



CD 8.5.1 DISCIPLINE CURRICULUM

Edition: 09

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FACULTY OF MEDICINE
STUDY PROGRAM 0912.1 MEDICINE
DISCIPLINE OF MICROBIOLOGY AND IMMUNOLOGY
DEPARTAMENT OF PREVENTIVE MEDICINE

APPROVED

at the meeting of the Commission for Quality
Assurance and Evaluation of the Curriculum
Faculty of Medicine
Minutes No. 1 of 16.09.21
Chairman PhD, associate professor

Suman Serghei

APPROVED

at the Council meeting of the Faculty of
Medicine
Minutes No. 1 of 21.09.21
Dean of Faculty of Medicine
PhD, associate professor

Placinta Gheorghe

APPROVED

at the meeting of the Discipline of microbiology and
immunology
Minutes No. 2 of 14.09.2021
Head of Discipline, PhD, Professor, academician

Rudic Valeriu

SYLLABUS

Discipline: **MICROBIOLOGY**

Integrated studies

Curriculum developed by the team of authors:

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I. INTRODUCTION

The objective of the Microbiology course is to provide students with the information and logistical support needed to understand the notions of morphobiology and pathogenicity of bacterial, fungal and viral infectious agents, as well as with practical knowledge and skills regarding modern and rapid laboratory diagnosis of infectious pathology.

Medical microbiology is one of the medical specialties that deals with the study of microorganisms involved in human pathology and the interactions between humans and these microorganisms. The content of the course is adapted to acquire the basic introduction of microbiology that include the role of microorganisms in the infectious process and the understanding of their metabolism. Acquiring the basic conceptions of general microbiology including: classification of microorganisms, structural and metabolic characteristics, ecology of microorganisms as well as general characters about pathogenic microorganisms.

The subject contributes to the scientific substantiation of the role of microorganisms in the infectious process and provides tools for determining the origin of infectious pathology - from classical microbiological diagnosis to modern automated techniques and molecular biology, by analyzing various biological or pathological samples and medical interpretation of results. establishing markers, antimicrobial resistance mechanisms, etc.).

Mission of the curriculum (aim) in professional training

The discipline of microbiology and immunology is designed to provide students with theoretical knowledge and practical skills of fundamental. Application of these knowledge in the basic fields of medicine: medical research, molecular diagnosis and epidemiology of infections. Preparing students to perform basic laboratory techniques as a general practitioner.

Microbiology is indispensable for the disciplines directly related to this field (infectious diseases, epidemiology), but also for the medical-surgical disciplines that have in the subject of study diseases of microbial etiology. Microbiology is a useful tool for the clinician and the epidemiologist to diagnose, treat and monitor infectious diseases, including nosocomial infections and the rapid alert system.

Theoretical knowledge and practical skills acquired in the discipline of microbiology, integrated with those obtained from other fundamental disciplines, will be used as a platform for clinical training, especially for medical-surgical disciplines that have in the study pathologies of microbial etiology.

- Language of the course English.
- Beneficiaries: students of the II-year, faculty Medicine 2.

II. MANAGEMENT OF THE DISCIPLINE

Code of discipline	F.03.O.028 / F.04.O.035		
Name of the discipline	Microbiology		
Persons in charge of the discipline	PhD, Profesor, academician V. Rudic Univ. assist. Cojocari Daniela		
Year	II	Semester	III/IV
Total hours including:	240 (120/120)		
Course	30/30	Practical/laboratory hours	25/25
Seminars	20/20	Individual work	45/45
Form of assessment	E/E	Number of credits	4/4



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III. TRAINING AIMS WITHIN THE DISCIPLINE

At the end of the study of the discipline the student will be able:

To know:

- Knowing the principles of classification and nomenclature of microorganisms
- Knowledge of the morphology, structure and physiology of bacteria, fungi and viruses
- Knowing the main families of antibiotics (classification, mechanism of action, spectrum of activity) Knowing the mechanisms of resistance to antibiotics
- Knowledge of in vitro activity parameters of antibiotics (antibiogram, CMI, CMB)
- Knowing the habitat of bacteria, fungi and viruses
- Knowing the pathogenicity of bacteria and understanding the role of pathogenic factors in the pathogenesis of infectious diseases
- Understanding the importance of bacteria, fungi and viruses as etiological agents of different infectious clinical entities. Specific prevention and treatment of infectious diseases
- Knowing the methods of microbiological diagnosis, indications for performing the microbiological diagnosis;
- Understanding the diagnostic procedures used in bacterial, fungal and viral infections and the factors that influence the results;
- Knowledge of the main diagnostic bacteriological analyzes (urine culture, blood culture, coprocultures, CSF, pus, sputum)
- Knowing the methods of diagnosis of viral infections
- Know basic notions of fundamental and medical immunology

To implement:

- Differentiating cellular and acellular forms of life
- Differentiation of the eukaryotic cell of the prokaryotic cell
- Abilities to comply with the rules / requirements of the anti-epidemic regime and safety technique in microbiological laboratories
- Skills to collect samples for microbiological investigations (pus, sputum, blood, CSF, urine, rhinopharyngeal secretions, faeces, etc.)
- Skills to complete the analysis forms / bulletins for bacteriological, virological and serological examinations
- Skills to interpret the results of the bacteriological, virological and serological examination in clinical context
- Skills for interpretation and application of antibiotic results
- Ability of preparation and staining of smears from pure and pure bacterial cultures
- Differentiation of gram negative and gram-positive bacteria, acid-resistant and acid-resistant
- Skills for correct use of the optical microscope with immersion.
- Skills for interpretation and application of modern methods of diagnosis of infections (ELISA, ELFA, RIF, PCR, etc.);
- Skills in applying the methods of prophylaxis and specific antibacterial, antifungal and antiviral treatment.

To integrate:

- Assessing the importance of Microbiology in the context of infectious pathology
- Understanding the interconnection between Microbiology and other related disciplines: Infectious diseases, Epidemiology. Implementation and integration of microbiological knowledge in clinical disciplines
- Assimilation of new knowledge in the field of infectious pathology
- Implementing the knowledge gained in the research activity



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- Critical and reliable use of scientific information obtained using the new information and communication technologies
- Use of multimedia technology to receive, evaluate, store, produce, present and exchange information, and communicate over networks via the Internet

IV. PROVISIONAL TERMS AND CONDITIONS

- Knowledge of the language of instruction;
- For the knowledge of microbiology and immunology, for the conceptual, methodological and factual support is necessary the contribution of chemistry, biochemistry, physics, biophysics, physiology, genetics, cellular and molecular biology;
- Digital competences (use of the Internet, document processing, electronic tables and presentations, use of graphics programs);
- Ability to communicate and team work;
- Qualities - tolerance, compassion, autonomy.

V. THEMES AND ESTIMATE ALLOCATION OF HOURS

Lectures, practical hours/ laboratory hours/seminars and self-training

No. d/o	THEME	Number of hours		
		Lectures	Practical hours	Self- training
1.	Introduction to microbiology. Taxonomy and nomenclature of bacteria. Morphology of bacteria.	2	3	3
2.	Ultrastructure of bacteria. Chemical composition, biological functions and methods for highlighting essential and non-essential structural elements.	2	3	3
3.	Physiology of bacteria. Metabolism. Enzymes. Nutrition. Bioenergetics.	2	3	3
4.	Growth and multiplication of bacteria. Principles of bacterial cultivation. Culture media.	2	3	3
5.	Bacteriological(culture) examination. The essence of the stages, practical use.	2	3	3
6.	Fungi. Taxonomy and nomenclature. Ultrastructure of the fungi. Highlighting methods.	2	3	3
7.	Cultivation of fungi. Laboratory diagnosis of mycoses.	2	3	3
8.	Viruses. Morphobiological characters. Reproduction of viruses. Bacteriophage.	2	3	3
9.	Replication and culture of viruses. Laboratory diagnosis of viruses. Virological examination.	2	3	3
10.	Microbial antagonism. Antimicrobial chemotherapy.	2	3	3
11.	Antibiotic Susceptibility Testing. Resistance of bacteria to antibiotics.	2	3	3
12.	The infectious process. Microbial pathogen factors. Pathogenicity and virulence of microorganisms.	2	3	3
13.	Immunity. Antigens and antibodies (immunoglobulins)	2	3	3
14.	Immunological method of diagnosis. Serological tests. Practical use. Classification and principles of serological reactions used in medical	2	3	3



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No. d/o	THEME	Number of hours		
		Lectures	Practical hours	Self-training
	practice.			
15.	Immunoprophylaxis and immunotherapy of infectious diseases.	2	3	3
16.	Microbiology and laboratory diagnosis of staphylococcal and streptococcal infections.	2	3	3
17.	Microbiology and laboratory diagnosis of meningo- and gonococcal infections.	2	3	3
18.	Microbiology and laboratory diagnosis of diphtheria, tuberculosis and whooping cough.	2	3	3
19.	Microbiology and laboratory diagnosis of anaerobic bacteria.	2	3	3
20.	Microbiology and laboratory diagnosis of spirochetosis.	2	3	3
21.	Genetal characteristics of the familly Enterobacteriaceae. Microbiology and laboratory diagnosis of bacterial dysentery.	2	3	3
22.	Microbiology and laboratory diagnosis of enteric fever and salmonellosis (non typhoid <i>Salmonella</i>).	2	3	3
23.	Microbiology and laboratory diagnosis of escherichiosis.	2	3	3
24.	Laboratory diagnosis of cholerae, infections caused by de <i>Campylobacter</i> și <i>Helicobacter</i> .	2	3	3
25.	Microbiology and laboratory diagnosis of candidiasis and mycoses caused by filamentous fungi.	2	3	3
26.	Laboratory diagnosis of influenza, parainfluenza, measles and mumps. Specific treatment and prophylaxis.	2	3	3
27.	Microbiology and laboratory diagnosis of infections caused by SARS, MERS and COVID-19. Specific treatment and prophylaxis.	2	3	3
28.	Microbiology and laboratory diagnosis of viral hepatitis. Specific treatment and prophylaxis.	2	3	3
29.	Microbiology and laboratory diagnosis of infections caused by Herpesviridae.	2	3	3
30.	Family Retroviridae. Laboratory diagnosis of HIV. AIDS. Viral oncogenesis.	2	3	3
Total 240		60	90	90

VI. REFERENCE OBJECTIVES OF CONTENT UNITS

Objectives	Content units
Chapter 1. Morphology and ultrastructure of bacteria.	



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Objectives	Content units
<ul style="list-style-type: none">• to define the notion of microorganism.• to possess knowledge about microorganism taxonomy.• to know the peculiarities of prokaryotes and eukaryotes.• to know the morphological forms and the tinctorial properties of the bacteria.• to possess staining techniques for smears.• to know the structure of the bacteria, viruses and fungi.• to be familiar with the rules for using the optical microscope with immersion, phase contrast and luminescence (fluorescent)• to know the rules of the antiepidemic regime and the safety techniques in the microbiological laboratories.• to develop own opinions on the biological and medical role of micro-organisms.	<p>Bacteria - Unicellular prokaryotic microorganism. Virus - acellular microorganism. Ultrastructure of bacteria - permanent and non-permanent elements. Ultrastructure of fungi. Particularities of the structure of viruses, prions, viroids. Highlighting microorganisms and structural elements by various microscopic techniques.</p>
Chapter 2. Physiology of bacteria. Growth and cultivation of bacteria. Antibiotics.	
<ul style="list-style-type: none">• to define the particularities of bacterial metabolism.• to know the mechanisms of biological oxidation.• to understand the particularities of bacterial growth and multiplication. Cell cycle.• to understand the peculiarities of viral reproduction• to know the principles of bacteria cultivation, viruses and fungi cultivation• to apply biosubstrate sampling techniques.• to have the skills to fill in the templates for the bacteriological(culture), virological and serological examinations of the specimens.• to apply the bacteriological method in the diagnosis of infectious diseases.• to read and and apply the results.• to know the action of physical, chemical and biological factors on microorganisms.• to know the concepts of disinfection, sterilization, aseptic and antiseptic.• to demonstrate the effectiveness of sterilization and disinfection• to define the notion of antibiotics and their classification.• to know the parameters of antibiotic activity in vitro.	<p>Microbial metabolism, peculiarities. Bacterial Enzymes. Role in bacterial physiology. Bioenergetics of microorganisms. Cultivation of bacteria and fungi. Culture media. Cultivation of viruses. Define aseptic and antiseptic. The main antiseptic substances. Notions of sterile and non-sterile object. Notions of specific and non-specific antagonism. The mechanisms of action of antibiotics. The mechanisms of bacterial resistance to antibiotics</p>



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Objectives	Content units
<ul style="list-style-type: none">• to possess techniques to determine the sensitivity to antibiotics.• reading and understanding an antibiogram• to explain the antibiotic resistance mechanisms.	
Chapter 3. Infection and Immunity.	
<ul style="list-style-type: none">• to know the particularities of the infectious disease and the factors involved in the infectious process.• to know the pathogenicity and virulence of microorganisms.• to know and to apply the techniques of the experimental (biological) method.• to define the notion of immunity and its types.• to apply immunological diagnostic methods in practice.• to formulate conclusions.• to develop their own opinions regarding the role of the immunological method in the diagnosis of infectious diseases• to apply knowledge to other disciplines.	<p>Appreciation of the role of the microorganism in the infectious process. Units virulence.</p> <p>Virulence factors of bacteria and fungi.</p> <p>Criteria for assessing the causal agent's etiological role.</p> <p>Notions of immunity. Immune system. Antigens, antibodies.</p> <p>Immunological tests.</p> <p>Definition of serodiagnosis and sero-identification</p> <p>Techniques for conducting direct, indirect serological reactions.</p> <p>Definition of immunoprophylaxis and immunotherapy.</p> <p>Classification of vaccines. Immunisation Program Schedule</p>
Chapter 4. Zoonosis. Pyogenic cocci. Airborne infections. Anaerobic infections. Spirochetoses	
<ul style="list-style-type: none">• to know the general characteristics of the pathogens of zoonanthroponosis, suppurative, aerogenic, anaerobic and spirochetosis infections• to apply informative methods for the diagnosis of the listed infections• to possess techniques for harvesting and transportation of samples to the laboratory.• to apply in practice the methods of prophylaxis and treatment of infectious diseases	<p>Taxonomy and classification of causative agents.</p> <p>Sources and mechanisms of transmission of agents.</p> <p>Pathogenesis and clinical forms. Pathogenicity factors.</p> <p>Diagnostic methods and interpretation of results.</p> <p>Peculiarities of post-infectious immunity and specific treatment.</p>
Chapter 5. The Enterobacteriaceae, Vibrionaceae families, the genera <i>Campylobacter</i> and <i>Helicobacter</i>. Laboratory diagnosis of intestinal infections.	
<ul style="list-style-type: none">• to know general characteristics of the causative agents from Enterobacteriaceae, Vibrionaceae families, the genera <i>Campylobacter</i> and <i>Helicobacter</i>.• to apply informative methods for the diagnosis of the listed infections• to possess techniques for harvesting and transportation of samples to the laboratory.• to apply in practice the methods of prophylaxis and treatment of infectious diseases.	<p>Taxonomy and classification of causative agents.</p> <p>Sources and mechanisms of transmission of agents.</p> <p>Pathogenesis and clinical forms. Pathogenicity factors.</p> <p>Diagnostic methods and interpretation of results.</p> <p>Peculiarities of post-infectious immunity and specific treatment.</p>
<ul style="list-style-type: none">• to know the morphobiological peculiarities of	<p>Taxonomy and classification of viruses.</p>



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Objectives	Content units
<p>viral agents</p> <ul style="list-style-type: none">• to apply informative methods for the diagnosis of the viral infections• to possess techniques for harvesting and transportation of biosubstrates to the laboratory.• to understand the particularities of the pathogenesis, immunity and treatment of viral infections• to know the viroscopic, virological methods for examining samples in viral infections• to know the immunological method in the diagnosis of viral infections• to apply in practice the methods of prophylaxis and treatment of viral infectious.• to possess techniques for identifying the viral genome using molecular biology techniques• to know the principles and particularities of antiviral chemotherapy	<p>Sources and mechanisms of transmission of viruses. Pathogenesis of viral infection and clinical forms. Virological method of diagnosis of viral infections. Preparation of specimens. Isolation, indication and identification of viruses. Reading and interpretation the results. Use of contemporary methods of diagnosis of infections (ELISA, IFT, PCR, etc.) Peculiarities of antiviral immunity. Methods of prophylaxis and specific antiviral treatment).</p>

VII. PROFESSIONAL (specific (SC)) and TRANSVERSAL (TC) COMPETENCES AND STUDY OUTCOMES

- **Professional (specific) (SC) competences**
- PC 1. Responsibly carrying out professional tasks according to the professional values and regulations, as well as the provisions of standing legislation.
- PC 2. Adequate knowledge of sciences about the structure of the body, the physiological functions and behavior of the human body in different physiological and pathological states, as well as relationships between its health, physical and social environment.
- PC 3. Promoting and applying measures to prevent infectious pathology;
- PC 4. Interdisciplinary integration of the doctor's activity in a team with efficient use of all resources;
- PC 5. Carrying out scientific research in the field of health and in other branches of science;

• Transversal competences (TC)

- CT1. Autonomy and responsibility in the activity.

Study outcomes

At the end of the course the student will be able to:

- Knowing the particularities of the structure, the fundamental properties of the microorganisms, the habitat and the role in the human pathology;
- Understanding the morphobiological properties of microorganisms;
- Understanding the mechanisms of occurrence of infectious diseases in humans (multiplication - colonization - penetration - generalization);
- Knowing the principles of development and model the stages of the infectious process;
- To know the particularities of the microorganism-microorganism interaction;
- To know the basics and the practical role of recombinant DNA technology, the principles of bacterial gene study techniques;



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- Understanding the basic processes that ensure the growth and multiplication of microorganisms in laboratory conditions environments. The phases of bacterial culture evolution.
- Be able to evaluate the place and role of microbiology in the preclinical preparation of the medical student;
- Be competent to implement the knowledge and methodology in microbiology and immunology to explain physiological or pathological processes;
- Be able to implement the knowledge gained in the work and in a research work;
- Be competent to critically and reliably use the scientific information obtained through new information and communication technologies.

VIII. STUDENT'S SELF-TRAINING

No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	Working with information sources	Read the lecture or textbook material on the topic carefully. Read questions on the subject, which require a reflection on the subject. To get acquainted with the list of additional information sources on the topic. Select the source of additional information for that theme. Reading the text entirely, carefully and writing the essential content. Formulation of generalizations and conclusions regarding the importance of the topic / subject.	Ability to notice the essential; interpretive skills; workload	During the semester
1.	Working with the GUIDELINES (work book):	Until solving the tasks in the notebook to analyze the information and images from the subject in the lecture and workbook. Solving consecutive tasks. Formulate conclusions at the end of each lesson. Verify the final lessons of the lesson and appreciate their achievement. Selection of additional information, using electronic addresses and additional bibliography.	Workload, problem solving, ability to formulate conclusions	During the semester
2.	Working with online materials	Online self-evaluation, study of online materials on the subject website, expressing your own opinions through forum and chat	Number and duration of website entries, self-evaluation results	During the semester

IX. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

The discipline of Microbiology and Immunology is taught in a classical manner: with lectures and practical works.

The theoretical course of lectures is teach by course lectures. In the theoretical lessons, also use modern methods: lesson-discussion, lecture-conference, problem-solving lesson, which are oriented towards the efficient acquisition and achievement of the objectives of the didactic process.



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Practical forms of individual, frontal, group, activities, virtual lab work are used. To deeply assimilate the material, the students discuss the basic and the most difficult topics in an interactive way, study the smears on different microscopes (optically with immersion system, phase contrast, dark field, luminiscent), perform culturing, identification of microbial cultures, tests the sensitivity to antibiotics of isolated strains, studies and performs some serological reactions, studies biological preparations (immune diagnostic and curative sera, diagnoses, vaccines, probiotics, allergens, etc.), fill in the workbook. When necessary, computer images are presented.

Informational communication technologies are used in extracurricular lessons and activities - PowerPoint presentations, video.

- **Applied didactic strategies / technologies (subject specific)**

- **Observation** - Identification of characteristic elements of microorganisms structures, description of these elements or phenomena.
- **Analysis** - disassembling virtually of the whole into component parts. Highlighting the essential elements. Studying each element as part of the whole.
- **Schema / figure analysis** - Select the required information. Recognition, based on knowledge and information, selected structures indicated in the drawing, drawing. Analysis of the functions / role of recognized structures.
- **Comparison** - Analysis of the first object / process in a group and the determination of its essential features. Analysis of the second object / process and the determination of its essential features. Comparing objects / processes and highlighting common features. Comparing objects / processes and determining differences. Establishment criteria for differentiation. Formulation of conclusions.
- **Classification** - Identification of the structures / processes to be classified. Determining the criteria on which classification is to be made. Distribution of structures / processes by groups according to established criteria.
- **Schematic drawing** - Selection of elements, which must be included in the schema. Playing the Elements Selected by Different Symbols / Colors and Indicating Their Relationships. Wording of an appropriate title and legend of the symbols used.
- **Modeling** - Identify and select the elements needed to model the phenomenon. The imaging (graphical, schematic) of the phenomenon studied. Presenting of the phenomenon using the developed model. Formulation of conclusions, deduced from arguments or findings.
- **Experiment** - Formulating a hypothesis, based on known facts, on the process / phenomenon studied. Verifying the hypothesis by performing the processes / phenomena studied under laboratory conditions. Formulation of conclusions, deduced from arguments or findings „Brainstorming“, „Multi-voting“, „Round Table“, „Group Interview“, „Case Study“, „Creative Controversy“, „Focus-group“, „Portfolio“.
- **Methods of assessment (including an indication of how the final grade is calculated)**

Current:

- applying the tests,
- solving problems,
- analysis of case studies
- control assessments

Final: Exam

The final mark will consist of the average score from three pre-exam oral evaluation and evaluation assessments (part 0.5), final test sample in computerized system (share 0.5).



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Method of mark rounding at different assessment stages

Intermediate marks scale (annual average, marks from the examination stages)	National Assessment System	ECTS Equivalent
1,00-3,00	2	F
3,01-4,99	4	FX
5,00	5	E
5,01-5,50	5,5	
5,51-6,0	6	
6,01-6,50	6,5	D
6,51-7,00	7	
7,01-7,50	7,5	C
7,51-8,00	8	
8,01-8,50	8,5	B
8,51-8,00	9	
9,01-9,50	9,5	A
9,51-10,0	10	

The average annual mark and the marks of all stages of final examination (computer assisted, test, oral) - are expressed in numbers according to the mark scale (according to the table), and the final mark obtained is expressed in number with two decimals, which is transferred to student's record-book. *Absence on examination without good reason is recorded as "absent" and is equivalent to 0 (zero). The student has the right to have two re-examinations.*

X. RECOMMENDED LITERATURE:

A. Mandatory:

1. Kenneth J. Ryan, Sherris Medical Microbiology, Seventh Edition, 2018.
2. Jawetz, Melnick, Adelberg's Medical Microbiology 28th Edition, 2020.
3. Guidelines, recommendations, and methodical indications.
4. Materials of theoretical courses.
5. Levinson W. Review of Medical Microbiology and Immunology, tenth edition. Mc Graw Hill LANGE, 2008
6. Ananthanarayan R., C. K. Jayaram Paniker. Textbook of Microbiology. Orient Longman, 2005.

B. Additional:

1. Bergey's Manual of determinative bacteriology (ninth edition), 2011.
2. Junie M. Microbiologie clinică: Bacteriologie și virusologie medicală. Cluj-Napoca. Cluj-Napoca: Editura Medicală Universitară "Iuliu Hațieganu"; 2017, 238 p.