DISCIPLINE ACADEMIC SHEET

ACADEMIC YEAR 2019 - 2020

1. PROGRAMME DATA

1.1 Higher Education Institution	*UNIVERSITY OF CRAIOVA*
1.2 School	*Automation, Computers and Electronics*
1.3 Department	*Computers and Information Technology*
1.4 Field of Study	*Computers and Information Technology*
1.5 Study Level[1]	*L (licence/ undergraduate)*
1.6 Study Program (name/code)[2] /Calification	*Computers* / L206010101010

2. DISCIPLINE DATA

2.1 Discipline Name				**Special Chapters in Mathematics**					
2.2 Course Activities Holder				Associate Professor Cristian VLADIMIRESCU					
2.3 Practical Activities Holder				PhD Student Andrei GRECU					
2.4 Study Year	**I**	2.5 Semester	**I**	2.6 Discipline Type (content)[3]	**DF**	2.7 Discipline Conditions (mandatory)[4]	**DI**	2.8Evaluation Type	**E**

3. ESTIMATED TOTAL TIME (hours per semester of teaching activities)

3.1 Number of hours per week	**5**	in which: 3.2 couse	**3**	3.3 seminar/laboratory/project	**2**
3.4 Total hours of curriculum	**70**	in which: 3.5 course	**42**	3.6 seminar/laboratory/project	**28**

3.7 Time distribution	hours
▪ Study after manual, course support, bibliography and notes	**20**
▪ Additional documentation in library, on specialized electronic platforms and field	**10**
▪ Training seminars / labs, homework, portfolios and essays	**20**
▪ Tutoring	**-**
▪ Examinations	**8**
▪ Other activities: consultations, student meetings	**2**

Total hours per individual activities	**60**
3.8 Total hours per semester[5]	**130**
3.9 Number of credits[6]	**5**

4. PRECONDITIONS (where appropiate)

4.1 of curriculum	The students should have mathematical notions learned during the college and the first semester.
4.2 of competence	There are not necessary.

5. CONDITION (where appropiate)

5.1. of the course	The teaching is explanatory and interactive at the blackboard. One ensures electronic course support and acces to updated documentation. The teaching process has the following structure: ▪ 70% theoretical presentation, based on the couse support; ▪ 30% interactive activity with the students.
5.2. of seminar/ laboratory/project	The seminar is developed interactively with the sudents, by ensuring also electronic support.

6. SPECIFIC LEARNED SKILLS [7]

Professional competences	Through the notions introduced at the course, the examples and the applications from the seminar, the Special Chpaters in Mathematics course contributes to the following: - professional competences: ▪ Proper use in professional communication of the eigen concepts of calculability, complexity, programming paradigms and modelling of computer and communications systems. ▪ Theoretical foundation of the features for the designed systems. ▪ Identification of a class of problems and solving methods specific for computer systems. ▪ Using interdisciplinary knowledge, solution patterns and tools to conduct experiments and interpret their results. ▪ Applying solution by means of engineering tools and methods.

Transversal Competences	

7. DISCIPLINE OBJECTIVES (based on the specific learned competences)

7.1 General objective of the discipline	▪ Fundamental discipline, necessary to each special approach. One presents the fundamental notions of complex analysis, ODE, Fourier analysis, Laplace, Z, and Fourier transforms. ▪ Teaching the students to be able to solve certain ODEs of first or higher order, systems of first order ODEs, Cauchy problems, to expand in Fourier series different types of functions, to determine the integral transforms of elementary (or not) functions, to determine various sequences that are defined reccursively apply differential and integral calculus to solving practical problems, to solve elementary PDES, to calculate the probabilities of different events, to determine the expectation, the variance, the moments of discrete and continuous random variables (r.v.), to find the marginal distributions to discrete or continous random vectors, to establish the independence of certain r.v, to find the covariance and the correlations of two r.v, to determine the regression line, to apply the central limit theorem to practical statistical problems. ▪ The aim of the seminar is to fix the theoretical knowledges and to create calculus abilities through practical applications, exercises, and problems.
7.2 Specific objectives	The achivement of some necessary abilities, as: complex analysis; ordinary differential equations and systems of ordinary differential equations; Fourier series; Laplace transform; Z transform; Fourier transform; elementary partial differential equations; probabilities; statistics.

8. CONTENT

8.1 COURSE (content units)	No hours	Teaching methods
1. Complex Analysis 1.1. Complex numbers. Algebraic properties. The Euclidean distance, the modulus, the conjugate. Inequalities. Geometric representation. 1.2. Sequences of complex numbers. Complex functions of ca complex variable. Continuity, differentiability, Cauchy-Riemann equations, holomorphic functions. 1.3. Power series with complex coefficients, convergence, fundamentaal theorems of Abel, Cauchy-Hadamard, differentiability, expansion in Taylor series. 1.4. Elementary functions defined as power series. The exponential, sin, cos, argument, logarithm, the power function, the root function. Solving simple equations. 1.5. Paths in the complex plane. The integral of a complex function: definition, properties. Cauchy's Theorem for holomorphic functions. Leibniz- Newton formula. Holomorphic and analytical functions. 1.6. The zeros of a holomorphic functions. Singularities: classification (removable, pole, essential). 1.7. Laurent series. The convergence annulus. The theorem of existence and uniqueness. Expansion in Laurent series. 1.8. The residues of a holomorphic functions at a singularity. The residue theorem. Application to the calculus of certain real improper integrals.	**6**	**Exposition** The teaching is explanatory and interactive at the blackboard. One ensures electronic course support and acces to updated documentation. The teaching process has the following structure: - 70% theoretical presentation, based on the couse support. - 30% interactive activity with the students.
2. Ordinary Differential Equations 2.1. ODEs, initial conditions, Cauchy problem 2.2. Solving first order ODEs through elementary methods: separable ODEs, homogenous ODEs, linear ODEs, Bernoulli, Riccati, Clairaut, Lagrange ODEs. 2.3. ODEs of highe order with constant coefficients. Euler ODEs. 2.4. Systems of linear first order ODEs with constant coefficients.	**3**	
3. Fourier Analysis –Fourier series 3.1. Periodic signals. Odd, even functions, extensión through periodicity, oddeness, odd extensions, even extensions. 3.3. Fourier coefficients, the Fourier series associated to a function. 3.4. Parseval's formula. Bessel's inequality. 3.6. Expansions in Fourier series of sines, cosines. The calculus of certain numerical series by using Fourier series.	**3**	
4. Laplace and Z transforms 4.1. Improper integrals. Euler's Beta and Gama functions. 4.2. Original signals. Laplace transform: definition, properties, fundamental	**6**	

theorems. 4.4. Laplace transforms of elementary functions. 4.5. Calculus of various Laplace transforms, finding the original, applications to ODEs and integral equations. 4.6. Elementary discrete signals. Z transform (discrete Laplace transform). 4.7. Finding of the general term of discrete signals that are defined by linear reccurence.		
5. Fourier transform 5.1. Integrable signals. Fourier transform. Inversion of the Laplace transform, Mellin- Fourier Theorem. 5.2. Fourier transforms through sine and cosine 5.3. Solving certain integral equations, representation of certain functions as Fourier integrals.	**3**	
6. Probability Theory and Statistics		
6.1. **Basics of Probability Theory.** Events and probabilities. Independence and conditional probabilities. Total probability formula. Bayes's formula.	**3**	
6.2. **Discrete random variables**. Expectation, variance, standard deviation, moments. Bernoulli distribution, binomial distribution, uniform distribution geometric distribution, Poisson distribution, Zipf distribution. Discrete random vectors. Marginal distributions.	**4.5**	
6.3. **Continuous random variables.** Cumulative distribution function, probability density function, expectation, variance, standard deviation, moments. Examples relevant for CS. Random continuous vectors. Marginal densities. Probability distribution. Uniform distribution, exponential distribution, normal distribution. Independence. Covariance. Correlation.	**4.5**	
6.4. **Discrete Markov chains**. Equilibrium distribution. Simulation. PageRank – Google algorithm	**3**	
7. **Elements of statistics.** The central limit theorem. Estimators of parameters. Linear regression. Logistical regression.	**6**	
Total	**42**	

Bibliography [8]

1. C. Avramescu, C. Vladimirescu, Ecuaţii diferenţiale şi integrale pentru informaticieni, Tipografia Universităţii din Craiova, 2003.
2. C. Avramescu, C. Vladimirescu, Curs de Calcul Ştiinţific, Reprografia Univesităţii din Craiova, 2002.
3. T. Bălan, Capitole de matematici speciale, 1998.
5. G. Popescu, Matematici Speciale (curs în format electronic).
6. E. Petrişor, Modele probabiliste şi statistice în ştiinţa şi ingineria calculatoarelor, Editura Politehnica, Timişoara, 2008.
7. C. Vladimirescu, Matematici Speciale (curs în format electronic).

8.2 Practical activities (topics/homework)	No hours	Teaching methods
1. Complex Analysis 1.1. Complex numbers. Algebraic properties. The Euclidean distance, the modulus, the conjugate. Inequalities. Geometric representation. 1.2. Sequences of complex numbers. Complex functions of ca complex variable. Continuity, differentiability, Cauchy-Riemann equations, holomorphic functions. 1.3. Power series with complex coefficients, convergence, fundamentaal theorems of Abel, Cauchy-Hadamard, differentiability, expansion in Taylor series. 1.4. Elementary funtions defined as power series. The exponential, sin, cos, argument, logarithm, the power function, the root function. Solving simple equations. 1.5. Paths in the complex plane. The integral of a complex function: definition, properties. Cauchy's Theorem for holomorphic functions. Leibniz- Newton formula. Holomorphic and analytical functions. 1.6. The zeros of a holomorphic functions. Singularities: classification (removable, pole, essential). 1.7. Laurent series. The convergence annulus. The theorem of existence and uniqueness. Expansion in Laurent series. 1.8. The residues of a holomorphic functions at a singularity. The residue theorem. Application to the calculus of certain real improper integrals.	**4**	**Solving practical applications** The seminar is developed interactively with the sudents, by ensuring also electronic support.

2. Ordinary Differential Equations 2.1. ODEs, initial conditions, Cauchy problem 2.2. Solving first order ODEs through elementary methods: separable ODEs, homogenous ODEs, linear ODEs, Bernoulli, Riccati, Clairaut, Lagrange ODEs. 2.3. ODEs of highe order with constant coefficients. Euler ODEs. 2.4. Systems of linear first order ODEs with constant coefficients.	**2**
3. Fourier Analysis –Fourier series 3.1. Periodic signals. Odd, even functions, extensión through periodicity, oddeness, odd extensions, even extensions. 3.3. Fourier coefficients, the Fourier series associated to a function. 3.4. Parseval's formula. Bessel's inequality. 3.6. Expansions in Fourier series of sines, cosines. The calculus of certain numerical series by using Fourier series.	**2**
4. Laplace and Z transforms 4.1. Improper integrals. Euler's Beta and Gama functions. 4.2. Original signals. Laplace transform: definition, properties, fundamental theorems. 4.4. Laplace transforms of elementary functions 4.5. Calculus of various Laplace transforms, finding the original, applications to ODEs and integral equations. 4.6. Elementary discrete signals. Z transform (discrete Laplace transform). 4.7. Finding of the general term of discrete signals that are defined by linear reccurence.	**4**
5. Fourier transform 5.1. Integrable signals. Fourier transform. Inversion of the Laplace transform, Mellin- Fourier Theorem. 5.2. Fourier transforms through sine and cosine 5.3. Solving certain integral equations, representation of certain functions as Fourier integrals.	**2**
6. Probability Theory and Statistics	
6.1. **Basics of Probability Theory.** Events and probabilities. Independence and conditional probabilities. Total probability formula. Bayes's formula.	**2**
6.2. **Discrete random variables**. Expectation, variance, standard deviation, moments. Bernoulli distribution, binomial distribution, uniform distribution geometric distribution, Poisson distribution, Zipf distribution. Discrete random vectors. Marginal distributions.	**3**
6.3. **Continuous random variables.** Cumulative distribution function, probability density function, expectation, variance, standard deviation, moments. Examples relevant for CS. Random continuous vectors. Marginal densities. Probability distribution. Uniform distribution, exponential distribution, normal distribution. Independence. Covariance. Correlation.	**3**
6.4. **Discrete Markov chains**. Equilibrium distribution. Simulation. PageRank – Google algorithm	**2**
7. **Elements of statistics.** The central limit theorem. Estimators of parameters. Linear regression. Logistical regression.	**4**
Total	**28**

Bibliography [8]

1. C. Avramescu, C. Vladimirescu, Ecuaţii diferenţiale şi integrale pentru informaticieni, Tipografia Universităţii din Craiova, 2003.
2. C. Avramescu, C. Vladimirescu, Curs de Calcul Ştiinţific, Reprografia Univesităţii din Craiova, 2002.
3. T. Bălan, Capitole de matematici speciale, 1998.
5. G. Popescu, Matematici Speciale (curs în format electronic).
6. E. Petrişor, Modele probabiliste şi statistice în ştiinţa şi ingineria calculatoarelor, Editura Politehnica, Timişoara, 2008.
7. C. Vladimirescu, Matematici Speciale (curs în format electronic).

9. COURSE CONTENT CONJUNCTION WITH EXPECTATIONS OF THE EPISTEMIC COMMUNITY REPRESENTATIVES, PROFESSIONAL ASSOCIATIONS AND EMPLOYEE REPRESENTATIVES IN THE PROGRAM DOMAIN

Developement and and acquiring of notions, methods, and actual mathematical techniques,used to the mathematical modelling of engineering problems.

10. EVALUATION

Activity Type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Final mark weight
10.4 + 10.5 Course + Practical activities	- The understanding the problem - The mathematical statement - The solving of the problem - The developement degree of practical abilities and capability to work with the notions, techniques, and fundamental introduces methods	Evaluations: written test: 6 applicative subjects; each subject is mandatory and is worth a score maximum 1.5. The mark at the written test is the sum of the scores at the 6 subjects + 1 for free. The weight of the score from the written test in the final mark is: 50%. Evaluations of continuous assessments is made during the semester, based on a written mid-semester test,with 3 applicative subjects; each subject is mandatory and is worth a score maximum 3. The mark at the mid-semester test is the sum of the scores at the 3 subjects + 1 for free. The weight of the score from the mid-semester test in the final score is: 50%. The minimum score to pass the mid-semester test is 5. The students who have passed the mid-semester test, will have to solve at the final written test only 3 subjects (from the existing 6) corresponding to the chapters that have not being assessed at the mid-semester test. The score is deduced similarly. The final score if deduced by using the formula: Sfinal = 0.5 x SFinalTest + 0.5 x SMidTest, where SFinalTest is the score (at least 5) obtained at the final written test; SMidTest is the score (at least 5) obtained at the mid-semester test. The minimum final score to pass the exam is 5.	100% 50% 50%
10.6 Minimum standard of performance (the minimum knowledge necessary to promote discipline and how to check the knowledge acquiring)			
- Minimum standards to promote: the understanding of the notions and basic terminology. - The obtaining of a minimum 50% from the continuous assessments and the final exam. - The estimate of the final mark is made by rounding to integer mark of the final scores.			

Date of completion: 17.02.2020

Course Holder

Assoc. Prof. Cristian VLADIMIRESCU, Ph. D.

(signature)

....

Applicative activities holder

Ph. D. Student Andrei GRECU

(signature)

....

Date of approval:

Head of Department
Prof. Marius BREZOVAN, Ph. D.
(signature)

....

Note:

1) Study level – select one of the possible choices: L (licence or undergraduate)/ M (master)/ D (doctoral).
2) Choose the code as defined by HG nr. 493/17.07.2013.
3) Type (content) - select one of the possible choices:
- for the licence or undergraduate level: DF (fundamental discipline)/ DD (domain discipline)/ DS (specialty discipline)/ DC (complementary discipline);
- for the master level: DA (thoroughgoing study discipline)/ DS (synthesis discipline)/ DCA (advanced knowledge discipline).

4) Condition of discipline (compulsoriness) - select one of the possible choices: DI (compulsory discipline)/ DO (optional discipline)/ FC (facultative discipline).
5) Obtained by means of adding the number of hours from 3.4 and 3.7.
6) A credit is equivalent with 25 – 30 hours of study (didactical activities and individual study).
7) The aspect of professional and transversal competences will be considered according to the OMECTS Methodology no 5703/18.12.2011. Competences are those listed in RNCIS (http://www.rncis.ro/portal/page?_pageid=117,70218&_dad=portal&_schema=PORTAL) for the field of study from 1.4 and the study program from 1.6 in which the discipline is enrolled, in this academic sheet.
8) At least one title is recommended to belong to the collective co-ordinating discipline, and at least 2-3 titles to refer relevant papers for the discipline from the national and international circuit, from the library of UCv.