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Developed in the frame of project "Erasmus+ (CBHE) BioArt "Innovative Multidisciplinary Curriculum in Artificial Implants for Bio-Engineering BSc / MSc Degrees" (586114-EPP- 1-2017- 1-ES- EPPKA2-CBHE-JP).

DESCRIPTION/Syllabi of Curricula/Module

Short Name of the University/Countrycode **Date (Month / Year)**	VNTU
TITLE OF THE MODULE	**Code**
Linear and Vector Algebra Fourier series and their use for signal and image analysis Monte-Carlo method (In: “Higher mathematics”)	

Teacher(s)	**Department**
Coordinating: Volodymyr Mykhalevych, Dr.Sc. **Others:**	Higher mathematics

Study cycle **(BA/MA)**	**Level of the module** **(Semester number)**	**Type of the module** **(compulsary/elective)**
BA	1-3th semestr (1, 2 year) for Bachelor	Compulsary

Form of delivery **(theory/lab/exercises)**	**Duration** **(weeks/months)**	**Language(s)**
Lectures/-/exercises	9 (54) weeks/2.5 (15)monts	Ukr / English

Prerequisites	
Prerequisites: Knowledge: Basic knowledge of elementary mathematics	**Co-requisites (if necessary):**

ECTS (Credits of the module)	Total student workload hours	Contact hours	Individual work hours
3 (18 –all course))	90 (540)	45 (288)	45 (252)

Aim of the module (course unit): competences foreseen by the study programme

Purpose of studying the discipline –

- mastering the mathematical apparatus necessary to study general engineering and special disciplines, developing the ability to consciously perceive mathematical material characteristic of the specialty of a modern engineer in the field of biomedical engineering and electronics;
- mastery of the basic mathematical methods necessary for the analysis and modeling of devices, processes and phenomena, the search for optimal solutions in order to increase production efficiency and choose the best ways to implement these solutions, process and analyze the results of experiments.

Competencies:

The ability to solve complex non-standard problems in the field of electronics, telecommunications and nanotechnology, providing for research and / or innovation when applying the methods and principles of digital processing of signals and images.

Components of mathematical competence:

- procedural - the ability to solve typical applied problems of linear algebra; Fourier series and Monte Carlo method;
- logical - possession of the deductive method of proving and refuting statements;
- technological - possession of modern information and communication technologies to support mathematical activities, in particular, computer mathematics systems;
- research - knowledge of research methods of applied problems by mathematical methods;

methodological - the ability to evaluate the appropriateness of using mathematical methods to solve applied problems.

Learning outcomes of module (course unit)	Teaching/learning methods (theory, lab, exercises)	Assessment methods (written exam, oral exam, reports)
Students should *be able to*: – - perform in the computer	Work with the lecture notes as well as on the available fundamental	Active attendance on lectures, exercises

mathematics system operations with matrices related to the configuration of the neural networks of Hopfield, Kohonen and Hamming; – - to solve in the environment of a computer mathematics system the applied problems associated with the use of Fourier series for the analysis of signals and images; – - apply the Monte Carlo method to solving applied problems, in particular, carry out statistical modeling of the properties of artificial implants; *know:* – - matrices, types of matrices, actions with them and their application to solving applied problems; – - Fourier expansion of even, odd, periodic functions with an arbitrary period and of the non-periodic functions, as well as their use for the analysis of signals and images;	subject literature. Perform independent work, practical work.	Knowledge test

Themes	Contact work hours							Time and tasks for individual work	
	Lectures	Consultations	Seminars	Practiacl work	Laboratory work	Placements	**Total contact work**	**Individual work**	**Tasks**
1. Theme 1. Matrices and actions on them. Application to the tuning of neural networks designed to solve problems of heteroassociative memory and in the neural networks of Hopfield and Kohonen	4			3			7	6	Matrices and operations on them. Application to the tuning of neural networks designed to solve problems of heteroassociative memory and in the neural networks of Hopfield and Kohonen. Types of matrices and their dimension. Square, diagonal, scalar and identity matrices of various orders. Matrix Addition and Multiplication.
2. Theme 2. Work with matrices in a computer mathematics system. Use for recognition tasks using the Hamming network.				3			3	3	Work with matrices in a computer mathematics system. Use for recognition tasks using the Hamming network. Manipulation with matrices
3. Eigenvalues and vectors of the matrix . Application to the construction of membership functions of fuzzy sets.	3			2			5	6	Eigenvalues and vectors of the matrix . Application to the construction of membership functions of fuzzy sets.
4. Fourier series and their use for the analysis of signals and images. Orthogonality of functions. Trigonometric system of functions, Rademacher and Walsh functions.	4			2			6	5	Fourier series and their use for the analysis of signals and images. Orthogonality of functions. Trigonometric system of functions, Rademacher and Walsh functions. of biodegradation of polymers. Structural materials. Stitch materials. Insulating materials. Polymeric prostheses and artificial fabrics. Waste processing and utilization in the production and application of biomaterials

5. Fourier expansion of even, odd, periodic functions with an arbitrary period and non-periodic functions.	3			3			6	5	Fourier expansion of even, odd, periodic functions with an arbitrary period and non-periodic functions.
6. The solution of applied problems in the environment of a computer mathematics system.	1			2			3	5	The solution of applied problems in the environment of a computer mathematics system.
7. Modeling of discrete random variables. Event modeling for seperate distributions: binomial distribution, geometric distribution, Poisson distribution	2			3			5	5	Modeling of discrete random variables. Event modeling for seperate distributions: binomial distribution, geometric distribution, Poisson distribution
8. Modeling continuous random variables. Uniform, normal and exponential distribution.	2			2			4	6	Modeling continuous random variables. Uniform, normal and exponential distribution.
9. Solution of applied problems. Statistical modeling of the properties of artificial implants.	2			3			5	5	Solution of applied problems. Statistical modeling of the properties of artificial implants.
Total	21			23			44	46	

Assessment strategy	**Weigh t in %**	**Deadlines**	**Assessment criteria**
Final exam	100%	19-20th week in the semester	test, oral exam

Author	**Year of issue**	**Title**	**No of periodical or volume**	**Place of printing. Printing house or internet link**
Compulsory literature				
Paul Dawkin	2018	Calculus I		Paul's Online Notes
Paul Dawkin	2018	Calculus II		Paul's Online Notes
Paul Dawkin	2018	Calculus III		Paul's Online Notes
Edwards C. Henr,	2018	Elementary differential		Pearson Education,

Penney Davd E.		equations		Upper Saddle River, NJ
Additional literature				
David Luengo	2017	Improving population Monte Carlo: Alternative weighting and resampling schemes	Signal Processing No 7.1. – P. 77-91	
David Luengo	2018	Signal Reconstruction in Multicarrier Comunications by Means of the Discrete Cosine Transform Type-III Even	No 7.1. – P. 1-4	Elsevier

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