MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

NATIONAL TECHNICAL UNIVERSITY
"KHARKIV POLYTECHNIC INSTITUTE"

Department Ukrainian Studies, Culturology and History of Science
(the name of the department providing the teaching of the discipline)

"APPROVED"
Head of the Ukrainian Studies, Culturology
and History of Science Department Volodymyr SKLYAR
(signature) (full name)

"_____" _____ 2021

THE EDUCATIONAL SUBJECT WORKING PROGRAM

History of Science and Technology

(title of the educational subject)

higher education level _____first_____
first (bachelor's) / second (master's)

field of knowledge_____ _____
(code and name)

specialty _____for all specialties_____
(code and name)

educational program _____ __
(names of education programs/ specialty)

type of subject _____general (required)_____
(general training / professional training; required / optional)

form of education _____full-time_____
(full-time / part-time/ distance)

Kharkiv – 2021

APPROVAL LIST

Work program on educational subject _ History of Science and Technology
(title of the subject)

Developer:

associate professor, PhD in History, docent___ _____Maryna GUTNYK____
(position, academic degree and academic title) (signature) (full name)

The working program was considered and approved at the department meeting
Ukrainian Studies, Culturology and History of Science
(the name of the department providing the teaching of the discipline)

Report from June, 29 2021 No 14

Head of the department Ukrainian Studies,
Culturology and History of Science _____Volodymyr SKLYAR__
(name of the department) (signature) (full name)

OBJECTIVE, COMPETENCE, LEARNING RESULTS AND STRUCTURAL-LOGICAL SCHEME OF EDUCATIONAL DISCIPLINE

The purpose of the discipline “History of Science and Technology” – is to promote the formation of a holistic scientific worldview in understanding the patterns of development of science and technology as a unique historical and cultural phenomenon

Competences:
GC5. Ability to learn and master modern knowledge.
GC 10. 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, use different types and forms of motion activities for active recreation and a healthy lifestyle.

Learning results:
LR 1. To know and understand the concepts, patterns and features of the development of civil society, human and civil rights and freedoms in Ukraine, as well as ethical and legal principles of professional activity.

Structural-logical scheme of study of discipline

Previous disciplines:
“History and Culture of Ukraine”, “Philosophy”
The following disciplines:
“Physics”, “General and inorganic Chemistry”

DESCRIPTION OF THE EDUCATIONAL DISCIPLINE
(Distribution of teaching time per semester classes and types)

Semester	Total amount			By type of classroom studies (hours)			Individual student task (CP, CW, CG, C, report)	Current control	Semester control	
	Total amount (hours) ECTS credits	From this		Lectures	Laboratory work	Practical studies, seminars		Control works (number of works)	Credit	Exam
		Classroom studies (hours)	independent work (hours)							
1	2	3	4	5	6	7	8	9	10	11
6	**60/ 3**	**32**	**28**	**16**		**16**	**R**	**2**	**credit**	

The ratio of hours of class to total is _36 (%):

STRUCTURE OF THE EDUCATIONAL SUBJECT

No	Types of training (Lectures, Laboratory works, Practical works, independent work)	hours	Semester number (if subject is taught in several semesters). Content module names. Name of Topics and questions of each lesson. Tasks for independent work.	Recommended literature (basic, Additional)
1	2	3	4	5
1			Module № 1 Science and technology in the pre-industrial era	Basic [1, 3]
			Topic 1. History of science and technology as a science and educational subject. The origin of knowledge about the environment and man in the Ancient World	Additional [1, 6, 8]
	L	2	Lecture 1. *Introduction to the history of science and technology* 1. The subject, purpose, objectives and structure of the course. 2. The emergence of primordial knowledge about man and the environment in the Ancient World.	
	P	2	Seminar 1. *Science and technology as a historical and cultural phenomenon. The initial stage of formation* 1. The essence of scientific and engineering activities. 2. Initial knowledge in the pre-civilization period. 3. Achievements of ancient civilizations of Egypt, Mesopotamia, India and China.	
	IW	2	Independent work of students 1. The role of science in the progress of human civilization. 2. The importance of technological progress in the history of mankind. 3. The origin of natural science in ancient civilizations. 4. Chemistry and medicine in Ancient Egypt, Mesopotamia of India and China. 5. The technique of the peoples of the Ancient World.	
2			**Topic 2.** Natural Philosophy and Technology of the Antiquity and the Middle Ages	
	L	2	Lecture 2. *The Age of Antiquity and the Middle Ages in the History of Science and Technology* 1. The main directions and stages of ancient natural philosophy. 2. Features of the development of scientific knowledge and technological progress of the Middle Ages.	Basic [1, 3]
	P	2	Seminar 2. *Scientific and Technical Knowledge of Antiquity and the Middle Ages* 1. The achievements of ancient science and technology. 2. Contradictions in the development of science and technology of the Middle Ages.	Additional [1, 6, 8]
	IW	4	Independent work of students 1. Development of mathematical and astronomical knowledge in ancient times. 2. Aristotle's scientific achievements, Archimedes. 3. Mechanics of the ancient world. 4. Arabic medieval science.	

			5. Universities of medieval Europe.	
3	L P IW	2 2 4	**Topic 3.** Scientific revolution and its role in the history (XVII century). Lecture 3. *The science of modern times* 1. The essence, defining features and periodization of the revolution in science. 2. The achievements of scientists in the field of astronomy, mechanics, mathematics, physics, optics, chemistry, medicine. Seminar 3. *Science and technology in the XVII century.* 1. Characteristics of the stages of the scientific revolution of the XVII century. 2. Achievements of the natural sciences. 3. Features of technology development. Independent work of students 1.Prerequisites of the scientific revolution of modern times. 2. The development of physics, mechanics in the XVI - XVIII centuries. 3. Outstanding mathematics of the second half of the 16th - 17th centuries. 4. Scientific achievements of G. Galileo, R. Descartes, I. Newton. 5. Leonardo da Vinci Scientific and Engineering Activities.	Basic [1] Additional [1, 6]
4	L P IW	2 2 4	**Topic 4.** Science and Technology in the XVIII century. The beginning of the industrial revolution Lecture 4. *The development of science and technological progress in the XVIII century*. 1. The main directions of scientific research. 2. Technical progress and the beginning of the industrial revolution. Seminar 4. *Determinants of science and technology of the XVIII century.* 1. The emergence of new areas of scientific research. 2. The beginning of the industrial revolution and its consequences. Independent work of students 1. The influence of mechanics and other branches of science in the XVIII century. 2. Development of biology and medicine in the Age of Enlightenment. 3. The development of chemistry in the XVII century. Achievements of A. Lavoisier. 4. Features of the Industrial Revolution in the leading countries of the world. 5. Geological studies.	Basic [1, 4] Additional [1, 6]
	CW		***Modular control work 1***	
5	L P	2 2	Module № 2 Science and technology in the industrial and post-industrial era **Topic 5.** The progress of science and the development of technology in the XIX century. Lecture 5. *Science at the stage of industrial revolution* 1. The main scientific achievements of the XIX century: the development of mathematics, classical physics, the origin of modern chemistry, the systematization of knowledge in biology. 2. The interconnection of science, industry and the emergence of new forms of educational institutions. Seminar 5 *Technical Progress in the XIX century* 1. Application of scientific achievements in the field of electricity and magnetism in practice. The electrical revolution.	Basic [1, 4, 5] Additional [1, 2, 5]

	IW	2	2. Distribution and improvement of machines. Development of transport, aviation, communication technology. 3. Formation of machine-building industry and its influence on the development of chemistry and electrical engineering. Independent work of students 1. Chemical industry of the XIX century. New technological processes and achievements. 2. Faraday - Maxwell electromagnetic theory and scientific picture of the world. 3. World Industrial Exhibition as a means of reproducing scientific connections. 4. Outstanding technical achievements in the nineteenth century. 5. Higher technical educational establishments of Ukraine as centers of scientific thought.	
6	L P IW	2 2 4	**Topic 6.** The newest revolution in natural science at the turn of the XIX - XX centuries. Scientific and technical progress of the first half of the XX century. Lecture 6. *Formation of non-classical science* 1. Scientific revolution in natural science. Electrodynamic picture of the world. 2. The directions of development of science and technology in the late nineteenth - early twentieth century. Seminar 6. *Technical achievements of the first half of the XX century.* 1. Features of scientific and technological development of the early twentieth century. 2. Utilization of science and technology for military purposes. Independent work of students 1. Scientific achievements of the Curie family. 2. The revolution in physics at the turn of the XIX - XX centuries. 3. Prominent Ukrainian scientists of the early twentieth century. 3. The development of military equipment in the late XIX - early XX centuries. 4. History of computers, periodization and characteristics.	Basic [1, 2, 4] Additional [2, 3, 5]
7	L P IW	2 2 4	**Topic 7.** The Scientific and Technical Revolution. The current stage of development of science and technology Lecture 7. *The integrative nature of the development of science and technology* 1. The concept of NTR. Its essence. Periodization. 2. Trends in the development of science and technology in the XXI century. Seminar 7. *Science and Technology of the 21st Century* 1. Science and technology in the context of globalization. 2. A person in the information society. Independent work of students 1. Development of the latest technologies in the world 2. Prospects for the development of technical sciences in the XXI century. 3. Outstanding scientific and technological achievements at the beginning of the XXI century. 4. Micro-revolution of the twentieth century. 5. Use of nuclear and chemical weapons 6. Study of the human genome	Basic [1, 2] Additional [2-4]
8			**Topic 8.** Historical path of the National Technical University "Kharkiv Polytechnic Institute"	Basic [1, 2]

	L P IW	2 2 4	Lecture 8 (1). *History of the NTU "KhPI"* 1. Formation of the Kharkiv Technological Institute as a scientific and educational institution in the first decades of its activity. 2. Scientific achievements and educational model of the 20s - 80s of the XX century. 3. NTU "KhPI" in the lateXX - earlyXXI century. Seminar 8. *Stages of development of NTU "KhPI"* 1. Kharkiv Institute of Technology in the late XIX - early XX century. 2. The main directions of development of the 1920s-1980s. 3. National Technical University "Kharkiv Polytechnic Institute" at the present stage. Independent work of students 1. The phenomenon of Professor V.L. Kirpychov as rector among rectors of other universities. 2. Architectural projects of professors of KhPTI – O.M Beketov, S.I. Zagoskin, M.I. Lovtsov, V.Kh. Nemkin. Their influence on the urban planning of the city of Kharkiv 3. The activities of the CPI during the occupation 4. History of the graduating department (at the student's choice)	Additional [2, 5]
8	L P IW	2 2 4	**Topic 8 (1).** *Oil and gas production* Lecture 8. *History of oil and gas production* 1. Fuel resources of the world. 2. Familiarity of mankind with oil products and natural gas. Development of technologies for oil refining. 3. Discovery of gas deposits in Europe 4.Prospects of the industry Seminar 8. Origin and development of knowledge in the field of oil and gas production. 1. Origin and development of knowledge in Egypt, Mesopotamia. 2. Alchemical period. 3. Development of the oil and gas industry in Ukraine. Independent work of students 1. The use of oil for medical and military purposes in Ancient times 2. KhTI scientists and their participation in oil exploration. Activities of A. Mevius, K. Zvorykin.	Basic [1, 3] Additional [1, 6-8]
	CW		***Modular control work 2***	
Total		60		

Notes

1. The semester number indicates if the subject is taught in several semesters.
2. In the Total (hours) indicator, the number of hours will differ from the total number of class hours by the number of hours allocated to study Topics and issues that are studied by the student.

INDEPENDENT WORK

Order No	Name of types of independent work	hours
1	Lecture material processing	8
2	Preparation for practical (laboratory) classes	8
3	Independent study of topics and non-teaching questions	4
4	Perform of an independent work	4
5	Other types of independent work	4
	Together	28

INDIVIDUAL TASKS

_____

(type of individual task)

№ з/п	Name of individual task and / or its sections	Terms of implementation (which week)
	The abstract (R) has the following structure: 1. Theoretical review: disclosure of the essence, content and features of the studied historical event or the development of a particular branch of science, production. 2. The general part: conclusions about the research, evaluation of the results of achievements in science or in technology. Application	5 10 15

TEACHING METHODS

(the description of teaching methods is provided)

The program of study provides for lectures and practical classes, individual task in the form of abstracts and tasks for independent work of students.

In teaching the discipline "History of Science and Technology" in order to activate the educational process, the use of modern educational technologies, such as: problematic lectures, open discussions, presentations, method of cases are envisaged.

Lectures of a problematic nature are one of the most important elements of problematic student learning. They include, in addition to reviewing the main lecture material, the establishment and consideration of a range of problematic issues of discussion that are not sufficiently developed in science and are relevant to theory and practice. Lectures of a problematic nature are distinguished by in-depth argumentation of the material presented. They promote the formation of students' independent creative thinking, impart cognitive skills to them. Students become involved in scientific research and problem-solving.

Discussion seminars provide for the exchange of views and views of participants on the topic, as well as develop thinking, help form views and beliefs, develop the ability to formulate thoughts and express them.

Presentations - speeches in front of the audience, used to present certain achievements, the results of work of the group on the report on individual tasks, project work. Presentations can be both individual, for example, a single listener's or collective presentations, i.e. performances by two or more listeners.

The case method (case method, case method, situation method, situational analysis method) is a training technique that uses a description of real economic, social and business situations. Students should investigate the situation, understand the nature of the problem, suggest possible solutions and choose the best from them. Cases are based on real factual material, or are close to the real situation.

CONTROL METHODS

(the description of control methods is provided)

Modular control works
Independent work (Abstract)
Form of final control of knowledge is credit

Modular tests include theoretical questions / situational tasks, tests and tasks.

Situational tasks are tasks that allow a student to master intellectual operations consistently in the process of working with information: familiarization - understanding - application - analysis - synthesis - assessment.

Situational tasks are close to problematic tasks and are aimed at identifying and understanding the mode of activity. When solving a situational problem, the teacher and the students pursue different goals: for students - to find a solution that fits the given situation; for the teacher - mastering by students the way of activity and awareness of its essence.

The **abstract** is an analytical review or a detailed review, which substantiates the relevance of the topic under investigation, summarizes and analyzes the substantive and formal positions of the studied texts, generalizes and concludes.

Credit is a form of assessment of the knowledge and skills of students, obtained at lectures and practical classes, industrial practice, as well as their mandatory independent work.

DISTRIBUTION OF POINTS THAT STUDENTS RECEIVED AND KNOWLEDGE AND SKILLS SCALE (NATIONAL AND ECTS)

Table 1. – Points distribution for student achievement evaluation for passing

Control work	Laboratory works	Course works (Course projects)	Computational graphic tasks	Individual tasks	Others	Passing	Sum
Module 1 - 20 Module 2 - 20	…..	….	…	Abstract 25	Speeches at seminars 35		100

Criteria and system for assessing students' knowledge and skills.

According to the guidelines of ECTS, an assessment system should be understood as a set of methods (written, oral and practical tests, examinations, projects, etc.) used in assessing the achievement of the expected learning outcomes by the students.

Successful assessment of learning outcomes is a precondition for awarding credits to a person under study. Therefore, statements of learning outcomes of programme components should always be accompanied by clear and appropriate

assessment criteria for awarding credits. This makes it possible to state that the learner has acquired the necessary knowledge, understanding, competences.

Assessment criteria are descriptions of what a person who is learning is expected to do in order to demonstrate the achievement of a learning outcome.

The main conceptual statements of the student's knowledge and skills assessment system are:

1. Improving the quality of training and competitiveness of specialists by stimulating independent and systematic work of students during an academic semester, establishment of constant feedback from teachers to each student and timely correction of his/her learning activities.

2. Improving the objectivity of students' knowledge assessment takes place through monitoring during a semester with the use of a 100-point scale (Table 2). Grades are necessarily translated into the national scale (with the state semester grades "excellent", "good", "satisfactory" or "unsatisfactory") and the ECTS scale (A, B, C, D, E, FX, F).

Table 2. – Knowledge and skills assessment scale: national and ECTS rating

Rating Assessment, points	**ECTS assessment and its definition**	**National assessment**	**Evaluation criteria**	
			positive	**negative**
1	**2**	**3**	**4**	**5**
90-100	A	Excellent	- **Deep knowledge** of the educational material of the module contained in the **main and additional literature sources**; - **ability to analyze** the phenomena being studied in their relationship and development; - **ability to** perform **theoretical calculations;** **- answers** to questions **are clear, concise, logically consistent;** **- ability to solve complex practical problems.**	Answers to questions may contain **minor inaccuracies**
82-89	B	Good	- **Deep level of knowledge** in the amount of **required material** provided by the module; - ability to give **reasonable answers** to questions and perform **theoretical calculations**; - ability to solve **complex practical problems**.	Answers to the questions contain **certain inaccuracies**;

75-81	C	Good	- **Strong knowledge** of the studied material and its **practical application**; - ability to give **reasonable answers** to questions and perform theoretical calculations; - ability to solve **practical problems**.	- Inability to use theoretical knowledge to solve **complex practical problems.**
64-74	D	Satisfactory	- **Knowledge of the basic fundamental provisions** of the studying material, and their **practical application**; - the ability to solve simple **practical problems**.	Inability to give **well-reasoned answers** to the questions; - inability to **analyse** the material presented and **perform calculations**; - Inability to solve **complex practical problems**.
60-63	E	Satisfactory	- Knowledge of **the basic fundamental provisions** of the module material, - ability to solve the simplest **practical problems.**	Ignorance of **individual (non-principled) questions** from the module material - inability to make a **coherent and well-reasoned** opinion; - inability to apply theoretical statements in solving **practical problems**
35-59	FX (additional study required)	Fail	**Additional study** of the module material can be performed **in the time provided by the educational curriculum.**	Ignorance of the **basic fundamentals** of the module - **significant errors** in answering questions; - inability to solve **simple practical problems**.

1-34	F (re-study required)	Fail	-	- Complete **lack of knowledge** of a considerable part of the module's study material; - **significant mistakes** in answering the questions; -ignorance of the main fundamentals; - inability to orient while solving **simple practical tasks**

EDUCATIONAL AND METHODICAL SUPPORT OF EDUCATIONAL SUBJECT

(A list of components of the educational and methodological support of the subject and a link to the site where they are located are provided)

1. Working curriculum of the discipline "History of science and technology".
2. List of basic and additional literature recommended to students.
3. Schedule of lectures, practical classes in history of science and technology.
4. Lecture demonstrations.
5. Test tasks for checking students' preparation. (http://web.kpi.kharkov.ua/ukin/wp-content/uploads/sites/195/2021/09/Test.pdf)
6. Criteria for assessing students' knowledge of the discipline.
7. Set of cards for modular control.
8. List of questions for a credit.
9. Methodological materials providing independent work of students.
10. Other materials.

BIBLIOGRAPHY RECOMMENDED

Basic literature

1	Tkachenko S. History of Science and Technology : tutorial / Tkachenko S., Gutnyk M., Sadkovska V. – Kharkiv : NTU “KhPI”, 2020. – 114 p.
2	Gapochenko Svitlana, Gutnyk Maryna, Tkachenko Svitlana The problem of “technocratism” in higher technical education and the role of “History of science and technology” course in the formation of the spiritual values of the engineer. Матеріали III всеукраїнської науково-практичної конференції «Неперервна освіта для сталого розвитку: філософсько-теоретичні контексти та педагогічна практика» (Дніпро, 4 грудня 2020 р.) КЗВО «ДАНО» ДОР». / Наук. ред. О.Є. Висоцька. – Дніпро: СПД «Охотнік», 2021. с. 91–93.
3	Gayko G. Stone age and the world of primitive mining / G. Gayko, V. Biletsky, Yu. Hunchenko // Схід. 2018. № 1 (153). С. 44–48.
4	Gutnyk M., Radohuz S. The impact of decisions of Mining Industrialists Congresses on the Industrial Revolution increasing in Ukraine in the late XIX century. History of science and technology, 2020, vol.10, iss. 1 (16), p. 50–61. doi:10.32703/2415-7422-2020-10-1(16)-50-61
5	Gutnyk M., Chrzan K.L. Beckmann's family contribution to the development of European motor transport at the beginning of XX century / Gutnyk Maryna, // Часопис української історії. – Київ, 2019. – Вип. 39. – С. 136-141. http://doi.org/94.10347/2522-4111.2018.39.2.17

Additional literature

1	Азимов Айзек. Краткая история химии [Текст] = A short history of chemistry : развитие идей и представлений в химии / Азимов А. ; пер. З. Е. Гельман ; ред. А. Н. Шамин. - Москва : Мир, 1983. - 189 с.
2	Commercialization of scientific activity at the higher technical school of east Ukraine in the late 19th and early 20th century / Maryna Gutnyk, Elena Tverytnykova, Volodymyr Sklyar // Acta Baltica Historiae et Philosophiae Scientiarum. – Vol. 7, № 3 (Autumn 2019). – P. 125–138. – doi: 10.11590/abhps.2019.3.05
3	Tverytnykova E., Gutnyk M. The patent-license system of Ukraine in the second half of the XX century. Studies in History and Philosophy of Science and Technology, 2020. Vol 29. № 2.· P.76–83.
4	Radohuz S., Petrov S., Ananieva V., Gutnyk M., Minakova K. STEM Techniques in History Lessons. Hands-on Science. Innovative Education in Science and Technology. Costa MF, Dorrio BV, Minakova K (Eds); Hands-on Science Network, 2019. 55–57.
5	Tverytnykova Elena, Gutnyk Maryna, Salata Halyna. Professors of the Kharkiv Technological Institute: unknown pages of biography History of science and technology, 2020, Vol. 10, iss. 2, p. 383–399
6	History of Strength of Materials [Текст] : with a Brief Account of the History of Theory of Elasticity and Theory of Structures / S. P. Timoshenko. - New York; Toronto ; London : McGraw-Hill Book Company, Inc., 1953. – 452 p.
7	The Chinese Oil Industry: History and Future / Lianyong Feng, Yan Hu, Charles A. S. Hall, Jianliang Wang, Springer, 2013, 112.
8	History of the European Oil and Gas Industry / ed. J. Craig, F. Gerali, F. MacAulauy, R. Sorkhabi, London, 2018, 468 p.

INFORMATION RESOURCES ON THE INTERNET

(list of information resources)

1. Electronic professional publication "History of Science and Biography" of the National Academy of Sciences of the National Academy of Sciences of Ukraine. Available at: http://www.nbuv.gov.ua/node/1252
2. Questions of the history of science and technology. Available at: http://pamjatky.org.ua/?page_id=685
3. Collection of scientific works "Studies in the history of technology". Available at: http://kpi.ua/publication-dit#sthash.yl2ZASr6.dpuf
4. International scientific journal "Science and science about science". Available at: http://stepscenter.org.ua/mizhnarodnyj-naukovyj-zhurnal-nauka-t