



## HISTORY OF SCIENCE AND TECHNOLOGY (GM 2)

### Programme of the academic discipline (Syllabus)

Details of the academic discipline	
<b>Level of higher education</b>	<i>First (Bachelor's degree)</i>
<b>Field of study</b>	<i>17 Electronics and telecommunications</i>
<b>Programme subject area</b>	<i>171 Electronics</i>
<b>Educational programme</b>	<i>Electronic components and systems</i>
<b>Course status</b>	<i>Compulsory</i>
<b>Mode of study</b>	<i>Internal study (full-time study)</i>
<b>Year of study, semester</b>	<i>First year, spring semester</i>
<b>Scope of the course</b>	<i>2 ECTS credits / 60 hours (Lectures - 18 hours, seminars - 18 hours, self-study - 24 hours)</i>
<b>Semester control / control measures</b>	<i>Final test, Module test</i>
<b>Schedule</b>	<i>Lectures (once every two weeks starting from the 1st week), Seminars (once every two weeks preferably after the lecture) For extramural students according to the session schedule</i>
<b>Language of instruction</b>	<i>Ukrainian / English</i>
<b>Information about course supervisor / lecturers</b>	<i><u>Responsible for the Syllabus</u> Candidate of Historical science, Associate Professor of the Department of History Vitalii Buzan <a href="mailto:buzan.vitalii@iill.kpi.ua">buzan.vitalii@iill.kpi.ua</a> <u>Lecturers, seminars:</u> academic staff of the Department of History, Faculty of Sociology and Law <a href="https://history.kpi.ua/department/academic-staff/">https://history.kpi.ua/department/academic-staff/</a></i>
<b>Course placement</b>	<i>The course is hosted on the platform of remote education named «Sikorsky» which included Moodle and Google Classroom etc. (URL-invite depends on the faculty)</i>

### Programme of the academic discipline

#### 1. Description of the academic discipline, its purpose, subject of study and learning outcomes

The academic discipline «History of Science and Technology» was developed on the basis of a combination of humanities and natural knowledge, and therefore, unlike «classic schemes» that were developed in the past and focused mainly on the history of natural science and technology, it is aimed at comprehension all forms of scientific knowledge – natural, technical and humanities. The study of this academic discipline is an important means of forming the scientific worldview of students, promoting the growth of their general erudition, and it is also an integral constituent part of the compulsory educational components of the general training at Igor Sikorsky Kyiv Polytechnic Institute.

The syllabus of the academic discipline «History of Science and Technology» is developed on the basis of the principle of constructive alignment, which makes it possible to determine the necessary educational tasks and activities that students need to achieve the

expected learning outcomes and to plan the educational process in such a way as to maximize the opportunities of students to achieve desired results.

The **subject** of study of the discipline «History of Science and Technology» is the genesis and patterns of the formation and development of world science and technology, the history of mankind's activity in the scientific and technical sphere from ancient times to the present in close connection with global historical and cultural processes. «History of science and technology» is a science that develops dynamically and is constantly replenished with new knowledge, scientific concepts and facts.

The **purpose** of the academic discipline is to form students' understanding of the main stages, processes and events from the history of science and technology from ancient times to the nowadays and to develop integral expertise of the development of science and technology as a historical and cultural phenomenon; familiarization with the history of the accumulation of scientific knowledge within the framework of particular branches of natural, social, humanities, technical sciences in accordance with specific historical stages of human development.

According to the educational and professional programme of the first «bachelor» level of higher education «*Electronic components and systems*», after completion of study the academic discipline, students must acquire the following **competencies**:

- **GC 6** Ability to learn and master modern knowledge.
- **GC 14** Ability to preserve and multiply moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development 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, active recreation and a healthy lifestyle.

According to the educational and professional programme of the first «bachelor» level of higher education «*Electronic components and systems*», after completion of study the academic discipline, students must demonstrate the following **programme learning outcomes**:

- **O11** Argue the legal framework for the implementation of electronic devices and systems; evaluate the benefits of engineering developments, their environmental friendliness and safety; to defend their own worldviews and beliefs in production or social activities.

## ***2. Prerequisites and postrequisites of the academic discipline (place in the structural and logical scheme of education according to the relevant educational programme)***

In the structural and logical schemes of educational and professional programmes of the first (bachelor) level of higher education, the academic discipline «History of Science and Technology» is included in the list of compulsory academic disciplines aimed at the formation of general competences of a professional.

Prerequisites – the academic discipline is interdisciplinary and is taught in the 1st or 2nd semester of the 1st year of study at all educational programmes of the first (bachelor) level of higher education and does not depend on other academic disciplines (credit modules) in the structural and logical scheme of the educational programme. The basis of the study of the academic discipline is the basic knowledge of world history, the history of Ukraine and other humanities, natural and exact courses acquired during general secondary education.

Postrequisites – this academic discipline forms students' skills / ability to preserve and increase moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development of the subject area of the relevant educational and professional programme of the first (bachelor) level of higher education.

### **3. Content of the academic discipline**

#### **Chapter 1. Historical aspects of the development of science and technology in the agrarian era.**

Topic 1.1. Introduction. Theoretical and methodological framework of «History of science and technology».

Topic 1.2. Accumulation of knowledge, technique and technology in Prehistoric times and the age of Ancient civilizations.

Topic 1.3. Medieval technology. Scientific knowledge during the 16<sup>th</sup> – 18<sup>th</sup> centuries.

#### **Self-study topics related to chapter 1.**

The state of scientific knowledge before the Ancient world.

Science, technology and culture in the ancient world.

The progress of human thought in the Middle Ages.

#### **Chapter 2. Scientific thinking and technological capabilities of humanity in the Industrial era.**

Topic 2.1. Development of technology and scientific knowledge in the middle of the 18th century – 1870s.

Topic 2.2. New discoveries in physical, mathematical and natural sciences at the turn of the 19th and 20th centuries.

Topic 2.3. The development of technology in the early 20th century and during the First World War.

#### **Self-study topics related to chapter 2.**

Scientific knowledge of the Renaissance.

Classical science of Modern times (XVII – XIX centuries).

Technological advancement and scientific knowledge in the 19th century.

#### **Chapter 3. Main trends in the development of science and technology in the Information age.**

Topic 3.1. World science and technology in the 1920s-1940s.

Topic 3.2. Development of science and technology in the second half of the 20th – in the early 21st century.

Topic 3.3 History of the emergence and development of engineering education and technical sciences. Summary of the course.

#### **Self-study topics related to chapter 3.**

Scientific and technical development in the 20th century.

Science of Ukraine at different stages of development.

The main trends and prospects for the development of science in the 21st century.

### **4. Teaching materials and resources**

Basic and additional literature (hereinafter referred to as literature) is used to prepare for lectures, seminars, module test (which consists of three parts), self-study etc. Students independently read the literature to study the academic discipline using Internet resources, Google classroom. In the case of distance learning students can use electronic literature which is placed on university and external platforms.

#### **4.1 Basic literature:**

1. Bernal, J. D. Science in History. 4 Volumes. – London: Routledge, 1954. Vol. 1 Available at Google Books. URL: <https://tinyurl.com/vy5mau9w>

2. Bernal J. D. The Social Function of Science. – London: Routledge, 1939. Available at Internet Archive. URL: <https://archive.org/details/in.ernet.dli.2015.221783/page/n9/mode/2up>
3. Bunch B., Hellemans A., The history of science and technology. : A Browser's Guide to the Great Discoveries, Inventions, and the People who Made Them, from the Dawn of Time to Today. – Boston-New York: Houghton Milfin, 2004. Available at Internet Archive. URL: [https://archive.org/details/isbn\\_9780618221233/page/n9/mode/2up](https://archive.org/details/isbn_9780618221233/page/n9/mode/2up)
4. Encyclopaedia of the History of Science, Technology, and Medicine in Non-Western Cultures / Ed. Helaine Selin. – Berlin-Heidelberg-New York: Springer: 2008. Available at Google Books. URL: <https://tinyurl.com/ym5zmhsn>
5. Herd M., Jamison A. Hubris and hybrids: A Cultural History of Technology and Science. - London-New York: Routledge, 2003. Available at Google Books. URL: <https://tinyurl.com/efwsy5ss>
6. McClellan J. E., Dorn H., Science and Technology in world History. – Baltimore: The Johns Hopkins University Press, 2006. Available at Google Books. URL: <https://tinyurl.com/ctm94dah>

#### **4.2 Additional literature:**

1. Cumo Christopher. Science and technology in 20th century American life. – Westport-London: Greenwood Press, 2007. Available at Internet Archive. URL: <https://archive.org/details/sciencetechnolog0000cumo/page/n9/mode/2up>
2. Deming David. Science and Technology in World History. 4 volumes. – Jefferson-London: macfarland&Company, 2010. Available at Google Books. URL: <https://tinyurl.com/pasz6c8>
3. De syon Guillaume. Science and technology in Modern European life. –Westport-Longon: Greenwood Press, 2008. Available at Google Books. URL: <https://tinyurl.com/yf3vd3wv>
4. A History of Chinese Science and Technology / Ed. Yongxiang Lu. – Beijing: Springer, 2015. – 3 Vol. Available at Google Books. URL: <https://tinyurl.com/yp4k7mxv>
5. Macleod R., Johnson J. A. Frontline and Factory: Comparative Perspectives on the Chemical Industry at War, 1914–1924. – New York: Springer, 2006. Available at Google Books. URL: <https://tinyurl.com/8nu48s5s>
6. Small James S., The Analogue Alternative: The electronic analogue computer in Britain and the USA, 1930-1975. – London-New York: Routledge, 2001. Available at Google Books. URL: <https://tinyurl.com/42cxyv78>

#### **Digital resources:**

1. <https://books.google.com> – Digital library
2. <https://www.hathitrust.org> – Digital library
3. <http://www.archive.org> – Digital library
4. <https://openlibrary.org> – Digital library
5. <https://www.europeana.eu> – European Digital Library
6. <https://artsandculture.google.com/> – an online platform of high-resolution images and videos of artworks and cultural artifacts from partner cultural organizations throughout the world.
7. <https://sourcebooks.fordham.edu/science/sciencesbook.asp> – Internet History of Science Sourcebook
8. <http://www.ukrainiancomputing.org/> – European Virtual Computer Museum. Development of Computer Science and Technologies in Ukraine. Brief History.

### **Educational content**

#### **5. Teaching methods of an academic discipline (educational component)**

Nine lectures and nine seminars are planned for the study of the academic discipline, during which students must take a module test (which consists of three parts) and express tests or creative works (tests in case of distance learning).

The following **teaching methods** are used for the study of the learning material:

Teaching method code	Teaching method	Recommended for	
		Lectures	Seminars
TM 1	<b>Explanatory and illustrative method or informational and receptive</b> (video method in combination with the emerging information technologies and computer learning tools (distance, multimedia, web-oriented etc.))	+	+
TM 2	<b>Verbal method</b> (lecture, conversation, instruction etc.)	+	+
TM 3	<b>Visual method</b> (illustration method and demonstration method)	+	+
TM 4	<b>Discussion method</b>	+	+
TM 5	<b>Business game</b> (method of active creative learning)		+
TM 6	<b>Partial search or heuristic method</b> (organization of an active search for a solution to the set cognitive tasks)		+
TM 7	<b>Problem presentation method</b> (to the presentation of the material: a problem is posed – a task is formed on the basis of various sources and means. The method to solve the the problem is considered in the lesson).		+
TM 8	<b>Research method</b> (independent research work with literary and informational sources / tasks etc. and analysis of material / task).		+

Allocation of classroom hours by course topics and their schedule.

Chapter and topics	Lectures		Seminars		Assessment
	hours	Study weeks	hours	Study weeks	
<b>Chapter 1. Historical aspects of the development of science and technology in the agrarian era.</b>					
Topic 1.1. Introduction. Theoretical and methodological framework of «History of science and technology».	2	1	2	2	Seminar
Topic 1.2. Accumulation of knowledge, technique and technology in Prehistoric times and the age of Ancient civilizations.	2	3	2	4	Express test during lecture. Seminar
Topic 1.3. Medieval technology. Scientific knowledge during the 16 <sup>th</sup> – 18 <sup>th</sup> centuries.	2	5	1,4	6	Seminar
<i>Module test № 1.1</i>			0,6		Module test -1
<b>Self-study topics related to chapter 1</b>					
The state of scientific knowledge before the Ancient world.					
Science, technology and culture in the ancient world.					
The progress of human thought in the Middle Ages.					
<b>Chapter 1 total</b>	<b>6</b>		<b>6</b>		
<b>Chapter 2. Scientific thinking and technological capabilities of humanity in the Industrial era.</b>					
Topic 2.1. Development of technology and scientific knowledge in the middle of the 18th	2	7	2	8	Seminar

century – 1870s.					
Topic 2.2. New discoveries in physical, mathematical and natural sciences at the turn of the 19th and 20th centuries.	2	9	2	10	Express test during lecture. Seminar
Topic 2.3. The development of technology in the early 20th century and during the First World War.	2	11	1,4	12	Seminar
<i>Module test № 1.2</i>			0,6		Module test-2
<b>Self-study topics related to chapter 2</b>					
Scientific knowledge of the Renaissance.					
Classical science of Modern time (17–19th centuries).					
Technological advancement and scientific knowledge in the 19th century.					
<b>Chapter 2 total</b>	<b>6</b>		<b>6</b>		
<b>Chapter 3. Main trends in the development of science and technology in the Information age.</b>					
Topic 3.1. World science and technology in the 1920s-1940s.	2	13	2	14	Seminar
Topic 3.2. Development of science and technology in the second half of the 20th – in the early 21st century.	2	15	2	16	Express control during lecture. Seminar
Topic 3.3 History of the emergence and development of engineering education and technical sciences. Summary of the course.	2	17	1,3	18	Seminar
<i>Module test № 1.3</i>			0,7		Module test-3
<b>Self-study topics related to chapter 3.</b>					
Scientific and technical development in the 20th century.					
Science of Ukraine at different stages of development.					
The main trends and prospects for the development of science in the 21st century.					
<b>Chapter 2 total</b>	<b>6</b>		<b>6</b>		
<i>Final test</i>			(2)		
<b>Final total</b>	<b>18</b>		<b>18</b>		

The correspondence of teaching methods and assessment is reflected in the rating system of assessment which involves creative tasks, express tests, module test, final test.

### 5.1. Lectures.

№ з/п	Topic of the lecture and a list of main questions
1	<p><b>Introduction. Theoretical and methodological framework of «History of science and technology».</b></p> <p><i>List of main questions:</i></p> <ol style="list-style-type: none"> <li>1. Subject, purpose, tasks and structure of the course.</li> <li>2. Sources, methodology of the history of science and technology.</li> <li>3. Forms of interaction of natural, physical, mathematical and technical sciences.</li> <li>4. The place and significance of the history of science and technology in the life of an individual, society and the state.</li> </ol>

№ 3/II	Topic of the lecture and a list of main questions
2	<p><b>Accumulation of knowledge, technique and technology in prehistoric times and the age of ancient civilizations.</b></p> <p><i>List of main questions:</i></p> <ol style="list-style-type: none"> <li>1. The appearance of simple tools. Use of fire and methods of make it.</li> <li>2. Invention of the bow and arrows. Emergence of complex tools. Neolithic revolution.</li> <li>3. The use of metals in the production process, the emergence of crafts and its separation from agriculture.</li> <li>4. Technical achievements of Ancient world civilizations. Emergence of certain branches of rational knowledge.</li> </ol>
3	<p><b>Medieval technology. Scientific knowledge during the 16<sup>th</sup> – 18<sup>th</sup> centuries.</b></p> <p><i>List of main questions:</i></p> <ol style="list-style-type: none"> <li>1. Development of agricultural, handicraft, mining and construction technology.</li> <li>2. Scientific and technical achievements of the countries of Central Asia and the Far East during the Middle Ages.</li> <li>3. Manufactures, inventions and the first machines. Scientific knowledge of the 16th – 18th centuries.</li> </ol>
4	<p><b>Development of technology and scientific knowledge in the middle of the 18th century – 1870s.</b></p> <p><i>List of main questions:</i></p> <ol style="list-style-type: none"> <li>1. Causes, beginning and stages of the Industrial revolution of the late 18th century – 1870s.</li> <li>2. The development of metallurgy, the emergence of mechanical engineering, a revolution in transport and communication.</li> <li>3. Development of physical and mathematical sciences and creation of classical natural science.</li> </ol>
5	<p><b>New discoveries in physical, mathematical and natural sciences at the turn of the 19th and 20th centuries.</b></p> <p><i>List of main questions:</i></p> <ol style="list-style-type: none"> <li>1. Development of mathematics and astronomy.</li> <li>2. Fundamental discoveries in physics.</li> <li>3. Chemistry, geology, mechanics and biology are at the the cutting edge of scientific and technological progress.</li> </ol>
6	<p><b>The development of technology in the early 20th century and during the First World War.</b></p> <p><i>List of main questions:</i></p> <ol style="list-style-type: none"> <li>1. Electrical engineering as the basis of a new stage of industrial development.</li> <li>2. Application of new technologies in the metallurgical, chemical and engineering industries.</li> <li>3. New types of transport, communication and construction methods.</li> <li>4. Military equipment during the First World War.</li> </ol>
7	<p><b>World science and technology in the 1920s-1940s.</b></p> <p><i>List of main questions:</i></p> <ol style="list-style-type: none"> <li>1. Electric-power supply industry, metallurgy, chemical industry and mining as the basis of technical and technological achievements of the first half of the 20th century.</li> <li>2. Peculiarities of the development of mechanical engineering in the interwar period and during the Second World War.</li> <li>3. Creation of jet aircraft and rocket technology.</li> <li>4. Electronics is a step into the future. The beginning of the Atomic age.</li> </ol>
8	<p><b>Development of science and technology in the second half of the 20th – in the early 21st</b></p>

№ 3/II	Topic of the lecture and a list of main questions
	<p><b>century</b>  <i>List of main questions:</i></p> <ol style="list-style-type: none"> <li>1. Electric-power engineering and electrical systems.</li> <li>2. Metallurgy, chemical technologies and mechanical engineering.</li> <li>3. Transport development. Astronautics.</li> <li>4. Electrical engineering and communication. Computer systems.</li> </ol>
9	<p><b>History of the emergence and development of engineering education and technical sciences</b>  <i>List of main questions:</i></p> <ol style="list-style-type: none"> <li>1. Origin and development of education and scientific research.</li> <li>2. Establishment of engineering science and engineering.</li> <li>3. Creation of technical educational institutions and development of technical education in Ukraine.</li> <li>4. Igor Sikorsky Kyiv Polytechnic Institute: history and the present time.</li> </ol>

## 5.2. Seminars.

### **The main objectives of the seminars:**

The purpose of the seminars is to promote in-depth acquisition and consolidation of topical theoretical issues of the academic discipline; to form student ability to work with historical, socio-political, scientific, educational and methodologic literature; to promote the development of elocution, logical thinking, general personal culture taking into account student programme subject area, as well as the skills to prepare speeches, make and defend their opinion, participate in the discussion, making scientifically based assessments of the achievements of the past and present level of historical and cultural development; integrate, critically comprehend and adequately evaluate foreign and domestic historical and cultural experience accumulated in history.

№	Topics of seminars
1	<p><b>History of science and technology as a science and academic discipline.</b>  <i>It is expected that students will prepare a report / presentation, express their own opinion on the following questions:</i></p> <ol style="list-style-type: none"> <li>1. History of science and technology as a science and academic discipline. Historical sources and historiography.</li> <li>2. Methodology of the history of science and technology and methods of learning the academic discipline.</li> <li>3. Types of timelines of the history of science and technology.</li> <li>4. Features of the development of historical-scientific and historical-technical research in Ukraine.</li> </ol> <p><b>Self-study task.</b></p> <ol style="list-style-type: none"> <li>1. History of science and technology is a complex interdisciplinary and interactive academic discipline.</li> <li>2. Science and technology in the context of material and spiritual culture of Ukraine.</li> </ol>



№	Topics of seminars
2	<p><b>Development of technology of ancient civilizations and accumulation of scientific knowledge.</b></p> <p><i>It is expected that students will prepare a report / presentation, express their own opinion on the following questions:</i></p> <ol style="list-style-type: none"> <li>1. The discovery of fire by humans and the invention of various means to get fire.</li> <li>2. Invention and use of the bow and arrow.</li> <li>3. The emergence of agriculture based on complex tools.</li> <li>4. The beginning of the use of metals in the production process.</li> </ol> <p><b>Self-study task.</b></p> <ol style="list-style-type: none"> <li>1. Origin and development of mining in Ancient times.</li> <li>2. Features of construction in the countries of the East (Egypt, China, India, Japan).</li> <li>3. Military equipment of Ancient times.</li> <li>4. Mathematical and natural knowledge of Ancient civilizations.</li> </ol>
3	<p><b>Peculiarities of the development of production and technology in the Middle Ages.</b></p> <p><i>It is expected that students will prepare a report / presentation, express their own opinion on the following questions:</i></p> <ol style="list-style-type: none"> <li>1. Medieval craft guilds and their influence on the development of production.</li> <li>2. Scientific and technical achievements of the states of the Middle and Far East during the Middle Ages.</li> <li>3. Features of the emergence of manufacturing production.</li> <li>4. Development of natural science during the Late Middle Ages.</li> </ol> <p><b>Self-study task.</b></p> <ol style="list-style-type: none"> <li>1. Blast furnace production in the 14–16th centuries.</li> <li>2. Beginning of book printing.</li> <li>3. A water wheel is an engine of manufacturing system.</li> <li>4. Outstanding scientists of the Middle Ages: Leonardo da Vinci, Nicolaus Copernicus, Giordano Bruno, Galileo Galilei, Johannes Kepler, Gottfried Leibniz, Charles François de Cisternay du Fay.</li> </ol>
4	<p><b>The development of science and technology during the Industrial revolution.</b></p> <p><i>It is expected that students will prepare a report / presentation, express their own opinion on the following questions:</i></p> <ol style="list-style-type: none"> <li>1. Industrial revolution in England. Invention of the steam engine.</li> <li>2. The emergence of mechanical engineering.</li> <li>3. Technological revolution in transport.</li> <li>4. Creation of classical natural science.</li> </ol> <p><b>Self-study task.</b></p> <ol style="list-style-type: none"> <li>1. Development of the metallurgical industry.</li> <li>2. Technical revolution in communication.</li> <li>3. Michael Faraday: life and activity.</li> </ol>
5	<p><b>Discovery in physics, mathematics and natural sciences of the last quarter of the 19th century.</b></p> <p><i>It is expected that students will prepare a report / presentation, express their own opinion on the following questions:</i></p> <ol style="list-style-type: none"> <li>1. Fundamental discoveries in physics.</li> <li>2. Development of mathematics.</li> <li>3. Chemistry at the cutting edge of scientific and technological progress.</li> <li>4. Emergence of new branches of mechanics.</li> </ol> <p><b>Self-study task.</b></p> <ol style="list-style-type: none"> <li>1. New trends in the development of astronomy at the end of the 19th century.</li> <li>2. Invention of the internal combustion engine and its consequence.</li> <li>3. Otto Lilienthal: life and activity.</li> </ol>

№	Topics of seminars
6	<p><b>The development of technology in the early of the 20th century.</b>  <i>It is expected that students will prepare a report / presentation, express their own opinion on the following questions:</i></p> <ol style="list-style-type: none"> <li>1. Electric power engineering is the basis of industrial development.</li> <li>2. Use of new technologies in mechanical engineering.</li> <li>3. Features of the creation of the oil industry.</li> <li>4. Development of aviation in the first decades of the 20th century.</li> </ol> <p><b>Self-study task.</b></p> <ol style="list-style-type: none"> <li>1. Metallurgical production technologies in the early of the 20th century.</li> <li>2. Beginning of creation and use of artificial materials.</li> <li>3. Academician Oleksii Krylov and his contribution to the development of shipbuilding.</li> <li>4. New equipment on the fields of the First World War.</li> </ol>
7	<p><b>Science and technology in the interwar period (1920-1940s)</b>  <i>It is expected that students will prepare a report / presentation, express their own opinion on the following questions:</i></p> <ol style="list-style-type: none"> <li>1. Development of mining in the 1920s-1940s.</li> <li>2. Mechanical engineering in the interwar period.</li> <li>3. Creation of jet aviation.</li> <li>4. Nuclear physics in the 1920s-1940s.</li> </ol> <p><b>Self-study task.</b></p> <ol style="list-style-type: none"> <li>1. The influence of the development of the electric power industry on the production of electrical equipment.</li> <li>2. Development of nonferrous metallurgy in the 1920s-1940s.</li> <li>3. Creation and use of rockets on solid and liquid fuel.</li> <li>4. The beginning of the age of television.</li> </ol>
8	<p><b>Development of science and technology in the second half of the 20th century.</b>  <i>It is expected that students will prepare a report / presentation, express their own opinion on the following questions:</i></p> <ol style="list-style-type: none"> <li>1. Development of electric power industry.</li> <li>2. Stages of development of computer equipment.</li> <li>3. Space exploration. Space astronomy.</li> <li>4. New directions of transport development.</li> </ol> <p><b>Self-study task.</b></p> <ol style="list-style-type: none"> <li>1. Academy fellow Serhii Lebedev and his contribution to modern science.</li> <li>2. Serhii Korolev: life and activity.</li> <li>3. «He was the first human being to walk on the Moon»: Neil Armstrong.</li> </ol>
9	<p><b>Development of science and technology in the early of the 21st century.</b>  <i>It is expected that students will prepare a report / presentation, express their own opinion with justification of the following questions:</i></p> <ol style="list-style-type: none"> <li>1. New directions of development of the electric power industry.</li> <li>2. Development of computer technology and digital technologies.</li> <li>3. Modern space programs.</li> <li>4. New directions for the development of ecological transport</li> </ol> <p><b>Self-study task.</b></p> <ol style="list-style-type: none"> <li>1. Hubble telescope makes the deepest image of the universe.</li> <li>2. Creation of computer equipment in Ukraine.</li> <li>3. Professional and sociocultural portrait of a modern Ukrainian engineer.</li> </ol>

### **Distance learning platform:**

In the period of remote education in order to better acquisition of the learning material of the academic discipline academic staff and students use e-mail, the distance learning platform named «Sikorsky» which based on the Google Classroom and video conferencing platforms Google Meet and Zoom. These digital tools help to:

- spread methodical recommendations, learning materials, literature etc.;
- receive feedback from students regarding educational tasks and the content of the academic discipline;
- check and evaluate completed tasks;
- keep records of implementation of the curriculum by students, schedule compliance of submission of educational / individual tasks and their assessment.

### **6. Students' self-study.**

Self-study includes: preparation for lectures, seminars, participation in the discussion of the relevant topic; self-control of acquired knowledge; reading of recommended history sources and literature; creation of multimedia presentations (upon request) for visual support of the report; preparation for the module test (which consists of three parts); preparation for the final test etc.

6.1. Topics for independent study (each topic is allocated up to 1.5 hours):

<b>№</b>	<b>Topics for independent study</b>
1.	The state of scientific knowledge before the Ancient world
2	Science, technology and culture in the Ancient world
3	The progress of human thought in the Middle Ages
4	Scientific knowledge of the Renaissance
5	Classical science of Modern times (17 -19th centuries)
6	Technical progress and scientific knowledge in the 19th century.
7	Scientific and technical development in the 20th century.
8	Science of Ukraine at different stages of formation
9	The main trends and prospects for the development of science in the 21st century.

6.2. *Preparation for lectures and seminars.* To prepare for lectures and seminars, the student needs to read the planned basic and additional literature, recommended historical sources, and prepare report for discussion during lessons. For this, the student is allocated approximately 1 hour for each topic of the academic discipline.

6.3. *Module test.* Up to 2 hours of self-study time are allocated to preparation for the modul test (up to 0.6 hours of self-study time for each of the three parts). A list of questions for preparing for the module test is provided in **Appendix B**.

6.4. *Final test.* Final test is taken during the semester control period (test period), at the end of the academic semester after the students have written a module test (which consists of three parts) based on the results of rating points scored during the semester or to take final test in the case of the lecturer's decision. 6 hours of self-study time are allocated to preparation for the final test. The list of questions for preparing for the final test is provided in **Appendix A**. During the distance learning period, the final test can be taken according to the schedule via Google Classroom and video conferencing platforms Google Meet and Zoom.

## **Policy and control**

### **1. Policy of academic discipline (educational component)**

Students are advised to comply with the rules of attendance and behavior at lessons.

### **7.1. Rules for attending lessons:**

Lectures. Today, the rapid growth of new scientific knowledge, the formation of the latest scientific concepts, and the relentless development of technology significantly outpace the process of creating modern educational publications. Therefore, it is very important for students to attend lectures where modern, systematized educational material will be covered, and scientific presentations will be demonstrated in an amount sufficient for the student to learn the academic discipline. It will be difficult for students to properly prepare for seminars, perform an express test, and prepare a report or theses for a student scientific conference if they do not attend lectures.

Seminars. Students are recommended to attend seminars, because the final rating score largely depends on the results of the seminars. The student's active participation in the seminars is compulsory: the student's rating will be largely formed by the results of work in the seminars. Absence from seminars or lack of preparation for them leads to a decrease in the final rating in the academic discipline.

### **7.2. Rules for completing tasks:**

Students studying the learning material of the academic discipline called «History of science and technology»:

#### 1) at lectures:

- periodically take express tests of retained knowledge from chapters of the academic discipline, which may include the fulfilment of three creative tasks on debatable issues or express test assignments (take tests via the platform «Sikorsky» during 5–10 minutes);
- take module test using the Sikorsky platform;
- participate in discussions.

#### 2) at seminars:

- prepare reports according to their own plan based on the study of historical sources and literature with obligatory reference to them. It is desirable to accompany the reports with self-prepared presentations.
- participate in discussions on problematic issues of the course, make their own analysis and generalization of scientific information;
- present an argument for their own opinions.

Tasks and materials for take express tests / creative tasks are formed by the lecturer on the basis of educational material and are submitted in Google Classroom or in another form.

### **7.3. Rules of behavior during lessons.**

While studying the learning material of the academic discipline called «History of Science and Technology», students listen carefully to the lecturer at lectures and, if necessary, note important information, periodically take express tests in written form (within 5-10 minutes) and module test using the platform «Sikorsky». The lecturer will talk about the regularities of the formation and development of world science and technology, the history of human activity in the scientific and technical sphere from ancient to the present time in close connection with global historical and cultural processes. Dialogue between students and the lecturer in the form of questions and answers is allowed.

At seminars students deliver verbal reports, demonstrate presentations, express their own point of view on the topic, and participate in discussions. When searching for information on the Internet, it is recommended to use reliable and verified sources. Students participate in interactive type of lesson (give answers to questions asked by the lecturer or students). It is expected that every student should be ready to deliver report on all questions of the seminar, elaborate the reports of other students and express their own opinion during thematic discussions. Students are allowed to use their own notes and handwritten notes. It is allowed to use laptops, tablets, phones for educational purposes. At the same time, student should try to

express their own opinion, and not just read texts of other authors. The lecturer critically analyzes the delivered reports, comments on mistakes, moderates discussions between students.

The topics of lectures and seminars are covered in the programme of the discipline (syllabus), which is posted on the Electronic Campus, on the website of the Department of History, on the platform «Sikorsky» (Moodle, Google Classroom).

#### **7.4. Incentive and penalty points**

##### *Incentive points*

Students are encouraged to research and publish its results, in particular, to participate in the Ukrainian student scientific and practical conference «Ukraine: history, culture, memory», which is hosted annually by the Department of History of Igor Sikorsky Kyiv Polytechnic Institute. Theses of report delivered at the conference on the subject of the academic discipline, are evaluated with a maximum of + 10 points. Students together with the lecturer determine the thesis topic, available historical sources and literature. Also, under the guidance of the lecturer, students get acquainted with the submission requirements and submit theses to the conference.

Students are encouraged to participate in the annual academic competition on the history of Ukraine (student get + 8 points if more than 80% of answers are true).

Fulfillment a creative task (for example, prepare an essay based on a film recommended by the lecturer) (maximum + 8 points).

Other tasks and scientific projects.

##### *Penalty points*

- Late take of module test (at an unscheduled lesson) - 5 points.
- Violation of academic integrity policy (use of information without proper references, submission of someone else's paper as their own) - 8 points.

#### **7.5. Deadlines and retaking policy.**

Retaking of the missed lecture learning material takes place through intensive preparation for seminars. Student take missed seminars at consultations by answer the questions of missed seminars. To retake missed module tests and/or express tests, the student should to contact the lecturer who organizes the retaking of the module test.

#### **7.6. University policy**

##### **Academic integrity.**

The policy and principles of academic integrity are defined in Chapter 3 of the Code of Honor of the National Technical University of Ukraine «Ihor Sikorsky Kyiv Polytechnic Institute». Read more: <https://kpi.ua/code>

##### **Norms of ethical behavior.**

Principles of ethical behavior of students and employees are defined in Chapter 2 of the Code of Honor of the National Technical University of Ukraine «Ihor Sikorskyi Kyiv Polytechnic Institute». Read more: <https://kpi.ua/code>

#### **8. Types of control and rating system for assessment of learning outcomes**

**Current control** is carried out during lessons and aims to check the level of students' preparation for lessons. During the seminars, a quiz of students is conducted on the question of the topic. The module test is taken three times per semester as a control of retained knowledge from three chapters of the academic discipline. Express test in written form is taken during lectures three times per semester.

**Calendar control** is conducted twice per semester as a monitoring of the current state of fulfillment of the syllabus requirements. There are two possible calendar control results: certified

(c) and non-certified (n/c). The result depends on points scored at the time of the calendar control in accordance with the requirements of Igor Sikorsky Kyiv Polytechnic Institute.

**Semester control:** final test.

#### **Assessment and control measures**

The student's rating in the academic discipline consists of points obtained for:

1) control of retained knowledge from 2 chapters of the academic discipline and includes the accomplishment of three creative tasks on discussion questions or take express tests (during 5-10 minutes using the platform «Sikorsky»);

2) activity on 9 seminars;

3) module test.

Student activity:

- at nine seminars determines 45% of rating in the academic discipline;

- control of retained knowledge from chapters determines 18% of his rating in the academic discipline;

- module test determines 37% of rating in the academic discipline.

In order to receive the highest rating, a student needs to take an active part in seminars, deliver properly prepared and reasoned verbal reports on seminar questions, actively elaborate the answers of other students, clearly and logically express own position on debate issues, timely take module test and express test. The student has a one-time opportunity to take the module test and express test.

A student's rating may decrease due to fail the module tests and express tests; improper preparation for seminars; incorrect, incomplete, false answers or references on unreliable historical sources.

The lecturer evaluates the student's activity at each seminar and assigns points for the activity at the seminars and the results of the module and express tests to the "Current control" module of the Electronic campus. The results of the first and second calendar control depend on the student's current rating and are submitted by the lecturer to the "Calendar control" module of the Electronic campus at the eighth and sixteenth study weeks respectively (see Appendix C).

The student can appeal the mark by make a complaint to the lecturer no later than the next day after announcement of marks. The complaint will be considered according to the procedures established by the university.

**Conditions for admission to the semester control:** The number of points is at least 40 points, the passing the module test is not less than «sufficient».

Table of correspondence of rating points to marks on the university scale:

<b>Grade points</b>	<b>Mark</b>
100-95	Excellent
94-85	Very good
84-75	Good
74-65	Satisfactorily
64-60	Sufficient
Less than 60	Unsatisfactorily
Admission requirements are not fulfilled	Not allowed

#### **9. Additional information on the academic discipline (educational component).**

Academic staff can make clarifications to content modules, rating system and module test tasks in accordance with the student's form of study and their own methodological developments.

The recommended list of questions for the semester control (final test) is provided in Appendix A to the syllabus.

If the student has documents confirming participation in academic competition and scientific conferences (city, intercity, Ukrainian etc.) on the topic of a seminar or chapter of an academic discipline, it can be scored according to the corresponding topic and the corresponding points of rating system.

### **Recommendations for students**

During the lecture the students should take note the main terms and concepts, main events of the topic, summary and conclusions made by the teacher. This material will be useful during the preparation for a seminars, module test, express tests.

During preparation for a seminars, the student must study the lecture material of a certain topic, it is advisable to get acquainted with additional resources on the network. If necessary, students should discuss any questions and unclear provisions with the lecturer. At a seminar, a well-prepared student should not remain a passive observer but try to actively participate in the discussion of the issue. The student should not refuse to answer the lecturer's question. Even if the student does not know the answer, it is advisable to try to answer, express opinion based on own knowledge, experience, logic of the question, etc. At the same time, student should not be afraid to make a mistake – one of the important objectives of studying humanities is to develop the ability to think logically and express own opinions accordingly. However, it is worth to remembering that non acquaintance with the learning material of the academic discipline is a significant drawback of the student's activity and has negative impact on their overall rating. A responsible attitude to the preparation for seminars allows students not only to learn the educational material correctly, but also to save effort when taking the semester control.

An important point in a student's education is developing the ability to deal with historical sources. During familiarizing with a new historical document, student should, first of all, find out the authenticity, conditions and reasons for its creation, understand the logic and sequence of relevant events and their impact on the present. Such an analysis will allow the applicant not only to better understand and uptake information, but also to analyze past historical events, draw conclusions and summary, apply historical experience to understand and determine the role and place of a particular scientist and inventor in the history of the development of science and technology.

Acquisition of scientific historical knowledge is interesting, but not an easy task. By studying the academic discipline «History of Science and Technology», students lay the foundations for their future professional development. This course will help to correctly understand the phenomenon of science and technology in the history of mankind and the main features of the process of accumulation of scientific and technical knowledge in accordance with specific historical stages of the human development.

Students can be credited with the topic of a course if they have certificates of completion of distance or online courses on the relevant topic or get winning place in history academic competition on the relevant topic.

### **Extracurricular activities.**

Students can participate in:

- scientific research and publication its results, in particular, at the Ukrainian student scientific and practical conference «Ukraine: history, culture, memory», which is held annually by the Department of history and others;
- activities of the student scientific club «History fans club»;
- academic competition in historical academic disciplines.

### **Distance Learning.**

Synchronous and asynchronous distance learning is possible using video conferencing platforms (Google Meet, Microsoft Teams, Zoom, Skype, etc.) and the distance learning educational platform «Sikorsky» (Moodle, Google Classroom).

**Inclusive education.**

It is allowed.

**The programme of the academic discipline (Syllabus) was prepared by:**

Associate Professor of the Department of History, Candidate of Historical Science Vitalii Buzan

**Approved by** the Department of History (protocol No. 14 from June 15, 2022).

**Adopted by** the Methodical Council of the Faculty of Electronics (protocol No. 06/2022 from June 30, 2022).



## List of questions for semester control (final test)

## A sample of a test paper

NATIONAL TECHNICAL UNIVERSITY OF UKRAINE  
«IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE»

Level of higher education first (bachelor's)  
(degree title)

Programme subject area All programme subject areas  
(code and title of programme subject area)

Educational programme Educational programmes of all programme subject areas  
(code and title of programme subject area)

Academic discipline History of science and technology  
(назва)

TEST PAPER № \_\_\_\_\_

- 1 Questions from the 1st block of questions
- 2 Questions from the II block of questions

Approved at the meeting of History department  
(department title)

Protocol № \_\_\_\_\_ from « \_\_\_\_\_ » 202

Head of the Department of History  
\_\_\_\_\_  
(signature) (First name Last name)

## Questions for test papers

**First question from question pool**

1. Determine the place of the history of science and technology in the system of humanities, natural, and technical sciences.
2. Give a definition and reasoned assessment of the problem of humanization of scientific and technical knowledge.
3. Compare the main systems of the periodization of the history of science and technology.
4. Describe the source base of the history of science and technology, taking into account the features of different types of sources.
5. Analyze the level of development of human knowledge and technology in the Paleolithic and Mesolithic.
6. Describe the Neolithic revolution and its main locations, connection between the level of development of knowledge and technology and natural conditions.
7. Make a comparative analysis of the scientific and technical achievements of the ancient civilizations of Egypt and the Mesopotamia.
8. Define the main achievements of science and technology of ancient India and China.
9. Describe and explain the features of the development of technology in ancient Greece.

10. Give a reasoned assessment of the transition from mythological to scientific perception of the world in ancient Greece using the example of the influence on natural and technical knowledge.
11. Apply the comparative-historical method to identify new features of the development of scientific and technical knowledge in the Hellenistic period.
12. Highlight the key features of the development of science and technology in the era of the Roman Empire. Justify your answer.
13. Compare approaches to the development of scientific knowledge in the Christian and Muslim worlds of the Middle Ages.
14. Describe the versions of the leading researchers regarding the role of the Middle Ages in the development of technology and select the most reliable. Justify your answer.
15. Explain how the spread of humanism and the Reformation influenced the development of science in Renaissance Europe.
16. Define the essence of Great geographical discoveries and their consequences for scientific and technological development.
17. Give a reasonable version of expediency of using the term «gunpowder revolution» and «agro-technical revolution» regarding Renaissance Europe.
18. Define the prerequisites and reveal the essence of the Scientific revolution of the 17th century.
19. Explain how the spread of Enlightenment ideology and scientific and technological progress are related.
20. Describe the main consequences of the Scientific revolution of the 17th century and the essence of the mechanistic view of the world.

***Second question from question pool***

1. Explain the causes of the Industrial revolution of the 18th-19th centuries and its uneven spread around the world.
2. Give a comparative description of machine and manufacturing production.
3. Reveal and evaluate the contribution of leading scientists to the development of classical natural science in the 18th and mid of 19th centuries.
4. Tell about the main stages and directions of the Industrial revolution.
5. Define the essence and consequences of the fundamental scientific discoveries of the late 19th and early 20th centuries.
6. Explain the difference between non-classical and classical science.
7. Give a well-argued version of the impact of the First World War on the development of science and technology.
8. Describe the leading scientific discoveries in the period between the First and Second World Wars.
9. Compare the rates of improvement of the production of peaceful and military direction in the interwar period.
10. Give a reasoned assessment of the general state of science and technology during the Second World War, depending on the degree of participation of countries in warfare.
11. Reveal the structure, timeline and main consequences of the Scientific and Technological Revolution.
12. Define the positive and negative effects of scientific and technological progress on the ecological system.
13. Give a reasoned assessment of the effectiveness of the main international environmental protection programs.
14. Compare the leading concepts for defining the information society and its components.
15. Observe the main stages of development of the emerging information technologies.
16. Describe the Internet as an environment for building an information society.

17. Explain the main features of scientific and technical development of Ukraine in market conditions.

18. Compare the achievements of academic and scientific institutions and the achievements of university scientists in independent Ukraine.

19. Describe Ukraine's international cooperation in the field of science and technology, possible ways to expand and extend such cooperation.

20. Give a reasoned assessment of the international cooperation of «Igor Sikorsky Kyiv Polytechnic Institute» in the scientific and technical sphere and outline its possible prospects.

**MODULE TEST**

The academic discipline

**HISTORY OF SCIENCE AND TECHNOLOGY***of the first (bachelor) level of higher education*

Mode of study

***Full-time study***

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After completion each of the three thematic modules, students have a one-time opportunity to take the module test, which consists of test tasks. The first and second module tests are estimated at 12 points each and third module test at 13 points. The maximum number of points for three module tests is 37 points.

**Tasks for Module test 1.1.** from Chapter 1. **Historical aspects of the development of science and technology in the Agrarian era**

**Test questions** are formed from such blocks

1. Theoretical and methodological bases of «History of Science and Technology»;
2. Accumulation of knowledge, technique and technology in Prehistoric times and the age of Ancient civilizations. The state of scientific knowledge before the Ancient world. Science, technology and culture in the Ancient world;
3. Medieval technology. The progress of human thought in the Middle Ages. Scientific knowledge of the Renaissance and Modern times (15-18 centuries).

**Tasks for Module test 1.2.** from Chapter 2. **Scientific thought and technological capabilities of humanity in the Industrial era**

**Test questions** are formed from such blocks

1. Development of technology and scientific knowledge in the middle of the 18th century – 1870s. Classical science of Modern times (17-19th centuries);
2. Technical progress in the 19th century. New discoveries in physical, mathematical and natural sciences at the turn of the 19th and 20th centuries.
3. Development of technology in the early 20th century and during the First World War.

**Tasks for Module test 1.3.** from Chapter 3. **Main trends in the development of science and technology in the Information age**

**Test questions** are formed from such blocks

1. World science and technology in the interwar period (1920-1940s);
2. Development of science and technology in the second half of the 20th century;
3. The main trends and prospects of the development of science in the 21st century;
4. Science of Ukraine at different stages of development;
5. History of the emergence and development of engineering education and technical sciences.

## RATING SYSTEM FOR ASSESSMENT OF LEARNING OUTCOMES

The academic discipline

### HISTORY OF SCIENCE AND TECHNOLOGY

of the first (bachelor) level of higher education «*bachelor*» *degree*

Mode of study

*Full-time study*

---

1. The rating of a student in an academic discipline consists of the points received for<sup>1</sup>:
- control of retained knowledge at 9 lectures;
  - activity on 9 seminars;
  - module test in three parts of 0.66 academic hours each.

#### **System of rating points (weighted grades) and assessment criteria:**

1. Control of retained knowledge can be carried at 9 lectures (in that case the maximum number of points for 1 control per lecture is 2 points):

– a complete answer (at least 90% of the required information), relevant justifications and a personal point of view are provided	2
– a sufficiently complete answer (at least 75% of the required information), completed in accordance with the requirements for the “skills” level, or minor inaccuracies)	1,5
– incomplete answer (at least 60% of the required information)	1

Or

Control of retained knowledge can be carried out at 3 lectures (then the maximum number of points for 1 control at the lecture is 6 points):

– a complete answer (at least 90% of the required information), relevant justifications and a personal view are provided	6
– a sufficiently complete answer (at least 75% of the required information), completed in accordance with the requirements for the “skills” level, or minor inaccuracies)	5-4
– incomplete answer (at least 60% of the required information)	3,5

2. Activity at 9 seminars (the maximum number of points for the 1seminars is 5 points, additional points are provided for active participation in the seminar, but no more than 5)

– a complete answer (at least 90% of the required information), relevant justifications and a personal view are provided	5
– a sufficiently complete answer (at least 75% of the required information), completed in accordance with the requirements for the “skills” level, or minor inaccuracies)	4
– incomplete answer (at least 60% of the required information)	3

3. Take module test in 3 parts of 37 test questions (the maximum number of points for 1 test question is 1 point).

True answer - 1 point

False answer - 0 points

#### ***Calculation of the rating scale (R):***

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<sup>1</sup> Academic staff can amend the rating system in accordance with student’s mode of study and their own methodological studies.

The sum of the weighted grades of control measures during the semester is:

$$\mathbf{RD = 18+45+37 = 100 \text{ points.}}$$

Students who scored 60 or more points during the semester ( $\mathbf{RD \geq 0.6 R}$ ) have a possibility to pass the course without a taking a test (so-called "automatic") in accordance with the obtained rating.

Students who did not take the module test (less than «sufficient») and received less than 40 starting points are not allowed to take test.

Students who have fulfilled the conditions for admission to test, but scored less than 60 points ( $\mathbf{RD < 0.6 R}$ ) during the semester, take a final test.

The final test is evaluated out of 100 points and consists of two questions (*the maximum rate of points for 1 question is 50 points*).

– complete answer (at least 90% of the required information)	50-45
– sufficiently complete answer (at least 75% of the required information)	44-38
– incomplete answer (at least 60% of the required information)	37-30

Based on its results, the student gets a grade points according to the table.

<b>Grade points</b>	<b>Mark</b>
100-95	Excellent
94-85	Very good
84-75	Good
74-65	Satisfactorily
64-60	Sufficient
Less than 60	Unsatisfactorily
Admission requirements are not fulfilled	Not allowed