NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Material Science and Material Technology Department

"APPROVED"
Faculty of Design and Engineering

"10" 06 2025

CURRICULUM OF ACADEMIC DISCIPLINE

Technology of machine building

Field of knowledge G Engineering, manufacturing and building industry
Specialty G11 Mechanical engineering (for specializations)
Academic programme Mechanical engineering
Faculty Design and Engineering
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Kyiv – 2025

Description of the discipline Technology of machine building

The discipline "Technology of machine building" is a comprehensive discipline that contains basic information about the basics of mechanical engineering technology, types and types of production and technological processes, the basics of the manufacturability of parts design, methods for achieving a given machining accuracy and surface quality, the basics of technical standardization and typical technological processes for assembling machines and manufacturing parts of various classes.

Field of knowledge, specialty, academic programme, academic degree		
Academic degree	Bachelor	
Specialty	G11 Mechanical engineering (for specializations)	
Academic programme	Mechanical engineering	
Characteristics of the discipline		
Type	compulsory	
Total number of hours	210	
Number of ECTS credits	7	
Number of modules	6	
Course project (work) (if any)	1	
Form of assessment	exam V semester/credit IV and VI semesters	
Indicators of the discipline for full-time and part-time forms of university study		
	Full-time	Part-time
Year of study	2,3	3
Semester	*IV, V, VI*	*V, VI*
Lectures	*15/30/15* hours.	*6/-* hours.
Practical classes and seminars	-	
Laboratory classes	*15/30/15* hours.	*16* hours.
Self-study	*30/30/30* hours.	*86* hours.
Number of hours per week for full-time students	*2/4/2* hours.	

1. Aim, objectives, competences and expected learning outcomes of the discipline

Aim providing general technological training for a future specialist in the field of engineering and production, as well as acquiring skills in mechanical engineering for the successful selection of technological methods for obtaining and processing workpieces, ensuring high product quality, technical and economic characteristics, saving materials, and high labor productivity. Laying the foundation for studying the disciplines: "Interchangeability, standardization and technical measurements", "Dynamics and

strength and mechanical and technological properties of agricultural materials", "Theory of mechanisms and machines", "Machine parts and PTM", "Fundamentals of mobile energy vehicles structures", "Modeling of machines and units", "Reliability of agricultural machinery", "Fundamentals of machine design", "Economic efficiency of design solutions".

Acquisition of competences:

Integral competence (IC): The ability to solve complex specialized tasks and solve practical problems in the field of mechanical engineering using the theories and methods of modern science based on a systems approach and taking into account the complexity and uncertainty of the operating conditions of technological systems.

General competences (GC):

GC1. The ability to think abstractly.

GC2. Ability to apply knowledge in practical situations.

GC3. Ability to plan and manage time.

GC4. Ability to search, process and analyze information from various sources.

GC5. Ability to generate new ideas (creativity).

GC10. Skills in using information and communication technologies.

special (professional) competencies (SC):

Special (professional) competences (SC):

SC1. Ability to apply typical analytical methods and computer software tools for solving engineering problems of industrial mechanical engineering, effective quantitative methods of mathematics, physics, engineering sciences, as well as appropriate computer software for solving engineering problems of industrial mechanical engineering.

SC2. The ability to apply fundamental scientific facts, concepts, theories, principles to solve professional problems and practical problems of industrial mechanical engineering.

SC4. The ability to implement engineering developments in industrial mechanical engineering, taking into account technical, organizational, legal, economic and environmental aspects throughout the life cycle of the machine: from design, construction, operation, maintenance, diagnostics and disposal.

SC7. The ability to make effective decisions regarding the selection of construction materials, equipment, processes and to combine theory and practice to solve an engineering task.

SC8. The ability to realize creative and innovative potential in project development in the field of mechanical engineering.

SC9. The ability to carry out commercial and economic activities in the field of mechanical engineering.

SC10. The ability to develop plans and projects in the field of mechanical engineering under uncertain conditions, aimed at achieving the goal, taking into account existing limitations, to solve complex problems and practical problems of improving product

quality and its control.

Expected Learning Outcomes (ELO):

ELO2. Knowledge and understanding of mechanics and mechanical engineering and their development prospects.

ELO3. To know and understand the systems of automatic management of objects and processes of industrial engineering, to have skills in their practical use.

ELO4. Carry out engineering calculations to solve complex problems and practical problems in industrial mechanical engineering.

ELO7. Prepare production and operate products using automatic life cycle support systems.

ELO10. To understand the problems of labor protection and legal aspects of engineering activity in industrial mechanical engineering, the skills of forecasting the social and environmental consequences of the implementation of technical tasks.

ELO11. Communicate freely with the engineering community orally and in writing in national and foreign languages.

ELO12. Apply means of technical control to evaluate the parameters of objects and processes in industrial mechanical engineering.

2. Programme and structure of the discipline

Modules and topics	Number of hours												
	full-time							part-time					
	weeks	total	including					in total	including				
			l	p	lab	ind	s.st		l	p	lab	ind	s.st
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Module 1: **Basics, fundamentals of machine building**													
Topic 1: Basics, fundamentals of machine building	1-2	6	2				4						
Topic 2: Fabricability (processability index, manufacturability, of products design	3-4	8	2	-	2	-	4						
Topic 3: Fundamentals of locating parts, workpieces, products	5-6	8	2	-	2	-	4						
Topic 4: Accuracy of mechanical processing and methods of its providing	7-12	23	3	-	6	-	10						
Total for module 1	41		9		10		22	32	2				30
Module 2. **Fundamentals of technical valuation**													
Topic 1: Quality of surfaces of machine parts and methods of its providing	12-13	11	4	-	3	-	4						
Topic 2: Fundamentals of technical valuation	14-15	8	2		2		4						
Total for module 2	19		6		5		8	6			2		4
Module 3. **Design of technological processes of mechanical processing**													
Topic 1: Design of technological processes of mechanical processing.	1-6		43	14		18		15					
Total for module 3	47		14		18		15	11	1		2		8
Module 4. **Devices for metalworking machine tools**													
Topic 1: Devices for metalworking machine tools	6-15	47	16		12		15						
Total for module 4	43		16		12		15		1		2		8
Module 5. **Typical technological processes of manufacturing parts**													
Topic 1:	1-2	8	2		2		4						

Machining, processing parts of "SHAFTS" class, type													
Topic 2: Machining, processing parts of "Sleeves" class, type	3	8	2		2		4						
Topic 3: Machining, processing parts of "Discs" and "Levers" class, type	4-5	8	2		2		4						
Topic 4: Machining, processing parts of " Gears " class, type	6-7	8	2		2		4						
Topic 5: Machining, processing parts of "Body parts" class, type	8-9	8	2		2		4						
Total for module 5	40		10		10		20						
Module 6. **Technological processes of manufacturing parts for agricultural machines**													
Topic 1: Manufacturing of working parts of agricultural machines	10-11	13	3		4		6						
Topic 8: Manufacturing of nonmetallic parts	12-13	7	2		1		4						
Total for module 6	20		5		5		10	37	1		6		30
Total hours	210		60		60		90		6		16		86
Course project (work) Of technology of machine building (if included in the curriculum)			-	-	-	108	-		-	-	-	15	-
Total hours	210		60		60		90		6		16		86

3. Topics of Lectures

№	Topic title	Hours
1	Introduction. Tasks of the discipline. Basics, fundamentals of machine building. Production, technological processes.	2
2	Types and types of machine-building industries and their technological characteristics	2
3	Fundamentals of locating (basing) parts, workpieces, products. Principles of combining and dividing bases.	2
4	Accuracy of mechanical processing and methods of its providing.	1
5	Influence of part deformation and workpiece shape on	2

	machining accuracy. Total processing error.	
6	Statistical methods of research of accuracy at mechanical treatment.	2
7	Fundamentals of the theory of dimensional chains. Basic concepts and definitions	2
8	Technical standardization of machining operations	2
9	Fundamentals of process design	4
10	Standardization in mechanical engineering technology	2
11	Selection of equipment and fixtures for the process	4
12	Preliminary development of the technological route	4
13	Machine fixture for the technological process of mechanical processing of parts	2
14	Machine fixture mechanisms	2
15	Machine fixture mechanisms. clamping mechanisms	4
16	Machine fixture mechanisms. for installing cutting tools	4
17	Optimization of cutting modes	2
18	Technical and economic indicators	2
19	Machining, processing parts of "SHAFTS" class, type	2
20	Machining, processing parts of "Sleeves" class, type	2
21	Machining, processing parts of "Levers" class, type	2
22	Machining, processing parts of " Gears " class, type	2
23	Machining, processing parts of "Body parts" class, type	2
24	Machining, processing parts of "Body parts" class, type	2
25	Manufacturing of working parts of agricultural machines	2
26	Technology for manufacturing parts from non-metallic materials	1

4. Topics of laboratory (practical, seminar) classes

№	Topic title	Hours
1	Determining the dependence of the surface turning error on the ratio of the dimensions of the part fixed in the chuck.	2
2	Investigation of the influence of temperature deformations of a lathe cutter on machining accuracy.	2
3	Investigation of the influence of the elements of the cutting mode on the roughness of the machined surface during turning.	2
4	Determination of the error of installation of the cutter on the size on a limb of the machine.	2
5	Determination of the dependence of temperature deformations of the spindle unit of the vertical - milling machine on the time of its operation and cooling.	2
6	Determination of the stiffness of the lathe. Determination of rigidity of a vertical milling machine by the production method	2

7	Determination of axial error, fixing the workpiece in a three-cam chuck.	2
8	Methods of studying working time. Timing of work on machines	1
9	Introduction. The main stages of technological process design. Preliminary elaboration of design decisions.	4
10	Determining the accuracy of processing with different methods of fixing the workpiece. Determination of base error during milling.	2
11	Analysis of the manufacturability of the design of the part. Preliminary selection of production type. Release stroke.	2
12	Influence of product rigidity on vibration resistance of technological system.	4
13	Choice of cutting modes. Standardization of technological process.	2
14	Processing of profile surfaces on the grinder on the copier.	4
15	Choice of workpiece type. Basic requirements for blanks. Calculation of interoperative allowances for machining.	2
16	Technical control of details of a class "shafts"	4
17	Preliminary development of the technological route.	4
18	Technical control of body parts.	4
19	Determining the size of the closing link in the compensatory method of assembling assemblies and units.	2
20	Methods of designing tool settings.	2
21	Design of the installation and clamping device. Requirements for clamping mechanisms.	2
22	Calculation of the accuracy of the device and the clamping force of the workpiece.	2
23	Registration of technological documentation.	2
24	Manufacturing of camshaft cam on a cylindrical grinding machine according to the copy method	2
25	Technical control of parts	2
26	Assembling of the rear axle gearbox	1

5. Topics for self-study

№ s/n	Topic title	Hours
1	Production process in mechanical engineering. Main characteristics of production processes.	15
2	Dimensional chains. Calculation of the closing link of the dimensional chain.	15
3	Main stages of designing the technological process. Preliminary development of design solutions.	10
4	Setting the processing route of individual surfaces depending	10

	on the accuracy	
5	Systems of machine tools. Their use for different types of production.	10
6	Methods of standardizing the technological process of machining workpieces.	10
7	Methods of increasing vibration resistance when machining workpieces on metal-cutting machines	10
8	Methods and schemes of technical control of parts in different types of production	10

6. Tools for assessing expected learning outcomes:
(select necessary or add)

- Exam/credit;
- Corse work;
- module tests;
- presentation of laboratory and practical works;
- Oral discussion

7. Teaching methods:

- problem-based learning method;
- practice-oriented learning method;
- research-based learning method

8. Assessment methods:

The assessment of students' knowledge and skills is conducted by means of a 100-point scale and is converted into national grades according to Table 1 of the current *Exam and Credit Regulations at NULES of Ukraine*.

8.1. Distribution of points by types of educational activities

Type of educational activity	**Learning outcomes**	**Evaluation**
4th semester		
Module 1. **Fundamentals of mechanical engineering technology**		
Lecture 1	ELO2**,** ELO3, ELO4 ELO7, ELO10, ELO11, ELO12 Know production and technological processes, their components, general concepts of manufacturability, foundations of basing, main factors influencing the accuracy of machining, statistical methods for studying accuracy in machining. Be able establish technological bases, analyze the part for manufacturability.	**-**
Laboratory work 1		**10**
Independent work 1		**20**
Lecture 2		**-**
Laboratory work 2		**10**
Lecture 3		**-**
Laboratory work 3		**10**
Lecture 4		**-**
Laboratory work 4		**10**
Lecture 5		**-**
Laboratory work 5		**10**

Modular test 1.		**30**
Total by module 1		**100**
Module 2. **Fundamentals of technical regulation**		
Lecture 6	ELO2**,** ELO3, ELO4 ELO7, ELO10, ELO11, ELO12 Know the basic methods and ways of calculating the technical standard of time for a technological process, its components. Be able to establish time standards using various analytical and calculation methods.	**-**
Laboratory work 6		**20**
Lecture 7		**-**
Laboratory work 7		**20**
Independent work 2		**20**
Lecture 8		**-**
Laboratory work 8		**10**
Modular test 2.		**30**
Total by module 2		**100**
Educational work		**(M1+M2)/2 *0.7 ≤ 70**
Test		**30**
Total for 4 semesters		**100**
5th semester		
Module 3. **Fundamentals of process design**		
Lecture 9	ELO2**,** ELO3, ELO4 ELO7, ELO10, ELO11, ELO12 Know the methods of standardization in mechanical engineering, the procedure for designing technological processes and checking parts for manufacturability, factors that affect the accuracy of machining, Be able to pre-develop a technological process for mechanical processing, select equipment for the technological process.	**-**
Laboratory work 9		**10**
Independent work 3		**15**
Lecture 10		**-**
Laboratory work 10		**10**
Lecture 11		**-**
Laboratory work 11		**10**
Lecture 12		**-**
Laboratory work 12		**10**
Independent work 4		**15**
Modular test 3.		**30**
Total by module 3		**100**
Module 4. **Accessories for metal-cutting machines**		
Lecture 13	ELO2**,** ELO3, ELO4 ELO7, ELO10, ELO11, ELO12 Know mechanisms and systems of machine tools, their use in various types of production, technical and economic indicators Be able to optimize cutting modes for the technological process. Calculate technical and	**-**
Laboratory work 13		
Lecture 14		**-**
Laboratory work 14		
Lecture 15		**-**
Laboratory work 15		
Lecture 16		**-**
Laboratory work 16		
Independent work 5		

Lecture 17	economic indicators. Choose attachments for machine tools	**-**
Laboratory work 17		
Lecture 18		**-**
Laboratory work 18		
Modular test work 4.		**30**
Total module 4		**100**
Educational work		**70**
Exam		**30**
Total for 5 semesters		**100**
Coursework		**100**
6th semester		
Module 5. **Typical technological processes for manufacturing parts**		
Lecture 19	ELO2**,** ELO3, ELO4 ELO7, ELO10, ELO11, ELO12 Know typical technological processes for machining parts of various types Be able to use typical technological processes when designing a technological process for manufacturing parts	**-**
Laboratory work 19		**10**
Lecture 20		**-**
Laboratory work 20		**10**
Independent work 6		**10**
Lecture 21		**-**
Laboratory work 21		**10**
Lecture 22		**-**
Laboratory work 22		**10**
Independent work 7		**10**
Lecture 23		**-**
Laboratory work 23		**10**
Modular test work 5.		**30**
Total modulo 5		**100**
Module 6. **Technological processes for manufacturing parts of agricultural machinery**		
Lecture 24	ELO2**,** ELO3, ELO4 ELO7, ELO10, ELO11, ELO12 Know technological processes of machining parts agricultural machines, working bodies of agricultural machines. Be able to use technological processes when designing the technological process of parts of agricultural machinery.	**-**
Laboratory work 24		**15**
Lecture 25		**-**
Laboratory work 25		**20**
Independent work 8		**20**
Lecture 26		**-**
Laboratory work 26		**15**
Modular test 6.		**30**
Educational work		**70**
Test		**30**
Total for 6 semesters		**100**

8.2. Scale for assessing knowledge of a higher education applicant

Higher education applicant rating, points	Assessment according to the national system (exams/credits)
90-100	perfectly
74-89	good
60-73	satisfactorily
0-59	unsatisfactorily

8.3. Evaluation Policy

Deadline and resubmission policy:	The student must Submit assignments within the deadlines set by the instructor. Assignments submitted after the deadlines without good reason will be given a lower grade. Modules can be retaken with the instructor's permission if there are good reasons (for example, sick leave).
Academic Integrity Policy:	Cheating during tests and exams is prohibited (including using mobile devices). Term papers and essays must have correct text references to the literature used.
Visitation Policy:	The student is required to attend all classes every day according to the established schedule, not be late, and have an appropriate appearance. For objective reasons (for example, illness, international internship), training may take place individually (online, in agreement with the dean of the faculty).

9. Educational and methodological provision :

- Electronic training course in the discipline "Mechanical Engineering Technology"
- Part 1. https://elearn.nubip.edu.ua/course/view.php?id=1291
- Part 2. https://elearn.nubip.edu.ua/course/view.php?id=1162
- Lecture notes and presentations;
- Textbooks, study guides, workshops;
- Methodological guidelines for performing laboratory work;
- Stands, posters;
- End-to-end internship program

10. Recommended sources of information

1. Тарельник В.Б., Коноплянченко Є.В., Зубко В.М. Галузеве машинобудування. Підручник. Видавництво Олді+, 2023, 468 с. ISBN 978-966-289-663-3
2. Добрянський, С. С. Технологічні основи машинобудування [Електронний ресурс] : підручник для студентів спеціальностей 131 «Прикладна механіка», 133 «Галузеве машинобудування» / С. С. Добрянський, Ю. М. Малафєєв ; КПІ ім. Ігоря Сікорського. – Електронні текстові дані (1 файл: 13,4 Мбайт). – Київ : КПІ ім. Ігоря Сікорського, 2020. – 379 с. https://ela.kpi.ua/bitstreams/90d2719f-8a75-4966-827f-b3a518b52012/download

3. Яковенко І. Е., Пермяков О. А., Фесенко А. В. Технологічні основи машинобудування: навчальний посібник для студентів спеціальностей 131 – Прикладна механіка, 133 –Галузеве машинобудування / І. Е. Яковенко, О. А. Пермяков, А.В. Фесенко – Харків: НТУ «ХПІ», 2022. – 421с. https://repository.kpi.kharkov.ua/bitstreams/c13d8e08-32f2-4521-860a-7485a7bc026e/download
4. Технологія машинобудування : навчальний посібник для студ. спец. : 133 “Галузеве машинобудування”, 015 «Професійна освіта (машинобудування)» та 131 «Прикладна механіка» / І. І. Назаренко, М. М. Ручинський, О. П. Дєдов, Є. О. Міщук. - Київ : Ямчинський О. В., 2024. - 164 с.
5. https://repositary.knuba.edu.ua/bitstreams/af192fa5-cd8d-4894-90ea-8a6cbac1997a/download
6. Технологія машинобудування. Практичні та лабораторні роботи: Навчальнометодичний посібник / Н.О. Балицька, Л.Є. Глембоцька, О.А. Громовий, В.М. Колеснік, Г.П. Кремнєв, О.Л. Мельник, П.П. Мельничук, В.М. Ночвай,О.М. Пилипенко, Л.Г. Полонський, В.А. Яновський. – Житомир: «Житомирська політехніка», 2023. – 171 с.
7. https://learn.ztu.edu.ua/pluginfile.php/277867/mod_resource/content/1/%D0%A2%D0%95%D0%A5%D0%9D%D0%9E%D0%9B%D0%9E%D0%93%D0%86%D0%AF%20%D0%9C%D0%90%D0%A8%D0%98%D0%9D%D0%9E%D0%91%D0%A3%D0%92%D0%90%D0%9D%D0%9D%D0%AF%20%20%D0%BF%D0%BE%D1%81%D1%96%D0%B1%D0%BD%D0%B8%D0%BA%20%20%D0%9A%D0%BE%D0%BB%D0%B5%D0%BA%D1%82%20%D0%B0%D0%B2%D1%82%D0%BE%D1%80%D1%96%D0%B2%20%282%29%20%281%29.doc.pdf
8. Технологія машинобудівних підприємств: підручник / В. Л. Дикань, Ю. Є. Калабухін, Н. Є. Каличева та ін., за заг. ред. В. Л. Диканя. – Харків: УкрДУЗТ, 2020. – 386 с. http://lib.kart.edu.ua/bitstream/123456789/3496/1/%D0%9F%D1%96%D0%B4%D1%80%D1%83%D1%87%D0%BD%D0%B8%D0%BA.pdf
9. Матеріалознавство і технологія конструкційних матеріалів: підруч. для вищ. навч. закл. України / А.С. Опальчук, Є.Г. Афтанділянц, Л.Л. Роговський, О.Є. Семеновський [та ін.]. – Вид. 2-ге, перероб. і допов. – Ніжин: Лисенко М.М., 2013. – 751 с.
10. Основні поняття і принципи технології машинобудування. Методичні вказівки з дисципліни "Технологія машинобудування" для студентів спеціальності (освітня програма) 133 «Галузеве машинобудування». К, НУБіП України. Укл. Семеновський О.Є., Похиленко Г.М.
11. Технологія сільськогосподарського машинобудування: підруч. для вищ. техн. закл. України / Б. М. Гевко [та ін.]. – Вид. 2-ге, перероб. і допов. – Тернопіль : Паляниця В. А., 2015. – 418 с.– ISBN 978-617-7331-10-9.
12. Технологія машинобудування. Проектування та виробництво заготованок [Текст] : підручник для студ. машинобуд. спец. вищ. навч. закладів / Л. І. Боженко. – Львів : Світ, 1996. – 368 с. – ISBN 5-7773-0319-6.
13. Технологічні процеси отримання заготовок для

сільськогосподарського машинобудування. Методичні вказівки з дисципліни "Технологія машинобудування" для студентів спеціальності (освітня програма) 133 «Галузеве машинобудування». – К., НУБіП України. Укл. Семеновський О.Є., Похиленко Г.М.
14. Технологія машинобудування. посібник для студ. машинобуд. спец. вищ. навч. закладів / Є.О. Горбатюк, М.П.Мазур та ін. – Львів: Новий Світ, 2009. – 358 с. РОЗМІРНІ ЛАНЦЮГИ Навчально-методичний посібник. Ю.Є. Паливода, А.Є. Дячун, Ю.Б. Капаціла, І.Г. Ткаченко. - Тернопіль : Тернопільський національний технічний університет імені Івана Пулюя, 2018. – 132 с.
15. Медвідь М.В., Шабайкович В.А. Теоретичні основи технології машинобудування. За ред. проф. М.В. Медвідя. Львів: Видавниче об'єднання «Вища школа», 1976. – 299 с.
16. Боровик А.І., Лінчевський П.А., Петраков Ю. В. Технологія машинобудування. Підручник.: ЖДТУ, Житомир. – 2005, 835 с.
17. Сучасні методи аналізу технологічних процесів у машинобудуванні: Навч. посібник /В.В. Душинський. – К.: 1СДО, 1994. – 216 с.
18. Технологія обробки на верстатах з ЧПК [Текст] : навч. посіб. для студ. машинобуд. спец. вищ. техн. навч. закл. / Гевко Б. М. [та ін.] ; Терноп. нац. техн. ун-т ім. Івана Пулюя, Каф. технології машинобуд. та автомобілів. – Т. : Крок, 2014. – 131 с. : табл., рис. – Бібліогр.: с. 126-128. - 300 экз. – ISBN 978-617-692-168-4.
19. Технологія машинобудування. Посібник-довідник для виконання кваліфікаційних робіт. – http://vlp.com.ua/node/3850
20. Машинобудування України: тенденції розвитку Бібліографічний список літератури. – http://library.zntu.edu.ua/bibliograf_pokaz/mashinobud.pdf
21. Технологія машинобудування Є.О. Горбатюк, М.П. Мазур, А.С. Зєнкін, В.Д. Каразей. – http://www.tnu.in.ua/study/refs/d184/file1357975.html
22. Нові технології виробництва ракет у КБ «Південне». – https://www.ukrmilitary.com/2018/12/new-technology-on-kb-pivdenne.html
23. The complete guide to machined parts. – https://www.3erp.com/blog/the-complete-guide-to-machined-parts/
24. Is Hybrid Manufacturing Technology the Future of Additive Manufacturing? – https://amfg.ai/2018/07/10/hybrid-technology-the-future-of-manufacturing/
25. Технологія машинобудування. Посібник-довідник для виконання кваліфікаційних робіт. Юрчишин І.І. та ін. – http://www.tnu.in.ua/study/refs/d184/file1357977.html