementacija čiji je osnov računarstvo u oblaku. - Optimizaciju čiji je osnov računarstvo u oblaku., - Sigurnost i programiranje sistema čiji je osnov računarstvo u oblaku.

Program predmeta:
Uvod. Osnove računarstva u oblaku. Arhitektura računarstva u oblaku i standardi. Public, private i nacionalni koncepti računarstva u oblaku. Softver kao usluga. Platforma kao usluga. Infrastruktura kao usluga. Prednosti i nedostaci – aspekti djeljenja resursa i sigurnosti. Implementacija. Migracija. Nedostaci. Rasporediti aplikacije preko komercijalnih cloud computing infrastrukture, kao što suAmazon Web Services, Windows Azure, i Google AppEngine.

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na dvije periodične praktične provjere znanja tokom semestra, seminarskog rada, domaće zadaće, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Praktičan rad	Teoretski ispit	Projektni zadatak	Domaća zadaća
10%	20%	30%	40%		

Literatura

Obavezna	1. Cloud Computing: Concepts, Technology & Architecture (The Prentice Hall Service Technology Series from Thomas Erl), 2013. 2. Cloud Computing for Programmers: Software Development in the Age of Cloud,by D. Casal, 2014.
Dodatna	- Preporučeni internet izvori

UNIVERZITET U ZENICI
POLITEHNIČKI FAKULTET

Naziv predmeta: **RAČUNARSKO MODELIRANJE I SIMULACIJE**

Semestar	Status	Broj časova sedmično		ECTS bodovi	Šifra
		Predavanja	Vježbe		
MASTER-B4	Izborni predmet	3	3	7	

Nastavnik: **E-mail**:	**Saradnik**: **E-mail**:

Predmeti koji su preduvjet za polaganje

Cilj predmeta	Simulacija je pokušaj imitacije stvarnosti. Koristi se u mnogim kontekstima, uključujući modeliranje prirodnih ili vještačkih sistema kako bi se dobio uvid u njihovo funkcioniranje. Računarski model je matematički prikaz funkcioniranja procesa, koncepta ili sistema, predstavljenog u obliku računarskog programa. Cilj ovog predmeta je upoznavanje studenata s nizom aspekata i pitanja povezanih s računarskim modeliranjem i simulacijom fenomena iz stvarnog svijeta.
Kompetencije (Ishodi učenja)	Po završetku predmeta, studenti će biti u stanju: - odabrati odgovarajući matematički metod za simulaciju stvarnog procesa ili sistema - koristiti odabrani softverski paket za modeliranje i simulacije - identificirati i kvantificirati moguće utjecajne faktore na rezultat simulacije - ocijeniti pouzdanost izabranog modela - izvršiti validaciju i verifikaciju simulacija

Program predmeta:
Uvod. Statistika i vjerojatnoća za simulacije. Modeliranje i simulacije. Razvoj simulacija sistema. Podjela stohastičkih procesa. Simulacijski izlazni podaci i stohastički procesi. Tehnike za simulaciju stabilnog stanja. Određivanje perioda zagrijavanja. Određivanje poželjnog broja simulacija. Odabir simulacijskog softvera. Animacija u simulacijama sistema. Dinamika sistema i simulacija diskretnih događaja. Socijalna simulacija. Simulacija na webu. Paralelna i distribuirana simulacija. Primjene osjetljivih podataka. Aproksimacije konačnih razlika. Simultane metode perturbacije. Perturbacijska analiza. Metode bodovanja. Harmonijska analiza. Metamodeliranje i problemi s ciljem postizanja ciljeva. Tehnike analize "Šta-ako". Monte Carlo simulacije. Tehnike smanjenja varijance. Eksperimentalni dizajn i optimizacija. Simulacija temeljena na agentu i dinamika sistema.

Izvođenje nastave: Predavanja se izvode uz upotrebu multimedijalnih sredstava, tehnika aktivnog učenja i uz aktivno učešće studenata u kabinetu. Vježbe se izvode kao auditorne, uz izradu zadataka koji predstavljaju praktičnu primjenu.

Provjera znanja: Provjera znanja se zasniva na izradi seminarskog rada, te finalnog pismenog ispita. Studenti samostalno rade seminarski rad na izabranu temu, u vidu praktičnog rješavanja problema, elaborata i javne prezentacije s diskusijom pred drugim studentima.

Težinski kriteriji za provjeru znanja

Predavanja	Vježbe	Seminarski rad	Teoretski ispit		
10%	10%	40%	40%		

Literatura

Obavezna	1. Hossein Arsham: Systems Simulation: The Shortest Route to Applications, University of Baltimore, http://home.ubalt.edu/ntsbarsh/simulation/sim.htm 2. Averill Law (2014) Simulation Modeling and Analysis, McGraw-Hill
Dodatna	- Dale K. Pace: Modeling and Simulation Verification and Validation Challenges, Johns Hopkins apl technical digest, volume 25, number 2 (2004) http://www.jhuapl.edu/techdigest/TD/td2502/Pace.pdf - National Science Foundation Blue Ribbon Panel on Simulation-Based Engineering Science. Simulation-Based Engineering Science. Technical report, National Science Foundation, USA, http://www.nsf.gov/pubs/reports/sbes_final_report.pdf, 2006 - Coleman H.W., Stern H.: "V&V State of the Art", Proceedings of Foundations '02 a Workshop on Model and Simulation Verification and Validation for the 21st Century JHU/APL Kossiakoff Education and Conference Center (Laurel, Maryland USA) 2002

UNIVERSITY OF ZENICA

CURRICULUM OF THE
II (second) STUDY CYCLE
SOFTWARE ENGINEERING

POLYTECHNIC FACULTY
OF THE UNIVERSITY OF ZENICA

Zenica, October 2017.

UNIVERSITY OF ZENICA

POLYTECHNIC FACULTY
DEPARTMENT SOFTWARE ENGINEERING

II (second) STUDY CYCLE		
Year of Study	**Courses compulsory/elective**	
Year I **(I + II) semester**	**Compulsory** **3 + 3** **Elective** **1+1 (taken from the group of 8 elective courses)**	
Year II **(III+IV) semester**	**Compulsory** **3 + 0** **Elective** **1+1 (taken from the group of 8 elective courses)**	
Total	**Compulsory: 9**	**Elective: 4 + Master Paper**

CURRICULUM

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

CURRICULUM OF THE STUDY PROGRAM SOFTWARE ENGINEERING – II CYCLE

Course code	No.	Course Title	Semester I (winter)						Teacher
			L	E	No. st.	LE	No. st.	ECTS	
	1.	Statistics	3	3				8,0	
	2.	Applied numerical methods in software engineering	2	3				8,0	
	3.	Artificial intelligence	2	3				7,0	
	4.	Elective course I	3	3				7,0	
		Number of hours per week L/E/LE	**10**	**12**					
		Total weekly number of hours	**22**						
		Total number of ECTS credits						**30,00**	

Course code	No.	Course Title	Semester II (summer)						Teacher
			L	E	No. st.	LE	No. st.	ECTS	
	1.	Database optimization	2	4				8,0	
	2.	Automata and formal languages	2	4				8,0	
	3.	Data mining	2	3				7,0	
	4.	Elective course II	3	3				7,0	
		Number of hours per week L/E/LE	**9**	**14**					
		Total weekly number of hours	**23**						
		Total number of ECTS credits						**30,00**	

Legend: L-lectures; E-exercises; LE- laboratory exercises; No. st. – number of students in groups according to optimum student group size for exercises and seminar work (Article 12. of the Decision on standards and norms for higher education in Zenica-Doboj Canton)

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

CURRICULUM OF THE STUDY PROGRAM SOFTWARE ENGINEERING – II CYCLE

Course code	No.	Course Title	Semester III (winter)						Teacher
			L	E	No. st.	LE	No. st.	ECTS	
	1.	Multimedia systems and applications	2	4				7,0	
	2.	Parallel computer systems	2	3				8,0	
	3.	Software engineering of large databases	2	3				8,0	
	4.	Elective course III	3	3				7,0	
		Number of hours per week L/E/LE	**9**	**13**					
		Total weekly number of hours	**22**						
		Total number of ECTS credits						**30,00**	

Course code	No.	Course Title	Semester IV (summer)						Teacher
			L	E	No. st.	LE	No. st.	ECTS	
	1.	Elective course IV	3	3				7,0	
	2.	Master paper						23,0	
		Number of hours per week L/E/LE	**3**	**3**					
		Total weekly number of hours	**6**						
		Total number of ECTS credits						**30,00**	

Legend: L-lectures; E-exercises; LE- laboratory exercises; No. st. – number of students in groups according to optimum student group size for exercises and seminar work (Article 12. of the Decision on standards and norms for higher education in Zenica-Doboj Canton)

	UNIVERSITY OF ZENICA POLYTECHNIC FACULTY	

CURRICULUM OF THE STUDY PROGRAM SOFTWARE ENGINEERING – II CYCLE ELECTIVE COURSES

Course code	No.	Course Title	Semesters I, II, III and IV (winter and summer)						Teacher
			L	E	No. st.	LE	No. st.	ECTS	
Group I of elective courses									
	1.	Business inteligence	3	3				7,0	
	2.	Risk management in software engineering	3	3				7,0	
	3.	Operational research	3	3				7,0	
	4.	Graph theory	3	3				7,0	
Group II of elective courses									
	1.	Shape recognition and image processing	3	3				7,0	
	2.	Electronics and microcontrolers	3	3				7,0	
	3.	Cloud computing	3	3				7,0	
	4.	Computer modeling and simulations	3	3				7,0	

Students choose elective courses I to IV from one of the groups of elective courses

	UNIVERSITY OF ZENICA **POLYTECHNIC FACULTY**	

CURRICULUM DEGREE PROGRAMME SOFTWARE ENGINEERING – II CYCLE

Course code	***No***	***COURSE TITLE***	**Semester I (winter)**						
			L	**E**	**S**	**WE**	**OE**	**ECT(A)S**	
	1	Statistics	2,0	2,0	1,0	2,0	1,0	8,0	
	2	Applied numerical methods in software engineering	1,5	2,0	1,5	2,0	1,0	8,0	
	3	Artificial inteligence	1,0	1,5	1,5	2,0	1,0	7,0	
	4	Elective course I	1,5	1,5	1,5	1,5	1,0	7,0	
		The total number of credit points						**30,0**	
Course code	***No***	***COURSE TITLE***	**Semester II (summer)**						
			L	**E**	**S**	**WE**	**OE**	**ECT(A)S**	
	1	Database optimization	1,0	2,0	2,0	2,0	1,0	8,0	
	2	Automati and formal languages	1,0	2,0	2,0	2,0	1,0	8,0	
	3	Data mining	1,0	1,5	1,5	2,0	1,0	7,0	
	4	Elective course II	1,5	1,5	1,5	1,5	1,0	7,0	
		The total number of credit points						**30,0**	

Legend: L-lectures; E-exercise; S-Seminar work; WE-Written exam; OE – Oral exam; ECT(A)S-number of credits

		UNIVERSITY OF ZENICA **POLYTECHNIC FACULTY**							
CURRICULUM DEGREE PROGRAMME SOFTWARE ENGINEERING – II CYCLE									
Course code	***No***	***COURSE TITLE***	**Semester III (winter)**						
			L	**E**	**S**	**WE**	**OE**	**ECT(A)S**	
	1	Multimedia systems and applications	1,0	2,0	1,5	1,5	1,0	7,0	
	2	Parallel computer systems	1,5	2,0	1,5	2,0	1,0	8,0	
	3	Software engineering of large databases	1,5	2,0	1,5	2,0	1,0	8,0	
	4	Elective course III	1,5	1,5	1,5	1,5	1,0	7,0	
		The total number of credit points						**30,0**	
Course code	***No***	***COURSE TITLE***	**Semester IV (summer)**						
			L	**E**	**S**	**WE**	**OE**	**ECT(A)S**	
	1	Elective course IV	1,5	1,5	1,5	1,5	1,0	7,0	
	2	Master paper						23,0	
		The total number of credit points						**30,0**	

Legend: L-lectures; E-exercise; S-Seminar work; WE-Written exam; OE – Oral exam; ECT(A)S-number of credits

		UNIVERSITY OF ZENICA **POLYTECHNIC FACULTY**							
CURRICULUM DEGREE PROGRAMME SOFTWARE ENGINEERING – II CYCLE ELECTIVE COURSES									
Course code	***No***	***COURSE TITLE***	**Semester I, II, III, IV (winter and summer)**						
			L	**E**	**S**	**WE**	**OE**	**ECT(A)S**	
Group I of elective courses									
	1	Business inteligence	1,5	1,5	1,5	1,5	1,0	7,0	
	2	Risk management in software engineering	1,5	1,5	1,5	1,5	1,0	7,0	
	3	Operational research	1,5	1,5	1,5	1,5	1,0	7,0	
	4	Graph theory							
Group I of elective courses									
	1	Shape recognition and image processing	1,5	1,5	1,5	1,5	1,0	7,0	
	2	Electronics and microcontrolers	1,5	1,5	1,5	1,5	1,0	7,0	
	3	Cloud computing	1,5	1,5	1,5	1,5	1,0	7,0	
	4	Computer modeling and simulation							
		The total number of credit points							

Legend: L-lectures; E-exercise; S-Seminar work; WE-Written exam; OE – Oral exam; ECT(A)S-number of credits

PROGRAM STRUCTURE

YEAR ONE

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **STATISTICS**

Semester	Status	Hours per week		ECTS	Code
		Lectures	Exercises		
MASTER-I	Compulsory	3	3	8	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learning objectives	To enable students to use basic methods of descriptive statistics
Learning outcomes	At the end of the course, the students will have the following competencies: - Be able to analyze the appeearances, processes, and their interdependence - Be able to look at practical, analitical and methodological aspects of IT appearances

Course topics:
Elements of Probability Theory**.** Discrete and Continous Random Variables. Some Important Distributions in Statistics. Basic Theory of the Samples. Presentation of Statistical Data. Estimation of Parameters. Confidence Intervals. Statistical Tests. Regression and Correlation.

Instructional methods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on two periodic written assessment during the semester, the seminar work, and final written exam. Students independently prepare seminar paper on a chosen topic in the form of written reports and public presentations with a discussion.

Assessment Criteria

Lectures	Exercises	Periodic tests	Final exam	Homework	
10%	10%	20%	40%	20%	

Reading

Essential	1. Verovatnoća i statistika, Milan Merkle, Petar Vasić, ETF Beograd, 1998.
Supplementary	- Elementi teorije verovatnoće i matematičke statistike, Svetozar Vukadinović, Privredni pregled, 1988. - Zbirka rešenih zadataka iz matematičke statistike, Svetozar Vukadinović, Jovan Popović, Naučna knjiga, Beograd, 1988.

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **APPLIED NUMERICAL METHODS IN SOFTWARE ENGINEERING**

Semester	Status	Hours per week		ECTS	Code
		Lectures	Exercises		
MASTER-I	Compulsory	2	3	8	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	Engineering mathematics
Learning objectives	– Develop an understanding of the mathematical principles of numerical methods. – Give a student practical knowledge in application of numerical methods in software engineering. – Master in application of numerical methods in development of applicative software.
Learning outcomes	After completion of this course students will be able to: – Apply root finding techniques for nonlinear equations using a programming language or package. – Solve numerically linear systems of equations for engineering problems using a programming language or package. – Conduct numerical differentiation and integration using a programming language or package.

Indicative syllabus content:

The basic ideas and concepts in numerical mathematics. Iteration, convergence, recursion. Acuracy, approximation and numerical instability. **Finding roots of non-linear equations**. Bisection method. Regula falsi. Fixed-point iteration. Newton-Raphson method. **Solving systems of linear equations.** Direct methods: Gaussian elimination, iterative improvement method, matrix inverse method. Iterative methods: simple iteration, Jacobi method, Gauss-Seidel method. **Approximating functions.** Interpolation: Lagrange interpolation polynomials. Approximation: least-square method, uniform approximation. **Numerical differentiation.** Forward, backward, central differencing. **Numerical integration.** Newton-Cotes formulas.

Learning delivery:

The teaching is delivered by means of lectures and tutorials. The purpose of lectures is to give the theoretical background related to the course with applications of the knowledge through examples. Tutorials consist of solving specific tasks given in homework assignments and some additional programs necessary for successful completion of the course.

Assessment rationale:

Assessments are carried out continuously during semester through a homework assignment (seminary work) and two theory tests, and the final exam in written form at the end of semester. The final exam consists of several problems to be solved.

Assessment Criteria

Homeworks	Periodic tests	Final exam			
30%	20%	50%			

Reading

Essential	1. Chapra, SC. Canale, RP, Numerical Methods for Engineers, McGraw-Hill Education, 7th Edition, 2014. 2. Demirdžić I, Numerička matematika, IP «Svjetlost», D. D., Univerzitetska knjiga, Sarajevo, 1997. , 3. Drmač Z et.al., Numerička analiza, Sveučilište u Zagrebu, 2003. 4. Hoffman J, Numerical Methods for engineers and Scientists, Marcel Dekker, Inc., New York, 1992.
Supplementary	1. Kiusalaas J, Numerical Methods in Engineering with MATLAB, Cambridge University Press, 2nd edition, 2010. 2. Press WH et.al., Numerical Recipes in C, Cambridge University Press, Third edition, 2007. 3. Knuth D., The Art of Computer Programming, Vols. 1-4, Addison-Wesley,1968-

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **ARTIFICIAL INTELLIGENCE**

Semester	Status	Hours per week		ECTS	Code
		Lectures	Exercises		
MASTER-I	Compulsory	2	3	7	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learning objectives	Introduce students with different approaches and provide an overview of methods for solving the problem of artificial intelligence, including methods for displaying knowledge, inferring, troubleshooting, automatic conclusion, learning, and optimization.
Learning outcomes	A student who successfully completes the course will be able to: - define basic concepts of artificial intelligence - distinguish between symbolic and connectivist approaches to artificial intelligence - apply space search algorithms and biologically inspired optimization algorithms to simpler problems - apply logical programming to solve simpler logical problems - apply automatic locking procedures to simpler logical problems - compare different approaches to the presentation of vague knowledge - evaluate the applicability of individual intelligence approaches to a given problem - summarize the philosophical aspects of artificial intelligence.

Course topics:
Examining the field of artificial intelligence. Historical development. Development Directions and Latest Trends. Relationships with other areas. The concept of intelligence and the Turing test. Troubleshooter by searching for space. Blind search techniques. Directional search techniques. Algorithm A*. Problem of satisfying the conditions. Playing games. Algorithm minimax. Knowledge and Conclusion. First order logic. Proof of theorem. Unification. Resolution rule. Logical programming. Prolog. Semantic Networks, Frames, and Rules. Ontology. Expert Systems. Natural language processing. Unreliable knowledge and conclusion. Models based on probability theory. Bayesian scheme. Fuzzy logic and fuzzy conclusion. Introduction to machine learning. Naive Bayesian classifier. The decision tree. Enhanced learning. Connective approach to artificial intelligence. Neural networks. Perceptron algorithm. Backward error propagation algorithm. Computer intelligence. Genetic algorithm. Ant colony algorithm. The philosophical foundations of artificial intelligence.

Instructional methods: Classes are taught in lectures and exercises. The purpose of the lectures is to provide theoretical knowledge related to the subject using the acquired knowledge through appropriate examples. Exercises address specific assignments in tasks, and additional tasks that are necessary for successful subject placement.

Assessment Rationale: Assessment is preformed continuously during the semester through two assignments and two theoretical tests, and the final written exam at the end of the semester. The final exam consists of several tasks that need to be solved.

Assessment Criteria

Homeworks	Periodic tests	Final exam			
30%	20%	50%			

Reading

Essential	1. Stuart Russel, Peter Norvig. Artificial Intelligence - A Modern Approach. Prentice Hall, 1995. 2. George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving. Addison-Wesley, 2005.
Supplementary	- Elaine Rich. Kevin Night. Artificial Intelligence. McGraw-Hill, 1990. - Blay Whitby. Artificial Intelligence. Oneworld Publications, 2003. - Patrick Henry Winston. Artificial Intelligence. Addison Wesley, 1992.

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **DATABASE OPTIMIZATION**

Semester	**Status**	**Hours per week**		**ECTS**	**Code**
		Lectures	**Exercises**		
MASTER-II	Compulsory	2	4	8	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learning objectives	The goal is that students master advanced optimization techniques in the aim to avoid duplication of data. Also mastering the advanced concepts of optimization of the database tier.
Learning outcomes	A student who successfully completes the course will have the following competencies: - Design database. - Modeling relational scheme and its optimization. - Writing optimal SQL code. - Refactoring. - Optimization of the existing SQL code.

Course topics:
Introduction. Optimizing the database. Modeling optimal scheme. Refactoring. Writing an efficient SQL code. Identification, measurement and elimination of the problematic code. Hardware topology database. Virtualization. In Memory concepts. VLDB - Very Large Database.

Instructional methods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on two periodic written assessment during the semester, the seminar work, and final written exam. Students independently prepare seminar paper on a chosen topic in the form of written reports and public presentations with a discussion.

Assessment Criteria

Lectures	Exercises	Practice	Theoretical exam	Project	
10%	20%	20%	20%	30%	

Reading

Essential	1. Microsoft SQL Server 2012 Internals (Developer Reference) Paperback by Kalen Delaney, Bob Beauchemin, Conor Cunningham, Jonathan Kehayias, Paul S. Randal, Benjamin Nevarez, 2013 2. SQL Server 2012 Query Performance Tuning (Expert's Voice in SQL Server) By Grant Fritchey, 2012 3. Microsoft SQL Server 2014 Query Tuning & Optimization by Benjamin Nevarez, 2014
Supplementary	- Microsoft SQL Server 2012 High-Performance T-SQL Using Window Functions (Developer Reference) By Itzik Ben-Gan, 2012 - Other online and offline resources

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **AUTOMATA AND FORMAL LANGUAGES**

Semester	Status	Hours per week		ECTS	Code
		Lectures	Exercises		
MASTER-II	Compulsory	2	4	8	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learning objectives	Enable students to understand the language and translation. The goal is for students to master the theoretical knowledge in the field of automata, grammar and language as the basis of the core computing.
Learning outcomes	A student who successfully completes the course will have the following competencies: - Understand the Apply of programs to interpret and develop an interpreter for a functional language. - Understanding of the basic terminology from theory of computing. - Understanding of different types of finite automata, their formal specification and properties. - Understanding of regular expressions and their relations with the final automata. - Ability to design simple deterministic and nondeterministic finite automata.

Course topics:
Introduction - language processors. Algorithms. Deterministic final automata. Non-deterministic final automata. Formal grammars and languages. Regular expressions. Regular languages and regular grammar. Properties of regular languages. Final automata with output. Automata with a stack. Deterministic and non-deterministic automata with a stack. Context-free languages and context-free grammars. Parsing techniques. Recursive enumerable languages: Turing machine. Universal Turing machine. Nondeterministic Turing machine. Turing thesis. Recursive and recursively enumerable languages. Linear bounded automaton. Context-sensitive languages and context-sensitive grammars. Chomsky hierarchy of languages. Decidable and undecidable problems.

Instructional methods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on two periodic written assessment during the semester, the seminar work, and final written exam. Students independently prepare seminar paper on a chosen topic in the form of written reports and public presentations with a discussion.

Assessment Criteria

Lectures	Exercises	Practice	Theoretical exam		
10%	20%	30%	40%		

Reading

Essential	1. Jezični procesori 1, Srbljić, S., Element, Zagreb, 2002. 2. Introduction to Automata Theory, Languages, and Computation, J. E. Hopcroft, R. Motwani, J. D. Ullman, Addison-Wesley, 2000
Supplementary	- Introduction to the Theory of Computation, M.Sipser, Course Technology, 2005. - Other online and offline resources

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **DATA MINING**

Semester	Status	Hours per week		ECTS	Code
		Lectures	Exercises		
MASTER-II	Compulsory	2	3	7	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	Statistics
Learning objectives	To enable students to independently choose methods and tools, and they will use and interpret results. Also, they know that in the available data notice interesting trends, relationships and patterns.
Learning outcomes	A student who successfully completes the course will have the following competencies: - Reviewing Data mining as a process that consists of stages for business planning, manipulation of data, exploratory analysis, modeling, evaluation and application of the model and interpretation of the results. - Untethered use software and scientific programming in the program R. - Understanding and application of algorithms: clustering, evaluation, prediction, classification, logistic and multivariate regression. - Understanding and application of the latest methods of data mining, such as text mining. - Understanding the concepts of mathematical statistics, which are the basis of previously stated.

Course topics:
Introduction. Understanding the concept of data mining. Phases in the process of data mining. Techniques and methods of data mining. Determining the distribution of frequencies. Analysis of the cluster. PCA and factor analysis. Link analysis. Classification. Predictive models. Supervised learning. Regression. Logistic regression. Techniques for prediction. Decision making tree. Nearest neighbor method. Method K nearest neighbor. Time series. Neural networks. Stage logic. Memory based reasoning. Clastering. Analysis of the consumer basket. Rule induction. Genetic algorithms.

Instructional methods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on two periodic written assessment during the semester, the seminar work, and final written exam. Students independently prepare seminar paper on a chosen topic in the form of written reports and public presentations with a discussion.

Assessment Criteria

Lectures	Exercises	Practice	Theoretical exam		
10%	20%	30%	40%		

Reading

Essential	1. Data Mining: Practical Machine Learning Tools and Techniques (Second Edition), Ian H. Witten and Eibe Frank, Morgan Kaufmann, 2005. 2. Computer-Aided Multivariate Analysis, Afifi, A.A., Clark, V., Chapman & Hall, Washington, D.C., 2000. 3. Principles of Data Mining, D. Hand, H. Mannila, and P. Smyth, MIT Press, 2001.
Supplementary	- Data mining: concepts and techniques. Morgan Kaufman, J. Han and M. Kamber, 2000. - The Elements of Statistical Learning: data mining, inference and prediction, T. Hastie, R. Tibshirani, and J. Friedman, Springer Verlag, 2001. - Other online and offline resources

YEAR TWO

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **MULTIMEDIA SYSTEMS AND APPLICATIONS**

Semester	**Status**	**Hours per week**		**ECTS**	**Code**
		Lectures	**Exercises**		
MASTER-III	Compulsory	2	4	7	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learning objectives	Acquire basic knowledge of multimedia signals and data, technologies for their efficient representation, processing, display and transfer, and their applications in multimedia systems.
Learning outcomes	A student who successfully completes the course will be able to: - define media signals, their representation, processes of processing and application - distinguish between source encoding and entropy encoding, and various compression processes of media signals - apply and analyze predictive and predictive coding procedures on media signals - describe the model of the human visual system and explain the characteristics of the video signal - explain the differences between analog and digital video signal display - use compression and video compression procedures

Course topics:
Multimedia technologies and systems, their architecture and application. Overview of media and data sources. The basics of coding and compression. Speech signaling, modeling and analysis, parameter display and encoding. Speech coding standards, basis of synthesis and recognition. Audio signal. Psychoacoustic model, coding procedures and standards. The basics of human visual system, the principles of image compression, standards. Video signal, appearance and features. Spatial, temporal and subjective redundancy. Compression of video signals and standards. Storage, transfer and processing of multimedia data. Sketch and program performance. Integration of multimedia content, synchronization. Multimedia systems and software tools.

Instructional methods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on two periodic written assessment during the semester, the seminar work, and final written exam. Students independently prepare seminar paper on a chosen topic in the form of written reports and public presentations with a discussion.

Assessment Criteria

Lectures	Exercises	Seminar	Theoretical exam		
10%	20%	30%	40%		

Reading

Essential	1. Z. N. Li, M. S. Drew (2004.), Fundamentals of Multimedia, Prentice Hall
Supplementary	- R. Steinmetz, K. Nahrstedt (2002.), Multimedia Fundamentals, Volume I: Media Coding and Content Processing, Prentice Hall - Y. Q. Shi, H. Sun (2008.), Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms, and Standards, CRC Press. - Preporučeni internet izvori

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **PARALLEL COMPUTER SYSTEMS**

Semester	Status	Hours per week		ECTS	Code
		Lectures	Exercises		
MASTER-III	Compulsory	2	3	8	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learning objectives	Introduction to the basics of parallel processing and principles of parallel computer systems operation.
Learning outcomes	A student who successfully completes the course will have the following competencies: - Knowledge about architecture based on parallelism and knowledge of the design and performance of parallel algorithms so they can understand various models of parallelism. - Knowledge to create algorithms based on parallel programming in an environment.

Course topics:
Introduction. Hardware for parallel processing: instruction-level parallelism. Parallelism at the level of shared memory. Parallelism with distributed memory. The principle of unlimited parallelism. Superscalar processors. Typologies of communication networks and their impact on performance. Software protocols for parallel processing: the Protocol to message passing (MPI) protocol. Parallel Virtual Machine (PVM). SIMD processing fields. Processing fields with distributed memory. Processing fields with a common (divisible) memory. Communication and synchronization processes in MIMD systems: semaphores, monitors, message sending. Examples of algorithms for MIMD systems. Example parallelization of numerical algorithms. Fast Fourier transformation using parallelism. N body problem using parallelism. Monte Carlo analysis using parallelism. Parallel Efficiency Account: History of computing system and the development of their performance. Definition of acceleration (Amhdalov law).

Instructional methods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on two periodic written assessment during the semester, the seminar work, and final written exam. Students independently prepare seminar paper on a chosen topic in the form of written reports and public presentations with a discussion.

Assessment Criteria

Lectures	Exercises	Practice	Theoretical exam		
10%	20%	30%	40%		

Reading

Essential	1. Praktikum za laboratorijske vježbe iz paralelnih računarskih sistema, E. I. Milovanović, V. Ćirić,Elektronski fakultet, Niš, 2003. 2. Advanced computer arhitecture and parallel processing, H. El-Rewini, M. El-Barr, John Wilej and Sons, Inc. 2005.
Supplementary	- Parallel Programming in openMP, R. Chandra, R. Menon, L. Dagum, D. Kohr, D. Maydan, J. McDonald, Morgan Kaufmann, 2001. - Parallel Computer Architecture: A Hardware/Software Approach, David E. Culler and Jaswinder Pal Singh - Other online and offline resources

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **SOFTWARE ENGINEERING OF LARGE DATABASES**

Semester	Status	Hours per week		ECTS	Code
		Lectures	Exercises		
MASTER-III	Compulsory	2	3	8	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	Database optimization
Learning objectives	Understanding the architecture of modern databases for large databases, getting acquainted with the various possibilities of their integration and evaluation of commercial tools.
Learning outcomes	A student who successfully completes the course will have the following competencies: - critically evaluate the different DBMS and their characteristics. - examine the various possibilities of integrating large databases. - implementing selected examples. - acquire practical experience with commercial tools.

Course topics:
Introduction. DB Taxonomy: DBMS models and architectures. DB accesses (relational, procedural, object-oriented, descriptive (XML), deductive). XML, XPath, XQuery. Consistently objects. DB integration. Integration DB: oriented languages (embedded SQL). Oriented Management (ODBC, JDBC) (architectures, types of management, application architecture). Database components. SOA integration. Web services. Base-Agent. Documenting the development process.

Instructional methods:
Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on two periodic written assessment during the semester, the seminar work, and final written exam. Students independently prepare seminar paper on a chosen topic in the form of written reports and public presentations with a discussion.

Assessment Criteria

Lectures	Exercises	Seminar	Theoretical exam		
10%	20%	30%	40%		

Reading

Essential	1. Professional XML (Programer to Programmer), Bill Evjen, at all, 2007. 2. Web Services: Concepts, Architectures and Applications by Gustavo Alonso, Fabio Casati, Harumi Kuno, and Vijay Machiraju, 2010. 3. Modern Database Management (10th Edition) by Jeffrey A. Hoffer, V. Ramesh, and Heikki Topi, 2010.
Supplementary	- Physical Database Design: the database professional's guide to exploiting indexes, views, storage, and more (The Morgan Kaufmann Series in Data Management Systems) by Sam Lightstone, Toby J. Teorey, and Tom Nadeau, 2007 - Other online and offline resources

ELECTIVE COURSES

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **BUSINESS INTELIGENCE**

Semester	Status	Hours per week		ECTS	Code
		Lectures	Exercises		
MASTER-A1	Election course	3	3	7	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learning objectives	The goal of the course is to introduce students to business decision support systems. The subject of the study is data warehousing, dimensional modeling, data integration (ETL) and OLAP systems. The curriculum is followed by homeworks in which students test the concepts.
Learning outcomes	A student who successfully completes the course will be able to: - define the basics concepts of business intelligence and data warehouses - apply the principles of data warehousing - use the basic ETL procedures - use the basics of OLAP technology - use basic BI tools - produce the BI tool prototype

Course topics:
Introduction to business intelligence and data warehousing. Definitions of basic terms. Introduction to Dimensional Modeling. Access to data warehouse building. Dimensional modeling (conforming dimensions, different roles). Dimensional modeling: surrogate keys, indexes, NULL values. Build a GUI client for a star connection. Dimensional modeling: dimensional types, heterogeneous dimensions and facts, hierarchy, fact sheet types, aggregates, cross-browsing. Dimensional Modeling: N: N Links, Early / Late Records, Complex Events). Current Data Warehouse, OLAP. ETL. Security, metadata, permissions, data quality.

Instructional methods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on two periodic written assessment during the semester, and final written exam.

Assessment Criteria

Lectures	Exercises	Periodic tests	Homeworks	Final exam	
10%	10%	20%	20%	40%	

Reading

Essential	1. Ralph Kimball, Margy Ross (2002.), The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling, Wiley
Supplementary	- Joe Caserta, Ralph Kimball (2004.), The Data Warehouse Etl Toolkit, Wiley - Christopher Adamson (2010.), Star Schema The Complete Reference, McGraw Hill. - Other online and offline resources

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **RISK MANAGEMENT IN SOFTWARE ENGINEERING**

Semester	Status	Hours per week		ECTS	Code
		Lectures	Exercises		
MASTER-A2	Election course	3	3	7	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learning objectives	The goal is to train students for their own logical decision-making in the process of assessing potential risks and their management, with particular emphasis on the risk of developing and using software products. The importance of mastering knowledge of potential risk, likelihood to occur and the economically damaging consequences.
Learning outcomes	A student who successfully completes the course will be able to: - gain a clear view of the potential risks of indefinite outcomes of their significance with the ability to identify at least two possible outcomes - make a choice in the risk management process in order to prevent its occurrence or to diminish the economically damaging consequences - master the risk so that it can be affected and managed by it - conduct an interdisciplinary risk assessment

Course topics:
Basic concepts of risk management; Nature and risk management; Function and risk management function; Modern approach to risk management; Nature of activity; Organization status and phases of risk management process; Adapting to the conditions of uncertainty in the environment; Conceptual framework for uncertainty analysis; Organizational adaptation to the conditions of uncertainty; Control Styles; Prediction and planning; imitation; Risk assessment: identification, hazard analysis, risk measurement; Risk Exposure: Assets, Obligations; Subjects exposed to risk; Methods and techniques of risk management; Risk Management Program: Policies and Procedures; Information bases; Review and monitor programs and procedures.

Instructional methods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on two periodic written assessment during the semester, the seminar work, and final written exam. Students independently prepare seminar paper on a chosen topic in the form of written reports and public presentations with a discussion.

Assessment Criteria

Lectures	Exercises	Periodic tests	Seminar	Final exam	
10%	10%	20%	20%	40%	

Reading

Essential	1. Frenkel, M.; Hommel, U.; Rudolf, M. (2012). Risk Management. 2nd ed. New York: Springer.
Supplementary	- Vaughan, E. (2000). Upravljanje rizicima. University of Iowa; - BAS EN 31010:2012 Upravljanje rizikom – Tehnike za ocjenu rizika - Other online and offline resources

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **OPERATIONAL RESEARCH**

Semester	Status	Hours per week		ECTS	Code
		Lectures	Exercises		
MASTER-A3	Election course	3	3	7	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learning objectives	The main goal of this course is that students learn some of the basic and for practice most important methods of optimization, as well as to be able independently apply the quantitative application of existing, and where appropriate, to develop new mathematical methods and models to solve practical problems.
Learning outcomes	A student who successfully completes the course will have the following competencies: - Select the technique that best suits the nature of a given system. - Practical knowledge and skills in the creative use of modern tools for developing complex system of decision-making and solve complex business problems. - Apply optimization program in practice. - Solving practical problems of operational research on the computer with the help of the program WinQSB, LINGO, and LINDO solver allowance.

Course topics:
Introduction. Subject and objective of operational research. New directions of development and application. Introduction to Optimization, Models and Methods of Operational Research. Operational Research Methods: - Linear Programming, Simplex and graphical method. Duality theory. Transport problem of linear programming, method of northwest corner (corners), method of jumping from stone to stone, MODI method. Hungarian method of assignment. Network planning, CPM, PERT, PERT-COST. Dynamic Programming. Use of computers: application of optimization programs in practice, choice and main features of the program. Solving Practical Problems of Accounting Operations on WinQSB, LINGO, LINDO Solver Add-ons.

Instructional methods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on two periodic written assessment during the semester, the seminar work, and final written exam. Students independently prepare seminar paper on a chosen topic in the form of written reports and public presentations with a discussion.

Assessment Criteria

Lectures	Exercises	Practice	Theoretical exam		
10%	20%	30%	40%		

Reading

Essential	1. Operaciona istraživanja i kvantitativne metode investicija, Urošević, B, Božović, M, Ekonomski fakultet, Beograd, 2009. 2. Operaciona istraživanja, S. Krčevinac, M. Čangalović, V. Kovačević-Vujčić, M. Matrić, M. Vujošević, FON, Beograd 2004. 3. Matematički modeli i metode programiranja u gospodarskom društvu, dr. sc. Stiepo Andrijić, Synopsis, Zagreb – Sarajevo, 2002. 4. Operaciona istraživanja 2, zbirka zadataka, Martić M i dr, FON, Beograd, 2007
Supplementary	- Operacijska istraţivanja-drugo neizmijenjeno izdanje, Z. Lukaĉ, L. Neralić, Uđbenici Sveuĉilišta u Zagrebu, 2013. - Zbirka zadataka iz operacionih istraživanja, J. Petrić, Z. Kojić, L. Šarenac, knjiga I i II, Naučna knjiga, Beograd, 1989. - Other online and offline resources

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **GRAPH THEORY**

Semester	Status	Hours per week		ECTS	Code
		Lectures	Exercises		
MASTER-A4	Elective course	3	3	7	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learning objectives	The objectives of the module are to get acquainted with the basic elements of graph theory and its applications. One of the most important goals is to show how to model problems using graphs and how to address them or at least define the appropriate problem.
Learning outcomes	At the end of the course, the students will have the following competencies: - To model realistic problems with the mathematical apparatus of graph theory. - Apply classical graphical algorithms for those types of problems that are known to be efficient solutions.

Course topics:
Introduction Basic concepts and definitions, graph as the model. Isomorph, special graphs and graph decomposition. Links, bipartite graphs, Euler graphs, graphs interval, degree of the vertex graph and counting. Oriented graphs and corresponding models. Basic characteristics of trees, the distance in the trees, counting trees. Matching and bedspreads, matching in bipartite graphs. Matching on graphs (Tutte theorem). The link (2 and 3 connections). Menger theorems and connections. Graph coloring, chromatic polynomials. Perfect graphs, triangular graphs. Planar, Planar and Kuratowski theorem. Hamiltonian cycle. Basic search algorithms on graphs.

Instructional methods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on two periodic written assessment during the semester, the seminar work, and final written exam. Students independently prepare seminar paper on a chosen topic in the form of written reports and public presentations with a discussion.

Assessment Criteria

Lectures	Exercises	Seminar	Theoretical exam		
10%	20%	30%	40%		

Reading

Essential	1. Graphs and Digraphs; G. Chartrand and L. Lesniak; Chapman & Hall / CRC; 2005. 2. Modern Graph Theory, Bela Bollobas, Springer-Verlag, 1998 3. Introduction to Graph Theory, D. West, Prentice Hall, Pearson; 2 ed 2000. 4. Jay Yellen Graph theory and its applications, Jonathan Gross, Chapman and Hall; 2 ed., 2005.
Supplementary	- A Beginners Guide to Graph Theory; W. D. Wallis; Birkhäuser; 2000. - Introductory graph theory Dover Publications, Gary Chartrand, 1984 - Other online and offline resources

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **SHAPE RECOGNITION AND IMAGE PROCESSING**

Semester	Status	Hours per week		ECTS	Code
		Lectures	Exercises		
MASTER-B1	Elective course	3	3	7	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learning objectives	The course aims to give an overview of basic image processing and analysis techniques starting from data representation and ending with basic shape detection methods.
Learning outcomes	At the end of the course, the students will be able to: - Use Image pre-processing methods - Use image segmentation methods - Choose shape description methods appropriate to a problem - Use classification methods appropriate to a problem

Course topics:
Introduction. Digital image acquisition and properties. Pre-processing: geometric transforms, linear filtering, image restoration. Introduction to Mathematical Morphology. Examples and applications. Segmentation and object extraction. Thresholding, edge detection, region detection. Segmentation by active contours. Applications in image segmentation. Shape representation and description. Contour-based representation, region-based representation. Morphological skeletons. Shape recognition. Statistical shape recognition, Bayesian classification, linear and non-linear classifiers, perceptrons, neural networks and unsupervised classifiers. Applications.

Instructional methods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on two periodic written assessment during the semester, the seminar work, and final written exam. Students independently prepare seminar paper on a chosen topic in the form of written reports and public presentations with a discussion.

Assessment Criteria

Lectures	Exercises	Seminar	Theoretical exam		
10%	20%	30%	40%		

Reading

Essential	1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing using MATLAB. 2. William K. Pratt, Digital Image Processing.
Supplementary	- Bernd Jähne: Digital Image Processing: Concepts, Algorithms, and Scientific Applications - Richard Szeliski: Computer Vision - Algorithms and Applications - Preporučeni internet izvori

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **ELECTRONICS AND MICROCONTROLERS**

Semester	**Status**	**Hours per week**		**ECTS**	**Code**
		Lectures	**Lectures**		
MASTER-B2	Elective	3	3	7	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learningobjectives	Getting acquainted with architecture and using a microcontroller. Learn about microcontroller programming and microcontroller programming.
Learningoutcomes	A student whosuccessfullycompletes the course will have the followingcompetencies: - Knowledge of architecture and application of microcontroller. - Ability to choose and know the role of components and sensors. - The ability to program a microcontroller. - Practicalapplication of microcontrollers in real situations.

Course topics:
Introduction; Microcontrollerarchitecture; Supervisor; configuration; Ports, DDR, PIN; Alternative functions; SerialInterface: UART, SPI, TWI; Analoginputs; Interruptions: mode of operation, softwaresupport; Timers - counters; AnalogOutputs - PWM; Analoguecomparator; Capacitiveproximitysensor; LCD module; LED display with multiplex; Methods for lowering the program. (ISP; Bootloader).

Instructionalmethods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed in laboratory, with drafting tasks that are practical applications.

AssessmentRationale: Knowledgeassessment are based on twoperiodicwrittenassessmentduring the semester, the seminar work, homework and finalwrittenexam. Studentsindependentlyprepare seminar paper on a chosentopic in the form of writtenreports and publicpresentations with a discussion.

AssessmentCriteria

Lectures	Exercises	Seminar	Periodictests	Homeworks	Finalexam
10%	10%	20%	20%	10%	30%

Reading

Essential	1. Gunther Gridling, Bettina Weiss (2007):Introduction to Microcontrollers, Vienna University of Technology, https://ti.tuwien.ac.at/ecs/teaching/courses/mclu/theory-material/Microcontroller.pdf
Supplementary	- Vojo Milanović (2007): Programiranje mikrokontrolera Pic Basic-om - Miroslav Kostadinović(2013): Praktikum za auditorne vježbe iz projektovanja digitalnih sistema sa mikrokontrolerom. ISBN 978-99955-36-37-4 - Preporučeni internet izvori

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **CLOUD COMPUTING**

Semester	**Status**	**Hours per week**		**ECTS**	**Code**
		Lectures	**Exercises**		
MASTER-B3	Elective course	3	3	7	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learning objectives	To train students for independent application of cloud computing in enterprise environments
Learning outcomes	After completion of the course, students will have the competence: - Implementation which basis is cloud computing. - Optimization which basis is cloud computing. - Safety and programming system which basis is cloud computing

Course topics:
Introduction. Basics of cloud computing. Cloud computing architecture and standards. Public, private and national concepts of cloud computing. Software as a service. Platform as a service. Infrastructure as a service. Advantages and disadvantages - aspects of resource allocation and security. Implementation. Migration. Disadvantages. Distribute applications across commercial cloud computing infrastructure, such as Amazon Web Services, Windows Azure, and Google AppEngine.

Instructional methods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on two periodic written assessment during the semester, the seminar work, and final written exam. Students independently prepare seminar paper on a chosen topic in the form of written reports and public presentations with a discussion.

Assessment Criteria

Lectures	Exercises	Practice	Theoretical exam		
10%	20%	30%	40%		

Reading

Essential	1. Cloud Computing: Concepts, Technology & Architecture (The Prentice Hall Service Technology Series from Thomas Erl), 2013. 2. Cloud Computing for Programmers: Software Development in the Age of Cloud,by D. Casal, 2014.
Supplementary	- Other online and offline resources

UNIVERSITY OF ZENICA
POLYTECHNIC FACULTY

Course title: **COMPUTER MODELING AND SIMULATIONS**

Semester	Status	Hours per week		ECTS	Code
		Lectures	Exercises		
MASTER-B4	Elective course	3	3	7	

Professor: **E-mail**:	**Assistant**: **E-mail**:

Pre-requisites	
Learning objectives	Simulation is an attempt to imitate reality. It is used in many contexts, including the modeling of natural or artificial systems in order to gain insight into their functioning. A computer model is the mathematical representation of the functioning of a process, concept or system, presented in the form of a computer program. The goal of this course is to introduce students with a number of aspects and issues related to computer modeling and simulation of the real world phenomena.
Learning outcomes	After completion of the course, students will be able to: - select the appropriate mathematical method for simulating the actual process or system - use the selected modeling and simulation software package - identify and quantify possible influencing factors on the simulation result - evaluate the reliability of the chosen model - validate and verify the simulation

Course topics:
Introduction. Statistics and Probability for Simulation. Modeling & Simulation. Development of Systems Simulation. Classification of Stochastic Processes. Simulation Output Data and Stochastic Processes. Techniques for the Steady State Simulation. Determination of the Warm-up Period. Determination of the Desirable Number of Simulation Runs. Simulation Software Selection. Animation in Systems Simulation. System Dynamics and Discrete Event Simulation. Social Simulation. Web-based Simulation. Parallel and Distributed Simulation. Applications of sensitivity information. Finite difference approximation. Simultaneous perturbation methods. Perturbation analysis. Score function methods. Harmonic analysis. Metamodeling and the Goal seeking Problems. "What-if" Analysis Techniques. Monte Carlo Simulation. Variance-Reduction Techniques. Experimental Design and Optimization. Agent-Based Simulation and System Dynamics.

Instructional methods: Lectures are performed with the use of multimedia resources, techniques of active learning and with the active participation of students in the cabinet. Exercises are performed as auditory, with drafting tasks that are practical applications.

Assessment Rationale: Knowledge assessment are based on the seminar paper and final written exam. Students independently prepare seminar paper on a chosen topic in the form of written reports and public presentations with a discussion.

Assessment Criteria

Lectures	Exercises	Seminar	Theoretical exam		
10%	10%	40%	40%		

Reading

Essential	1. Hossein Arsham: Systems Simulation: The Shortest Route to Applications, University of Baltimore, http://home.ubalt.edu/ntsbarsh/simulation/sim.htm 2. Averill Law (2014) Simulation Modeling and Analysis, McGraw-Hill
Supplementary	- Dale K. Pace: Modeling and Simulation Verification and Validation Challenges, Johns Hopkins apl technical digest, volume 25, number 2 (2004) http://www.jhuapl.edu/techdigest/TD/td2502/Pace.pdf - National Science Foundation Blue Ribbon Panel on Simulation-Based Engineering Science. Simulation-Based Engineering Science. Technical report, National Science Foundation, USA, http://www.nsf.gov/pubs/reports/sbes_final_report.pdf, 2006 - Coleman H.W., Stern H.: "V&V State of the Art", Proceedings of Foundations '02 a Workshop on Model and Simulation Verification and Validation for the 21st Century JHU/APL Kossiakoff Education and Conference Center (Laurel, Maryland USA) 2002