FACULTY OF PHARMACY

STUDY PROGRAM 0916.1 PHARMACY

CHAIR OF DRUG TECHNOLOGY

APPROVED
at the meeting of the Commission for Quality Assurance and Evaluation of the Curriculum faculty Pharmacy
Minutes No.2 of 09.11.2021
Chairman, Doctor of pharmacy, Associate Professor
Uncu Livia_____

APPROVED
at the Council meeting of the Faculty of Pharmacy
Minutes No.3 of 16.12.2021
Dean of Faculty, Doctor of pharmacy, Associate Professor
Nicolae Ciobanu_____

APPROVED
approved at the meeting of the chair Drug Technology
Minutes No.1 of 25.08.21
Head of chair, Doctor of pharmacy, Associate Professor
Ciobanu Nicolae_____

SYLLABUS

DISCIPLINE **INDUSTRIAL PHARMACEUTICAL TECHNOLOGY**

Integrated studies

Type of course: **Compulsory discipline**

Curriculum developed by the author:

Nicolae Ciobanu - Doctor of pharmacy, Associate Professor

Chisinau, 2021

I. INTRODUCTION

- General presentation of the discipline: place and role of the discipline in the formation of the specific competences of the professional / specialty training program

The **Industrial Pharmaceutical Technology** course is a logical continuity of the previous course of Pharmaceutical Technology and is a fundamental component of the pharmaceutical field, which aims at acquiring technologies, equipment and methods for formulating medicines on an industrial scale. The actuality of the course is incontestable, considering that over 90% of the world's pharmaceuticals are produced under factory conditions.

Future pharmacists need knowledge in the field of developing, preparing and assessing the quality of drugs produced under industrial conditions.

The content of the course is structured by chapters depending on the presentation of the finished product (powders, solutions, tablets etc.) and results in the obtaining for the future pharmacist both the theoretical knowledge and the practical skills of using industrial equipment and machinery.

During the course, computer technology is widely used to demonstrate how the equipment and machinery work (schemes, thematic films).

- Mission of the curriculum (aim) in professional training

To provide to the students the knowledge and skills to preform and formulate pharmaceutical forms according to the biopharmaceutical requirements under industrial conditions; the acquisition of technology and methods of manufacturing of liquid, semisolid and solid forms of medicine, as well as extractive forms of plant and animal products; forming the skills of assessing the quality of the pharmaceutical forms according to the requirements of the normative analytical documentation.

- Language (s) of the course: Roumanian, English.
- Beneficiaries: students of the IV year, faculty of Pharmacy.

II. MANAGEMENT OF THE DISCIPLINE

Code of discipline		**S.07.O.072, S.08.O.078**	
Name of the discipline		**Pharmaceutical technology II**	
Person(s) in charge of the discipline		**Nicolae Ciobanu**	
Year	**IV**	Semester/Semesters	**VII, VIII**
Total number of hours, including: 300			
Lectures	**30**	Practical/laboratory hours	**105**
Seminars	**-**	Self-training	**165**
Form of assessment	**E**	Number of credits	**10**

III. TRAINING AIMS WITHIN THE DISCIPLINE

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

- ✓ ***at the level of knowledge and understanding:***
- ✓ **To determine** the objectives and content of the industrial pharmaceutical technology;
- ✓ **To determine** the object of study of the discipline;
- ✓ **To define** the concepts of pharmaceutical technology and its biopharmaceutical assessment;
- ✓ **To correctly interpret** the technological operations at different stages of the technological process of manufacturing of pharmaceutical forms;
- ✓ **To identify** the main physico-chemical and technological parameters of drug substances, auxiliary substances, adjuvants and packaging materials that determine the quality of the finished pharmaceutical product.
- ✓ **To know** the rules of good manufacturing practice (GMP) under the conditions of the pharmaceutical industry;
- ✓ **To describe** the pharmaceutical processes and devices used in the pharmaceutical industry;
- ✓ **To know** the physico-chemical properties of drug substances, auxiliary substances, adjuvants and packaging materials
- ✓ ***at the application level:***
  - **To identify** the particularities of the application of technological operations in pharmaceutical technology;
  - **To classify** the principles of preformulation and formulation of pharmaceutical forms according to biopharmaceutical requirements;
  - **To explain** the essence of the principles for selecting the physico-chemical properties of drug substances, auxiliary substances and packaging material in formulating pharmaceutical forms;
  - **To compare** the practical experience and the doctrine of pharmaceutical technology at various stages of evolution in preformulation and formulation of drugs;
  - **To interpret** pharmacopoeial quality standards and reference standards;
  - **To apply** effective methods of developing new pharmaceutical forms.
  - **To organize** in the pharmaceutical industry the production on different technological flows.
  - **To use** the information from various acknowledged sources, for the purpose of elaboration of Quality Norms for Production of Medicines Documents.

- ✓ ***at the integration level:***
- ✓ **To create** new technologies for the manufacture of medicines;
- ✓ **To modify** the existing drug manufacturing technologies in order to reduce production costs;
- ✓ **To design** the technological flows of drug production according to the requirements of the GMP rules;
- ✓ **To develop** the composition of a drug to increase the bioavailability of the active substance;
- ✓ **To formulate** new prescriptions of medicines with the use of various auxiliary substances;
- ✓ **To argue** from the biopharmaceutical point of view the quantities of auxiliary substances and adjuvants in the formulations of the medicines;
- ✓ **To validate** the technological processes of drug manufacture and the interphase quality control methods;
- ✓ **To assess** the influence of biopharmaceutical factors on the bioavailability of active substances in pharmaceutical forms;
- ✓ **To recommend** new auxiliaries and adjuvants needed in drug formulation;
- ✓ **To develop** Technological Regulations for the manufacture of medicines;
- ✓ **To analyze** the failure modes and the effects of failures in the manufacturing process ("AMDE" process);
- ✓ **To coordinate** the stages of the technological process with the interphase control requirements for the quality of intermediate, semi-finished and finished products;
- ✓ **To schedule** research to develop new technologies for the manufacture of medicines;
- ✓ **To propose** new methods of assessing the quality of medicines in the manufacturing process;
- ✓ **To select** packaging materials suitable for packaging pharmaceutical forms;
- ✓ **To optimize** the composition of pharmaceutical forms in biopharmaceutical and pharmacokinetic aspect

IV. PROVISIONAL TERMS AND CONDITIONS

Industrial Pharmaceutical Technology addresses a wide range of problems in formulating and assessing the quality of various drugs, and therefore requires in-depth prior knowledge in the field of inorganic and organic chemistry, physical and colloidal chemistry, pharmaceutical chemistry as well as physicochemical methods analysis, pharmacology, pharmacognosis and technology of extemporaneous medicines.

V. THEMES AND ESTIMATE ALLOCATION OF HOURS

✓ ***Lectures***

Nr.	**Tema**	*No of hours*
1.	Actuality and main directions of development of the Industrial Technology of Medicines in the Republic of Moldova. Solutions. Preparation of aqueous and anhydrous solutions. Enhancement of the dissolution process. Standardization	2
2.	Separation of liquid and solid (solution purification). Sedimentation, filtration, centrifugation, pressing.	2
3.	Solvents. Alcoholometers. Alcohol. Correction. Methods for determining the concentration of ethanol.	2
4.	Tinctures. Characteristics, preparation, standardization.	2
5.	Fluid extracts 1: 1 and 1: 2. Methods of preparation. Standardization.	2
6.	Heat processes. Use of vapors. Heat exchangers. Evaporation. Evaporative installations. Secondary evaporation phenomena.	2
7.	Drying. Static and kinetics of drying. Drying methods. Gear. Drying by sublimation (lyophilization).	2
8.	Dense and dry extracts. Extraction methods for obtaining the extractive solution. Technological scheme for manufacturing dense and dry extracts.	2
9.	Capsules.	2
10.	Characteristic, classification. Methods of manufacture. Quality control.	2
11.	Tablets. Characteristic. Technological scheme for tablet manufacturing. Auxiliary substances used in the preparation of tablets. Influence of auxiliary substances and diluents on the therapeutic effect of the drug substances in the tablets.	2
12-13.	Importance and types of granulation. Verification of grain quality. Direct compression, compression machines. Characteristic. Influence of granulation type on the bioavailability of drug substances.	4
14.	Coating of tablets (by classic, compressed film wrapping). Quality testing of the tablets. Ways of completeness and development prospects, packaging and preservation of tablets.	2
15.	Sterile medicinal forms and aseptic preparations. Requirements for injectable drug forms. Preparation conditions, G.M.P. Solvents used in the preparation of injectable solutions. Obtaining demineralised water and water for injection under plant conditions. Non-aqueous solvents.	2

16.	Glass and polymers used in the manufacture of ampoules, vials. Formation of ampoules and their preparation for filling.	2
17.	Injection technology, stiffening and purification. Methods of solution spraying and ampoule welding. Methods of sterilization.	2
	Total	34

✓ ***Laboratory hours and self-training***

№	**Tema**	*Practical hours*	*Hours for ind. work*
1.	Assimilation of safety and safety rules. Shredding. Sifting. Preparation of compound powders. Compilation of material balance.	3	6
2-5.	Aqueous drug solutions. Preparation of the aluminum sub-acetate solution. Standardization. Aromatic waters. Syrups.	12	12
6.	Control work: "Grinding, sieving, mixing. Drug solutions. Aromatic waters. Syrups. "	3	8
7-8.	Anhydrous solutions. Alcoholometry. (Determination of concentration, dilution of ethanol). Tinctures. Preparation by different methods. Extracting. Standardization of tinctures. Determination of active principles, extractive substances, ethanol concentration. Compilation of the material balance for absolute ethanol.	6	12
9-10.	Maximum purified preparations (adonisid, ramnil, plantaglucide). Standardization. Individual preparations (routine, digitoxin, plantaglucide).	6	8
11.	Control work: "Theoretical basis of extraction. Pharmaceutical preparations obtained by extraction. Tinctures.	3	8
12-13.	Fluid extracts 1: 1 and 1: 2. Preparation of extracts by means of percolation, accelerated maceration, countercurrent. Standardization of fluid extracts (determination of the concentration of ethanol, active principles, extractive substances). Compilation of material balance for extractive substances.	6	10
14.	Dense and dry extracts.	3	9
15.	Control work: "Heat processes. Evaporation, drying. Fluid, dense and dry extracts. "	3	8
16-18.	Medicinal capsules (flexible, rigid). Preparation, quality check. Preparation of suspensions, emulsions, ointments, emplasts (streptocide liner, sintomycin, Wišnevskii, zinc ointment, lead oxide). Quality check. Assimilation of mixers, mills, dispersants.	12	12

19.	Seminar. Capsules gelatinous. Ointments. Liniments. Pastes. Patches. Mustard plaster.	4	8
20.	Tablets. Determination of physical - chemical and technological properties of powders and granules	4	6
21.	Manufacture of tablets by direct pressing (sodium chloride, sodium bromide, boric acid) and auxiliary substances (acetylsalicylic acid tablets). Quality check. Assimilation of compressing machines.	4	8
22-23.	Manufacture of tablets by wet granulation (streptocide, sulfadecyzine, dibazol, caffeine and sodium benzoate tablets). Quality check.	8	8
24.	Coating of coated tablets. Friable tablets, granules. Quality check.	4	6
25.	Seminar. Tablets	4	8
26.	Solution for injection in vials. Preparation of ampoules for filling. Control of the thermal and chemical stability of ampoule glass. Determining the size of the vacuum to fill ampoules with solutions.	4	6
27.	Injection solutions that require special purification (calcium chloride, magnesium sulphate, glucose) etc. Quality check.	4	6
28-29.	Preparation of injectable solutions with stabilizers (novocaine hydrochloride salt, caffeine and sodium benzoate, novocainamide, ascorbic acid), etc. Checking the quality of injectable solutions. Injection solutions without thermal stabilization (sol Hexamethylenetetramine) sol oily injectables (camphor sol). Quality check.	8	8
30.	Seminar. Completion of technology and standardization of injectable drug forms.	4	8
	Total	**105**	**165**

VI. REFERENCE OBJECTIVES OF CONTENT UNITS

Objectives	Content units
Chapter 1. Powders. Fading, sieving, material balance	
• to define the particularities of the powders as a pharmaceutical form • To know the stages of the process of obtaining powders, methods of analysis, conditioning and delivery • demonstrate ability to analyze and systemize the material in the form of technological regulation • apply the methodology for calculating the material balance by stages of the technological process as well as the global material balance sheet • integrate the theoretical knowledge and practical methods of obtaining powders and calculate the material balance	Introduction to industrial drug technology Structure and role of technological regulation of production. The type and methods of calculating the balance sheet. Definition and methods of powder preparation. Grinding and sifting as stages of the technological process. Appliance and equipment
Chapter 2. Solutions for internal and external use	
• define solutions as a pharmaceutical form and distinguish between different types of solutions and their particularities • know the specifics of the preparation of solutions for internal and external use, syrups, aromatic waters, the main methods of obtaining and purifying • demonstrate skills to analyze the effectiveness of different solution preparation techniques • apply different methods of preparing solutions for internal or external use, syrups and aromatic waters • integrate the theoretical and practical knowledge to establish the most effective techniques for working with solutions	Definition and methods of preparing solutions for internal and external use, syrups, aromatic waters. Mixing methods: Pipe, circulation, pneumatic and mechanical mixing. Methods of separation of solid bodies of liquids: sedimentation, centrifugation, filtration.
Chapter 3. Extractive preparations - tinctures, extracts (fluids, soft, dried), maximally purified preparations	

• Define the main types of extractive preparations • know the differences and specificities of obtaining, controlling and standardizing extractive products • demonstrate the knowledge of different heat processes and the equipment used in these processes • correctly apply the calculation methods for obtaining different alcohol alcohol • to integrate the theoretical and practical knowledge for the correct selection of the optimal extraction method in order to obtain an extractive preparation	Ethyl alcohol - obtaining, properties, methods for determining the concentration of ethyl alcohol. Tinctures - definition, classification, stages of technological process, equipment and machinery. Extracts - Definition, classification, stages of technological process, equipment and machinery. Maximum purified preparations - definition, classification, process steps, equipment and machinery. Heat processes. Equipment and machinery
Chapter 4. Semi-solid pharmaceutical forms: gelatine capsules, ointments, pastes, emulsions, suspensions and pharmaceutical emulsions	
• Define the main semi-solid pharmaceutical forms • know the specificity, classification and properties of semisolid pharmaceutical forms • demonstrate skills to appreciate the advantages and disadvantages of different methods of preparing gelatinous capsules and other semisolid pharmaceutical forms • apply different methods of preparation of gelatine capsules, ointments, tangles, pastes and emplasts • integrate the theoretical and practical knowledge for the multi-faceted assessment of a concrete semisolid pharmaceutical form.	Gelatin Capsules - definition, classification, process steps, equipment and machinery. Ointments, liniments, pastes - definition, classification, stages of technological process, equipment and machinery. Emplastre and Sinapism - definition, classification, stages of technological process, equipment and machinery. Pharmaceutical Suspensions and Emulsions - Definition, classification, stabilization methods, equipment and machinery.
Chapter 5. Tablets	
• define different types of tablets and their particularities • know the types and role of the auxiliary substances used in the preparation of the tablets • demonstrate ability to analyze the properties of the active and auxiliary substances in order to	Physico-chemical and technological properties of powders and granulates. Tablets - definition, classification, stages of the technological process, equipment and equipment. Excipients and their role in the

select the optimum method of obtaining the tablets • correctly apply the methods of obtaining the tablets, observing the standards imposed by the DAN • integrate the theoretical and practical knowledge for the purpose of assessing the quality of a tablet using pharmacological analysis methods	formulation of tablets Modern types of tablets.
Capitolul 6. Injectable solutions	
• define injectable solutions, their classification and their particularities • know the type and role of the auxiliary substances used in the preparation of injection solutions, as well as the glass for their packaging • demonstrate ability to analyze different injectable solutions for the correct selection of the optimum method of production • apply modern techniques and methods to formulate injectable solutions • integrate the theoretical and practical knowledge in order to correctly assess the quality of an injectable solution according to pharmacopoeial rules.	Water for injections - description, properties, methods of production, equipment and machinery. Bottle vials - types, properties, equipment and machinery. Injection solutions - definition, classification, stages of the technological process, equipment and machinery. New Trends in Formulation of Parenteral Preparations.

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

✓ Professional (specific) (SC) competences

• SC1. Strong knowledge and understanding of the theoretical bases of industrial drug technology processes as well as basic principles in organizing the preparation of drugs under factory conditions.

• SC2. Understanding the responsibility and role of the pharmacist-technologist in the process of producing the drug, as well as assessing the production process through the material balance sheet, yield and consumption coefficients.

• SC3. Knowledge of the stages of the technological process of preparation of drugs, equipment and equipment used in this process.

• SC4. Understanding the importance of complying with the requirements of the sanitary regime and the rules of good manufacturing practice under plant conditions in order to obtain a qualitative product.

• SC5. Understanding the influence of pharmaceutical factors on the quality of biopharmaceutical preparations, as well as the general and specific methodologies for assessing the quality of the finished product.

• SC6. Applying computing and virtual environments to solving situations.

✓ Transversal competences (TC)

• TC1. Applying the scientific and theoretical knowledge in the pharmaceutical field in the process of organizing the production. Observing the rules of good manufacturing practice and professional ethics. Adaptation to new technologies, application of logical reasoning, professional-personal development, assessment and self-evaluation capacities.

• TC2. The ability to identify a complicated problem and to analyze it in order to form the plan of realization.

• TC3. The ability to develop the drug production process (promoting initiative spirit, dialogue, cooperation, positive attitude) and forming an attitude of individual responsibility towards the quality of the finished product..

✓ Study outcomes

- **To determine** the subject of study of the discipline;
- **Define** the concepts of industrial drug technology and their assessment according to DAN requirements;
- **To correctly interpret** the technological operations at different stages of production of drugs according to the technological regulation;

- **Identify** the role and main physico-chemical and technological parameters of drug substances, auxiliary substances, adjuvants and packaging materials that determine the quality of the drug.
- **To know** the rules of good manufacturing practice in factory conditions;
- **Describe** the processes, equipment and machinery used to obtain finished drugs;
- **Know** the physico-chemical properties of drug substances, auxiliary substances, adjuvants and packaging materials

VIII. STUDENT'S SELF-TRAINING

No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	Working with information sources	Reading the lecture or the material in the manual to the topic carefully. Read questions on the subject, which require a reflection on the subject. Wording of generalizations and conclusions regarding the importance of the theme / subject.	Ability to extract the essentials; interpretative skills; volume of work	During the semester
2.	Referat and other research works	Analysis of relevant sources on the topic of the paper. Preparation of papers and other analysis and research papers. Compilation of the report in accordance with the requirements in force and presentation to the chair.	Relevance of the material used and the source of information Concordance of the information with the proposed theme. Originality and complexity of exposure	During the semester
3.	Solving of situational problems	Selecting the main information from the problem and identifying the unknown. Correct method selection. Making calculations. Full and succinct description of the answer.	Corresponding to the correct answer. Compliance of the calculation method. Solve the problem by several methods.	During the semester

IX. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

- ***Teaching and learning methods used***

The discipline of Industrial Pharmaceutical Technology is traditionally taught: lectures and laboratory works. Lectures are held by the course holder. In the laboratory, the work of the students is maximized, each student or group of students prepares a specific pharmaceutical form, appreciates the quality of the pharmaceutical form prepared in accordance with the pharmacopoeial requirements, assesses the efficiency of the work by calculating the material balance and controlling the prepared pharmaceutical form.

- ***Recommended learning methods***

- **Observation** - Identification of the specific elements of each pharmaceutical form, description of these elements.
- **Analysis** - Imaginary decomposition of the technological process into parts or component stages. Highlighting the essential elements. Studying each element as part of the whole.
- **Schema / figure analysis** - Selection of required information. Recognition of the equipment or replaying equipment, of the process in which it is used. Analysis of the functions / role of recognized structures.
- **Comparison** - Analysis of the first equipment / equipment in a group and determination of its essential features. Analysis of the second equipment / equipment and the determination of its essential features. Comparison of equipment / equipment and highlighting common features. Comparison of equipment / equipment and determination of differences. Establishment criteria for decommissioning. Formulation of conclusions.
- **Classification** - Identification of pharmaceutical forms or technological processes to be classified. Determining the criteria on which classification is to be made. Breakdown by groups according to established criteria.
- **Elaboration of the scheme** - 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** - Identifying and selecting the elements needed to model the phenomenon. The imaging (graphical, schematic) of the phenomenon studied. Formulation of conclusions, deduced from arguments or findings.

- ***Applied teaching strategies / technologies*** *(specific to the discipline)*

"Brainstorming", "Round Table"; "Group Interview"; "Case Study"; "Focus-group technique", "Portfolio".

Practical virtual works with the use of computer technology - the demonstration of the process of the technological process, the way of working different equipment and machines with the help of films. The chair has a computer room (PC Workstation PC1330 Navigator and PC Mini Nettop Seli 3Q Core and BENQ monitor). Computers are connected to the Internet via Wireless (Router Model WR941 ND).

Virtual training (movies)

No	Name of the movie	PPages, slides, minutes
1.	001. Alcohol rectification. Correction columns (English video)	**10,32 minutes**
3.	002. Getting the Ointments (video in English)	**7,45 minutes**
4.	003. Obtaining the gelatin capsules by the pressing method (video in English)	**10,45 minutes**
5.	004 Obtaining and filling the capsules (video in English)	**13,15 minutes**
6.	005 Rotary tablet machines (English video)	**9,35 minutes**
7.	006 Eccentric compressing machines (video in English)	**8,36 minutes**
8.	007 Packaging capsules and tablets in blisters (English video)	**7,41 minutes**
9.	008 Preparation of ampoules (video in English)	**12,24 minutes**
10.	009 Preparation of Injection Solutions (video in English)	**6,34 minutes**
11.	010 Preparation and packaging of infusion solutions (video in English)	**9,40 minutes**
	TOTAL	**94,47 minutes**

- ***Methods of assessment*** *(including the method of final mark calculation)*
  - **Current**: Front and individual control by:

➢ Problems solving;

➢ Applying theoretical material to work practice;

➢ Seminars

Final*:* examen

The average annual mark and the scores of all the final examination (computer assisted, test, oral) - all will be expressed in numbers according to the scoring scale (according to the table), and the final grade obtained will be expressed in two decimal digits will be transferred to the notes book.

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. Compulsory:

1. I.Barbăroşie, N.Ciobanu, A.Znagovan. Tehnologia industrială a medicamentelor. Indicaţii pentru studenţi. Chişinău 1992.
2. I.Barbăroşie, E.Diug, N.Ciobanu. Tehnologia medicamentelor industriale, „Stiința,, , Chișinău, 1993.
3. Nomenclatorul de Stat al Medicamentelor.
4. Под ред. А.И.Тенцовой. Руководство к лабораторным занятием по заводской технологии лекарственных форм. (для студентов фарм. Институтов) М.«Медицина», 1986
5. Под ред. Л.А.Ивановой. Технология лекарственных форм. Для студентов фарм. Институтов М. «Медицина» 1991 Т.2.

B. Additional:

1. Leucuţa S. Tehnologia farmaceutică industrială. – Dacia.- 2001
2. Iuliana Popovici, Dumitru Lupuleasa. Tehnologia farmaceutică , vol.1.– Ed. Polirom– Iaşi, 1997.
3. Iuliana Popovici, Dumitru Lupuleasa. Tehnologia farmaceutică (tratat), vol.2.– Ed. Polirom– Iaşi, 2008.
4. Iuliana Popovici, Dumitru Lupuleasa. Tehnologia farmaceutică (tratat), vol.3.– Ed. Polirom– Iaşi, 2009.