Syllabus
Environmental aspects of car recycling

Subjects:	**Environmental aspects of car recycling**
Level of higher education:	**the first (educational and professional)**
Course page in Moodle:	*https://dl.khadi.kharkov.ua/course/view.php?id=2930*
The scope of the educational component	**4 credits (120 hours)**
Final control form	Test
Consultations	on schedule
Name of the department:	Department of Ecology
Teaching language:	English
Course leader:	Ph. D Pozdnyakova O. I.
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Brief content of the educational component:
The goal

The goal is to prepare specialists for the organization and regulation of production processes in the field of transport vehicles and transport technologies in such a way that would ensure rational use of nature and minimization the consequences of the production, operation and disposal vehicles motors on the state of the environment using resource-saving technologies;

- provision of competences to determine ways to ensure the implementation of complex actions for the disposal of cars at the end of their life cycle in compliance with the conditions of economic and commercial expediency and environmental protection.

Subject: modern technologies of recycling and disposal of auto components and materials used in the automotive industry

The main tasks of studying an academic discipline are:

- analysis the EU countries experience in the formation of the legislative and regulatory framework and the organization of work on the collection and disposal of cars after the end of their life cycle;
- formation of the ability of students of higher education to possess knowledge, abilities and skills in the field of operation and maintenance of modern technologies and equipment for waste disposal, in particular motor vehicle waste;

Prerequisites for studying the educational component:
Ecology; Physics; Chemistry

Competencies acquired by the applicant:

General competences:

the ability to solve complex tasks and problems in road transport during professional activities or in the learning process, which involves conducting research and/or

Professional competences:

- the ability to understand and take into account social, environmental, ethical, economic and commercial considerations affecting the implementation of technical solutions in road transport;
- the ability to assess risks when planning or implementing new technological processes in the field of road transport;
- the ability to scientifically substantiate the choice of materials, equipment and measures for the implementation of the latest technologies in road transport.

Learning outcomes according to the educational program:

demonstrate the ability to critically consider problems in the field of road transport, including at the border with related fields, engineering sciences, physics, ecology, economics;

- to be able to propose new technical solutions and apply new technologies;
- to be able to develop and implement energy-saving technologies.

Thematic plan

№ of topic	Name of topics (LC, LW, PW, SC, IW)	Number of hours	
		intramural	extramural
1	LC. Introduction. The current state of the problem of disposal of used cars. Ecologist - economic justification of the need to dispose of used cars. Characteristics of the main directive documents of the EU countries on the disposal of used cars	1	1
	PW (LW, IW) Calculation of the recycling rate of domestic cars according to the requirements of the ISO 22628 standard.	2	
	IW. Work on the topic. Preparation for practical work.	2	3
2	LC. Specific features of processing scrap metal of motor vehicles. Technologies and equipment for preparing scrap metal for remelting. The only scheme of the car recycling algorithm. Technological schemes of metal scrap and waste processing.	1	1
	PW (LW, IW)		
	IW. Work on the topic. Preparation for practical work.	2	3
3	LC. Specific features of non-ferrous metal scrap processing of motor vehicles. Preliminary processing of scrap metal. Classification of non-ferrous scrap metal processing methods.	1	1
	PW (LW, IW) Calculation of the recycling rate of domestic cars according to the requirements of the ISO 22628 standard	2	
	IW. Work on the topic. Preparation for practical work.	2	3
4	LC. Magnetic, electromagnetic, x-ray separators for scrap non-ferrous metals and their use in car recycling.	1	
	PW (LW, IW)		
	IW. Work on the topic. Preparation for practical work.	1	3
5	LC. Ecological and economic aspects of secondary processing of catalytic converters. Features of the design of catalytic converters that affect the technology of their disposal.	1	1

	PW (LW, IW) Estimation of greenhouse gas emissions and energy consumption during the life cycle of a car using the environmental calculator computer program	2	1
	IW Work on the topic. Preparation for practical work...	1	3
6	LC. The EU countries and Ukraine legislation on disposal of electrical and electronic equipment. Secondary recycling of batteries. Design features of battery accumulators, which affect the means of their disposal. Typical battery recycling schemes used in industry	1	1
	PW (LW, IW)		
	IW. Work on the topic. Preparation for practical work.	2	3
7	LC. Modern technologies for the disposal of battery electrolytes and the practical application of battery recycling products.	1	1
	PW (LW, IW). Determining the amount of reagents needed to neutralize battery electrolytes during their disposal	2	1
	IW. Work on the topic. Preparation for practical work.	1	3
8	LC. The lithium-ion batteries design features, which affect the methods of their disposal. Characterization of the environment impact on the extraction technologies of basic metals used in lithium-ion batteries.	1	
	PW (LW, IW)		
	IW. Work on the topic. Preparation for practical work..	1	3
9	LC. Environmental aspects of secondary processing of used oils.	1	1
	PW. Determination of combustion heat of alternative fuels by their elemental composition.	2	1
	IW. Work on the topic. Preparation for practical work.	2	3
10	LC. Use of lubricants utilization products in complex mixed fuels in power plants	1	
	PW		
	IW Work on the topic. Preparation for practical work...	2	3
11	LC. Peculiarities of the structure of polymer components that affect the methods of their secondary processing. Modern recycling technologies of thermoplastic and thermosetting polymers	1	
	PW. The primary analysis by express methods of thermosetting plastics for selection the recycling technologies.	2	
	IW. Work on the topic. Preparation for practical work.	2	3
12	LC. Marking system of polymer automotive components. Terms of their use in the industry of secondary plastics.	1	
	PW		
	IW. Work on the topic. Preparation for practical work.	2	3
13	LC. Classification of used tire recycling methods.	1	1
	PW. The primary analysis by express methods of thermoplastic for selection the recycling technologies.	2	
	IW. Work on the topic. Preparation for practical work.	2	3
14	LC. Application of tire processing products for the construction of noise protection screens and rubber-asphalt coatings.	1	
	PW		
	IW. Work on the topic. Preparation for practical work.	2	3
15	LC. Terms of application the tires pyrolysis products for obtaining alternative fuels.	1	
	PW. The use of primary identificatione the polymer auto components in order to select the utilization technology	2	1

	IW Work on the topic. Preparation for practical work.	2	3
16	LC. Application of rubber crumb of worn tires to obtain various coatings. Influence of crumb properties on coating characteristics	1	
	PW		
	IW. Work on the topic.	2	3
Total	LC	16	8
	PW	16	4
	IW	28	48

Individual educational and research task: (does not have):

Teaching methods:
1) verbal: 1.1 traditional: lectures, explanations, stories, etc.;
1.2 interactive (non-traditional): discussions, etc.;
2) visual: method of illustrations, method of demonstrations
3) practical: 3.1 traditional: practical classes;
3.2 interactive (non-traditional): discussions.

Evaluation system and requirements:
Current performance
1 The current performance of applicants for the performance of educational types of work in training sessions and for the performance of independent work tasks is evaluated using a four-point rating scale with subsequent transfer to a 100-point scale. During the evaluation of current performance, all types of work provided for by the educational program are taken into account.
1.1 Lecture classes are evaluated by determining the quality of performance of specified tasks.
1.2 Practical classes are evaluated by the quality of performance of a control or individual task, performance and design of practical work.
2 Evaluation of the current academic performance of students of higher education is carried out at each practical session on a four-point scale ("5", "4", "3", "2") and is entered in the journal of academic performance.

- "excellent": the winner mastered the theoretical material flawlessly, demonstrates in-depth knowledge of the relevant topic or academic discipline, the main provisions;
- "good": the applicant has mastered the theoretical material well, has the main aspects from primary sources and recommended literature, presents it in a reasoned manner; has practical skills, expresses his thoughts on certain problems, but certain inaccuracies and errors are assumed in the logic of the presentation of theoretical content or in the analysis of practical ones;
- "satisfactory": the applicant has basically mastered the theoretical knowledge of the educational topic or discipline, orients himself in primary sources and recommended literature, but answers unconvincingly, confuses concepts, answers additional questions uncertainly, does not have stable knowledge; when answering questions of a practical nature, reveals inaccuracy in knowledge, does not know how to evaluate facts and phenomena, connect them with the future profession;
- "unsatisfactory": the applicant has not mastered the educational material of the topic (discipline), does not know scientific facts, definitions, hardly orients himself in primary sources and recommended literature, lacks scientific thinking, practical skills are not formed.

3 The final score for the current activity is recognized as the arithmetic mean sum of points for each lesson, for individual work, current test works according to the formula:

$$K^{поточ} = \frac{K1 + K2 + ... + Kn}{n},$$

де $K^{поточ}$ – final assessment of success based on the results of current control; $K1, K2, ..., Kn$ – evaluation of the success of the current control measure;

n - the number of measures of current control.

Estimates are converted into points according to the calculation scale (table 1).

Table 1 – Recalculation of the average grade for the current activity into a multi-point scale

4- points scale	100-points scale	4- points scale	100-points scale	4- points scale	100-points scale	4- points scale	100- points scale
5	100	4,45	89	3,90	78	3,35	67
4,95	99	4,4	88	3,85	77	3,3	66
4,9	98	4,35	87	3,80	76	3,25	65
4,85	97	4,3	86	3,75	75	3,2	64
4,8	96	4,25	85	3,7	74	3,15	63
4,75	95	4,20	84	3,65	73	3,1	62
4,7	94	4,15	83	3,60	72	3,05	61
4,65	93	4,10	82	3,55	71	3	60
4,6	92	4,05	81	3,5	70	from 1,78 to 2,99	from 35 to 59
						reassembly	
4,55	91	4,00	80	3,45	69	from 0 to 1,77	from 0 to 34
4,5	90	3,95	79	3,4	68	repeated study	

Final assessment

1 The exam is held after studying all topics of the discipline and is completed by students of higher education during the examination session after the end of all classroom classes

2 Students of higher education who have completed all types of work prescribed by the curriculum in the discipline are admitted to the exam:

- were present at all classroom classes (lectures, seminars, practical);
- completed all missed classes on time;
- scored the minimum number of points for the current academic performance (at least 36 points, corresponding to the national scale "3");

If the current success in the discipline is lower than 36 points, the higher education applicant has the opportunity to increase his current point to the minimum before the beginning of the examination session.

3 Assessment of the knowledge of applicants when taking the exam is carried out on a 100-point scale.

Assessment of the knowledge of applicants through testing is carried out according to the following scale:

- "Excellent": at least 90% of correct answers;
- Very good": from 82% to 89% of correct answers;
- "Good": from 74% to 81% of correct answers;
- "Satisfactory": from 67% to 73% of correct answers;

- "Satisfactory enough": from 60% to 66% of correct answers;
- "Unsatisfactory": less than 60% of correct answers.

4The final grade for the academic discipline is defined as a weighted average grade that takes into account the overall grade for the current academic performance and the grade for passing the exam.

5 The calculation of the overall final grade for the study of an academic discipline is carried out according to the formula:

$$ПК^{екз} = 0,6 \cdot К^{поточ} + 0,4 \cdot Е,$$

де $ПК^{екз}$ – final assessment of success in disciplines, the form of final control for which is an exam;

$К^{поточ}$ – final assessment of success based on the results of current control (on a 100-point scale);

$Е$ - evaluation based on the results of the exam (on a 100-point scale).

– coefficients of the ratio of points for current success and passing the exam.

6 Additional points are awarded to winners for individual independent work and participation in scientific events.

6.1 Additional points are added to the sum of points scored by the student of higher education for the current educational activity (for disciplines for which the final form of control is a credit), or to the final grade for a discipline for which the final form of control is an exam.

6.2 The number of additional points awarded for different types of individual tasks depends on their volume and significance:

- prize places in the discipline at the international / all-Ukrainian competition of scientific student works - 20 points;
- prize places in the discipline at the All-Ukrainian Olympiads - 20 points;
- participation in the international / all-Ukrainian competition of scientific student works - 15 points
- participation in international / all-Ukrainian scientific conferences of students and young scientists - 12 points;
- participation in all-Ukrainian Olympiads in the discipline - 10 points
- participation in Olympiads and scientific conferences of the Khnadu in the discipline - 5 points;
- performance of individual scientific and research (educational and research) tasks of increased complexity - 5 points.

6.3 The number of additional points cannot exceed 20 points.

7 The total final grade for studying an academic discipline cannot exceed 100 points.
The overall final grade for the study of the academic discipline is determined according to the scale given in Table 2**.**

Table 2 – The scale for evaluating the knowledge of students based on the results of the final control of the academic discipline

Score in	Evaluation on a national scale	Evaluation according to the scale of the European credit transfer-accumulation system

points			estimation	Criteria
	examination	test		
90-100	**Perfectly**	**Enrolled**	**A**	The theoretical content of the course has been mastered in its entirety, without gaps, the necessary practical skills for working with the mastered material have been formed, all educational tasks provided for in the training program have been completed, the quality of their performance has been assessed with a number of points close to the maximum
80–89	**Fine**	**Enrolled**	**B**	The theoretical content of the course has been mastered in its entirety, without gaps, the necessary practical skills for working with the mastered material have mainly been formed, all educational tasks provided for by the training program have been completed, the quality of most of them has been assessed with a number of points close to the maximum
75-79			**C**	The theoretical content of the course has been mastered in its entirety, without gaps, some practical skills of working with the mastered material have not been formed enough, all educational tasks provided for by the training program have been completed, the quality of none of them has been assessed with a minimum number of points, some types of tasks have been completed with errors
67-74	**Satisfactorily**		**D**	The theoretical content of the course is partially mastered, but the gaps are not of a significant nature, the necessary practical skills for working with the mastered material are basically formed, most of the educational tasks provided by the training program have been completed, some of the completed tasks may contain errors
60–66			**E**	The theoretical content of the course has been partially mastered, some practical work skills have not been formed, many educational tasks provided by the training program have not been completed, or the quality of some of them has been assessed with a number of points close to the minimum.

Score in points	Evaluation on a national scale		Evaluation according to the scale of the European credit transfer-accumulation system	
			estimation	Criteria
	examination	test		
35–59	**Unsatisfactorily**	**Not counted**	**FX**	The theoretical content of the course has been partially mastered, the necessary practical work skills have not been formed, most of the prescribed training programs of educational tasks have not been completed, or the quality of their implementation has been assessed with a number of points close to the minimum; with additional independent work on the course material, it is possible to improve the quality of the performance of educational tasks (with the possibility of retaking)
0–34	**Unacceptable**		**F**	The theoretical content of the course has not been mastered, the necessary practical work skills have not been formed, all completed educational tasks contain gross errors, additional independent work on the course material will not lead to any significant improvement in the quality of the performance of educational tasks (with a mandatory repeat course).

Course policy:

– the course involves working in a team, the environment in the classroom is friendly, creative, open to constructive criticism;

– mastering the discipline involves mandatory attendance of lectures and practical classes, as well as independent work;

– independent work involves the study of individual topics of the academic discipline, which are presented in accordance with the program for independent study, or were considered briefly;

– all tasks provided by the program must be completed within the set time;

– if the student of higher education is absent from classes for a good reason, he presents the completed tasks during independent preparation and consultation of the teacher;

– while studying the course, students of higher education must adhere to the rules of academic integrity set forth in the following documents: "Rules of academic integrity of participants in the educational process of the Khnadu" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_dobroch_1.pdf), "Academic Integrity. Checking the text of academic, scientific and qualification papers for plagiarism" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_85_1_01.pdf), "Moral and ethical code of participants in the educational process of the Khnadu (https://www .khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_MEK_1.pdf).

– in case of detection of plagiarism, the applicant receives 0 points for the task and must repeat the tasks provided for in the syllabus;

– writing off during tests and exams is prohibited (including using mobile devices). Mobile devices are allowed to be used only during online testing.

Recommended Books:

1. N.V. Vnukova, V.P. Volkov, O.I., Hrytsuk I.V., Pozdniakova, T.V. Volkov. "Eco-safety and resource conservation during car recycling" - Textbook. Kherson: OLDI-PLUS Publishing House, 2021, 229 p.

Н.В. Внукова, В.П. Волков, О.І., Грицук І. В.,Позднякова, Т.В. Волкова. «Екобезпека та ресурсозбереження при утилізації автомобілів» - Підручник. Херсон: Видавництво ОЛДІ-ПЛЮС,2021, 229с.

2. Turenko A. M., Vnukova N. V., Pozdniakova OI. Environmental aspects of car recycling: a textbook. Recommended by the Ministry of Education and Culture, Khnadu, 2016. Kharkiv, 360 p.

Туренко А. М., Внукова Н. В., Позднякова ОІ. Екологічні аспекти рециклінгу автомобілів: підручник. Рекомендований МОН, ХНАДУ, 2016 г. Харьков, 360 с.

3. Gutarevich Y. F., Zerkalov D. V., Govorun A. G., Korpach A. O., Merzhievska L. P. Ecology and road transport: Study guide. — K.: Aristei, 2006. — 292p.

Гутаревич Ю. Ф., Зеркалов Д. В., Говорун А. Г., Корпач А. О., Мержиєвська Л. П. Екологія та автомобільний транспорт: Навчальний посібник. — К.: Арістей, 2006. — 292с.

4. O. Zaporozhets. Transport ecology. Tutorial. - Center for Educational Literature, 2018, 508 p.

О. Запорожец. Транспортна екологія. Навчальний посібник. - Центр навчальної літератури, 2018 р., 508 с.

5. Vnukova N. V., Pozdniakova O. I. Methodical instructions for practical works in the discipline "Environmental aspects of car recycling", KHNADU, 2020. 40 p.

Внукова Н. В., Позднякова О. І. Методичні вказівки до практичних робіт з дисципліни «Екологічні аспекти рециклінгу автомобілів», ХНАДУ, 2020 р. 40с.

6. . Methodical guidelines for practical work in the discipline of Resource-saving and environmental protection technologies in transport" / Vnukova N.V., Pozdniakova O.I.– KHNADU, 2016. - 81p.

Методичні вказівки до практичних робіт з дисципліни Ресурсозберігаючи та природоохоронні технології на транспорті» /Внукова Н. В., Позднякова О. І.–ХНАДУ, 2016. – 81с.

7. Vnukova N.V., Pozdniakova EI. Recycling of tires - a monograph, KHNADU, 2013, Kharkiv, 335 p.

Внукова Н. В., Позднякова ЕИ. Утилизация шин – монография, ХНАДУ, 2013 г. Харьков, 335 с.

8. Oscillations and vibroacoustics of a car tire. Monograph / V. A. Peregon, V. A. Karpenko, E. I. Pozdniakova and others - Kharkiv: Leader, 2017, 359 p.

Колебания и виброакустика автомобильной шины. Монография / Перегон В. А., Карпенко В. А., Позднякова Е. И. и др. – Харьков: Лидер, 2017г., 359 с.

9. Hrytsenko, A. V. Co-incineration of pyrolysis products of tires and wood pellets / A. V. Hrytsenko, N. V. Vnukova, E. I. Pozdniakova // Energy. Izv. higher education studies wind and energy united CIS. 2021. Vol. 64, No. 4. P. 363–376. https://doi.org/10.21122/1029-7448-2021-64-4-363-37

Гриценко, А. В. Совместное сжигание продуктов пиролиза шин и древесных пеллет / А. В. Гриценко, Н. В. Внукова, Е. И. Позднякова // Энергетика. Изв. высш. учеб.

заведений и энерг. объединений СНГ. 2021. Т. 64, № 4. С. 363–376. https://doi.org/10.21122/1029-7448-2021-64-4-363-376

10. V.Volkov, N.Vnukova, I.Taran, O.Pozdnyakova, T.Volkova. Influence of diesel vehicles on the biosphere. *Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu. 2021, (5) P. 094 - 099*

Additional sources:

1. . Ya. Bedryi, B. Bylynskyi, R. Ivakh, M. Kozyar. Industrial ecology Handbook for universities. - Condor, 2018, 374 p.

Я. Бедрий, Б. Билинський, Р. Ивах, М. Козяр. Промислова екологія Посібник для ВНЗ.- Кондор, 2018 р., 374 с.

2. Vnukova N.V., Pozdniakova OI. "Resource-saving and environmental protection technologies in transport" Copyright certificate for a service work of a scientific and practical nature No. 58460 dated 02.05.2015

Внукова Н. В., Позднякова ОІ. «Ресурсозберігаючі та природоохоронні технології на транспорті» Свідоцтво про авторське право на службовий твір науково-практичного характеру№ 58460 від 05.02.2015

3. ISO 22628: 2002 «Road vehicles – Recyclability and recoverability – Calculation method». [Электронный ресурс]. – Режим доступа: http://www.standards.com.au/

4.Vehicle Utilization: How Do You Define It? » [Electronic resource]. – Access mode. –- https://blog.agilefleet.com/vehicle-utilization-how-do-you-define-it

5. The effect of increasing vehicle utilization on the automotive industry».
[Electronic resource]. – Access mode].
https://www.sciencedirect.com/science/article/pii/S0377221722008189

6. Bureau of Economic Analysis. (2020). *GDP by industry*. Retrieved from https://www.bea.gov/data/gdp/gdp-industry

7. Report - Vehicles in use, Europe 2021 – ACEA. [Electronic resource]. – Access mode].
https://www.acea.auto/publication/report-vehicles-in-use-europe-january-2021/

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