

SYLLABUS

1. General information on the course

Full course name	Fundamentals of scientific research in medicine
Full official name of a higher education institution	Sumy State University
Full name of a structural unit	Medical Institute. Department of Morphology
Author(s)	Korniienko Viktoriia Volodymyrivna
Cycle/higher education level	The Second Level Of Higher Education, National Qualifications Framework Of Ukraine – The 7th Level, QF-LLL – The 7th Level, FQ-EHEA – The Second Cycle
Semester	18 тижнів протягом 11-го семестру
Workload	The volume of the discipline is 3 ECTS credits, 180 hours, of which 50 hours are contact work with teacher (30 hours - lectures, 20 hours - practical classes), 130 hours - individual work
Language(s)	English

2. Place in the study programme

Relation to curriculum	Compulsory course available for study programme "Medicine"
Prerequisites	Krok-1, Required knowledge of internal medicine (including medical genetics, endocrinology, dermatology, venereology, clinical pharmacology, clinical immunology and allergology, tuberculosis), obstetrics and gynecology, surgery (including pediatric surgery, neurosurgery).
Additional requirements	There are no specific requirements
Restrictions	There are no specific restrictions

3. Aims of the course

The purpose of the discipline is to acquire constructive, fundamental thinking and modern knowledge and professional skills to formulate a scientific hypothesis, goals and objectives of scientific research in medicine, development of design and plan of scientific research and its implementation in scientific work, use of acquired skills in performing professional duties.

4. Contents

Module 1. Methodology of scientific research

<p>Topic 1 General scientific aspects of research methodology.</p> <p>Methods of empirical research, methods of theoretical knowledge, and general methods and techniques of research. Basic concepts of information analysis and synthesis, methods of abstraction, idealization, generalization, and systems approach. The general structure of research work: 1) formation of a theme of scientific research; 2) formation of the purpose and tasks of research; 3) theoretical research; 4) experimental or empirical research; 5) analysis and design of scientific research; 6) implementation and effectiveness of scientific research. The use of general methods in medical research.</p>
<p>Topic 2 Specific research methods and their application.</p> <p>Selection of specific research methods to test the hypothesis, features of intra- and interdisciplinary research. Experimental and clinical research methods. The use of specific research methods in practical work and clinical trials. Features of formation of research groups.</p>
<p>Topic 3 The motivation of scientific research. Methods of analysis of the literature selected for research.</p> <p>Extract. Abstract. Compendium. Classification and systematization of literary sources. Thematic review.</p>
<p>Topic 4 Criteria for evaluating the methodological quality of the study.</p> <p>Draft Concept of evaluation of scientific results. Basic principles: perspective, relevance, and consistency with priority areas of development (in science and technology, innovation), scientific novelty and innovation orientation, practical value, global integration.</p>
<p>Topic 5 Types of scientific data and methods of their calculation.</p> <p>Types of scientific data and methods of their calculation. Sequence processing, image analysis, modeling interrelation, probabilistic modeling, process modeling, and graphical data.</p>
<p>Topic 6 Description of scientific research.</p> <p>Transitional words and phrases for the logical presentation of a scientific text. Tokens to describe the chronological order. Causal constructions in a scientific text.</p>
<p>Module 2. General research methods in medicine</p>
<p>Topic 7 Histopathological research methods.</p> <p>The place of histological methods in scientific research. Collection of material, transportation, features of histological conducting of various tissue. Immunohistochemistry, cytological research methods. Histopathology in the diagnosis of malignant tumors. Bioethical principles in histological examination.</p>
<p>Topic 8 Biochemical methods in scientific research.</p> <p>Biochemical analysis of blood and other biological fluids. Modern biochemical analyzers - possibilities and features of interpretation of results. Elements of work in the biochemical laboratory.</p>
<p>Topic 9 The use of cell cultures in scientific research.</p> <p>Types of cell cultures. Assessment of cytotoxicity and biocompatibility. Interpretation of the results of experiments with cell cultures. Methods of visualization of living cells: fluorescence microscopy, dyes, quantitative evaluation.</p>

<p>Topic 10 Methods of microbiological laboratory diagnostics.</p> <p>Microbiological diagnosis of infectious diseases, rules of selection of pathological material, storage and transportation conditions. Methods of isolation and identification of bacteria, determination of sensitivity to antibiotics.</p>
<p>Topic 11 Methods of molecular genetic research.</p> <p>Methods for determining genetic polymorphism on the example of the development of the most common cardiovascular diseases (atherosclerosis, hypertension) and complications (ischemic stroke, acute coronary syndrome).</p>
<p>Module 3. Specific research methods in medicine</p>
<p>Topic 12 Methods for assessing the mechanical and physicochemical properties of biomaterials for medical purposes.</p> <p>Evaluation of physicochemical properties of implants: SEM, EDX, XRD, Raman spectroscopy, measurement of the type of wettability of the material, surface roughness and durability characteristics, corrosion resistance.</p>
<p>Topic 13 Visualization of the surface of biological objects.</p> <p>Scanning electron microscopy as a method of visualization, principles of procedure. Preparation of biological samples: types of fixation, dehydration, sputtering.</p>
<p>Topic 14 Introduction of new methodological approaches to the development and study of nanomaterials for medical purposes.</p> <p>Modern methods of synthesis of nanomaterials. Methods of structural and physical parameters evaluation, electrical conductivity. Sensors.</p>
<p>Module 4. Arrangement and carrying out of independent research</p>
<p>Topic 15 Arrangement of an independent research project.</p> <p>Choice of research method within the project. Determining the relevance of the selected study. Work with literary sources. Formation of research groups.</p>
<p>Topic 16 Conducting own research within the planned project.</p> <p>Preparation of the research samples. Application of selected research methods.</p>
<p>Topic 17 Evaluation of the obtained research results and formation of conclusions.</p> <p>Analysis of the results of the study using statistical methods. Description, generalization of results and presentation of conclusions.</p>
<p>Topic 18 Graded test</p> <p>Defense and presentation of an independent research project.</p>

5. Intended learning outcomes of the course

After successful study of the course, the student will be able to:

LO1	Be able to abstract thinking, analysis, and synthesis.
LO2	Be able to learn, master modern knowledge, and apply the knowledge in practice.

LO3	To know and understand of the subject area and professional activity comprehension.
LO5	Be able to make reasoned decisions; teamwork ability; interpersonal skills.
LO6	Be able to communicate in a foreign language.
LO7	Be able to use information and communication technologies.
LO8	Be determined and persistent on the tasks and commitments undertaken.
LO10	Be able to maintain and multiply moral, cultural, scientific values and achievements of society based on understanding the history and development patterns of the subject area, its place in the general system of knowledge about nature and society and in the development of society, techniques and technologies using different types and forms of physical activity for active recreation and a healthy lifestyle.
LO11	Be able to solve medical problems in new or unfamiliar environments given incomplete or limited information, taking into account aspects of social and ethical responsibility.

6. Role of the course in the achievement of programme learning outcomes

Programme learning outcomes achieved by the course.

For 222 Medicine:

PO22	To communicate one's knowledge, conclusions, and arguments on health issues and related concerns clearly and unambiguously to professionals and non-specialists, in particular to students.
PO23	To manage healthcare workflows that are complex, unpredictable and require new strategic approaches; to organize conditions for work and professional development of staff.
PO24	To communicate freely in state and foreign languages orally and in writing in order to discuss professional and research activities.
PO25	To make effective healthcare decisions assessing resources and considering social, economic, and ethical implications.

7. Teaching and learning activities

7.1 Types of training

<p>Topic 1. General scientific aspects of research methodology.</p> <p>pr.tr.1 "General scientific aspects of research methodology." (full-time course)</p> <p>Methods of empirical research, methods of theoretical knowledge, and general methods and techniques of research. Basic concepts of information analysis and synthesis, methods of abstraction, idealization, generalization, and systems approach. The general structure of research work: 1) formation of a theme of scientific research; 2) formation of the purpose and tasks of research; 3) theoretical research; 4) experimental or empirical research; 5) analysis and design of scientific research; 6) implementation and effectiveness of scientific research. The use of general methods in medical research.</p>
<p>Topic 2. Specific research methods and their application.</p>

pr.tr.2 "Specific research methods and their application." (full-time course)

Selection of specific research methods to test the hypothesis, features of intra- and interdisciplinary research. Experimental and clinical research methods. The use of specific research methods in practical work and clinical trials. Features of formation of research groups.

Topic 3. The motivation of scientific research. Methods of analysis of the literature selected for research.

pr.tr.3 "The motivation of scientific research. Methods of analysis of the literature selected for research." (full-time course)

Extract. Abstract. Compendium. Classification and systematization of literary sources. Thematic review.

Topic 4. Criteria for evaluating the methodological quality of the study.

pr.tr.4 "Criteria for evaluating the methodological quality of the study." (full-time course)

Draft Concept of evaluation of scientific results. Basic principles: perspective, relevance, and consistency with priority areas of development (in science and technology, innovation), scientific novelty and innovation orientation, practical value, global integration.

Topic 5. Types of scientific data and methods of their calculation.

pr.tr.5 "Types of scientific data and methods of their calculation." (full-time course)

Types of scientific data and methods of their calculation. Sequence processing, image analysis, modeling interrelation, probabilistic modeling, process modeling, and graphical data.

Topic 6. Description of scientific research.

pr.tr.1 "Description of scientific research." (full-time course)

Transitional words and phrases for the logical presentation of a scientific text. Tokens to describe the chronological order. Causal constructions in a scientific text.

Topic 7. Histopathological research methods.

pr.tr.2 "Histopathological research methods." (full-time course)

The place of histological methods in scientific research. Collection of material, transportation, features of histological conducting of various tissue. Immunohistochemistry, cytological research methods.

Topic 8. Biochemical methods in scientific research.

pr.tr.6 "Biochemical methods in scientific research." (full-time course)

Biochemical analysis of blood and other biological fluids. Modern biochemical analyzers - possibilities and features of interpretation of results. Elements of work in the biochemical laboratory.

Topic 9. The use of cell cultures in scientific research.

<p>pr.tr.9 "The use of cell cultures in scientific research." (full-time course)</p> <p>Types of cell cultures. Assessment of cytotoxicity and biocompatibility. Interpretation of the results of experiments with cell cultures. Methods of visualization of living cells: fluorescence microscopy, dyes, quantitative evaluation.</p>
<p>Topic 10. Methods of microbiological laboratory diagnostics.</p>
<p>pr.tr.10 "Methods of microbiological laboratory diagnostics." (full-time course)</p> <p>Microbiological diagnosis of infectious diseases, rules of selection of pathological material, storage and transportation conditions. Methods of isolation and identification of bacteria, determination of sensitivity to antibiotics.</p>
<p>Topic 11. Methods of molecular genetic research.</p>
<p>pr.tr.11 "Methods of molecular genetic research." (full-time course)</p> <p>Methods for determining genetic polymorphism on the example of the development of the most common cardiovascular diseases (atherosclerosis, hypertension) and complications (ischemic stroke, acute coronary syndrome).</p>
<p>Topic 12. Methods for assessing the mechanical and physicochemical properties of biomaterials for medical purposes.</p>
<p>pr.tr.12 "Methods for assessing the mechanical and physicochemical properties of biomaterials for medical purposes." (full-time course)</p> <p>Evaluation of physicochemical properties of implants: SEM, EDX, XRD, Raman spectroscopy, measurement of the type of wettability of the material, surface roughness and durability characteristics, corrosion resistance.</p>
<p>Topic 13. Visualization of the surface of biological objects.</p>
<p>pr.tr.13 "Visualization of the surface of biological objects." (full-time course)</p> <p>Scanning electron microscopy as a method of visualization, principles of procedure. Preparation of biological samples: types of fixation, dehydration, sputtering.</p>
<p>Topic 14. Introduction of new methodological approaches to the development and study of nanomaterials for medical purposes.</p>
<p>pr.tr.14 "Introduction of new methodological approaches to the development and study of nanomaterials for medical purposes." (full-time course)</p> <p>Modern methods of synthesis of nanomaterials. Methods of structural and physical parameters evaluation, electrical conductivity. Sensors.</p>
<p>Topic 15. Arrangement of an independent research project.</p>
<p>pr.tr.15 "Arrangement of an independent research project." (full-time course)</p> <p>Choice of research method within the project. Determining the relevance of the selected study. Work with literary sources. Formation of research groups.</p>
<p>Topic 16. Conducting own research within the planned project.</p>

pr.tr.16 "Conducting own research within the planned project." (full-time course) Preparation of the research samples. Application of selected research methods.
Topic 17. Evaluation of the obtained research results and formation of conclusions.
pr.tr.17 "Evaluation of the obtained research results and formation of conclusions." (full-time course) Analysis of the results of the study using statistical methods. Description, generalization of results and presentation of conclusions.
Topic 18. Graded test
pr.tr.18 "Graded test." (full-time course) Defense and presentation of an independent research project.

7.2 Learning activities

LA1	The accomplishment of practical tasks
LA2	E-learning in systems (the list is specified by the teacher, for example, Google Classroom, Zoom and in the format of the You tube channel)
LA3	Individual research project
LA4	Preparation of research work
LA5	Preparation of multimedia presentations
LA6	Solving of situational problems
LA7	Solve practical problems with the help of online technologies

8. Teaching methods

Course involves learning through:

TM1	Cross-discussion
TM2	Educational discussion / debate
TM3	Practice-oriented learning
TM4	Case-study
TM5	Brain storm
TM6	Design method
TM7	Research work

The educational discussion/debate will help understand the subject area and its place in the general system of knowledge about nature and society (LO7). The brainstorming method will develop the ability to make informed decisions, work in a team, and have interpersonal interaction skills (LO4). Opportunity to exchange views during cross-discussion, students will acquire the skills of a defined and persistent attitude to the tasks and responsibilities (LO6). Analysis of specific situations will improve the ability to think abstractly, analyze the information obtained, draw conclusions based on

the synthesis of the received data, and use information and communication technologies (LO1, 5). Practical-oriented learning will develop the ability to learn, master modern knowledge and apply it in practical situations (LO2). The project method will deepen knowledge and understanding of the subject area and professional activity (LO3).

During the practical classes, the educational discussion/debate and analysis of specific situations will develop communication skills, a systematic approach, and flexibility of thinking; creativity and responsibility in solving the tasks will be formed through cross-discussions. To develop skills of analysis and synthesis of information, forecasting, analyzing expected and obtained research results, and expressing opinions in writing and orally, applicants will prepare projects as part of their research. Self-study skills and the ability to self-assess while planning research will develop practice-oriented learning; the ability to produce new ideas, use the acquired theoretical knowledge and practical skills in a coordinated manner, and reasonably manage the implementation of research will be developed using the method of brainstorming.

9. Methods and criteria for assessment

9.1. Assessment criteria

ECTS	Definition	National scale	Rating scale
A	Outstanding performance without errors	5 (Excellent)	$90 \leq RD \leq 100$
B	Above the average standard but with minor errors	4 (Good)	$82 \leq RD < 89$
C	Generally sound work with some errors	4 (Good)	$74 \leq RD < 81$
D	Fair but with significant shortcomings	3 (Satisfactory)	$64 \leq RD < 73$
E	Performance meets the minimum criteria	3 (Satisfactory)	$60 \leq RD < 63$
FX	Fail – some more work required before the credit can be awarded	2 (Fail)	$35 \leq RD < 59$
F	Fail – considerable further work is required	2 (Fail)	$0 \leq RD < 34$

9.2 Formative assessment

FA1	Defens of presentations and abstracts
FA2	Interviews and oral comments of the teacher on his results
FA3	Peer assessment
FA4	Checking and evaluating written assignments

9.3 Summative assessment

SA1	Current success in the discipline
SA2	Final control: graded test

Form of assessment:

11 semester	100 scores
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SA1. Current success in the discipline		60
	Oral questioning and testing	60
SA2. Final control: graded test		40
	Graded test, which is conducted in the form of presentation and defense of the project	40

Form of assessment (special cases):

11 semester		100 scores
SA1. Current success in the discipline		60
	In case of quarantine restrictions, practical classes are held remotely using the platform Mix.sumdu.edu.ua, Zoom, Google meet.	60
SA2. Final control: graded test		40
	In case of quarantine restrictions, practical classes are held remotely using the platform Mix.sumdu.edu.ua, Zoom, Google meet.	40

10. Learning resources

10.1 Material and technical support

MTS1	Libraries
MTS2	Computers, computer systems and networks
MTS3	Graphic tools (drawings, drawings, maps, diagrams, posters, etc.)
MTS4	Laboratory equipment BRC MI (compact CO2 incubator, cryo container, microplate photometer)
MTS5	Multimedia, video and audio playback, projection equipment (video cameras, projectors, screens, smart boards, flipchart)
MTS6	Medical premises / premises and equipment (Center for Collective Use of Scientific Equipment of the Medical Institute "Center for Biomedical Research", SSU University Clinic, Center for Collective Use of Scientific Equipment "Laboratory of Materials Science of Helioenergy, Sensory and Nanoelectronic Systems")

10.2 Information and methodical support

Essential Reading	
1	A Guide to Systems Research [Электронный ресурс] : Philosophy, Processes and Practice / edited by Mary C. Edson, Pamela Buckle Henning, Shankar Sankaran. — 1st ed. 2017. — Singapore : Springer Singapore, 2017. — XV, 244 p.
2	Antimicrobial resistance - theory and methods https://www.coursera.org/learn/antimicrobial-resistance
Supplemental Reading	

1	Principles of Research Methodology / Phyllis G. Supino, Jeffrey S. Borer Editors, Springer-Verlag New York, 2012. - 276c.
2	Methods of molecular biology https://www.coursera.org/learn/methods-of-molecular-biology
Web-based and electronic resources	
1	https://rc.med.sumdu.edu.ua/