



## RTU Course "Shipbuilding Materials"

0J000 Latvian Maritime Academy

**General data**

Code	JA0138
Course title	Shipbuilding Materials
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Sergejs Gaidukovs
Academic staff	Valdis Priednieks
Volume of the course: parts and credits points	2 parts, 9.0 credits
Language of instruction	LV, EN
Annotation	<p>The study course covers modern materials used in shipbuilding and operation, their manufacture, internal structure and properties, material processing technologies, methods of improving material properties and surface treatment of components, methods of joining machine and machinery components, designation systems for metals and their alloys, classification society directives for materials and products used in shipbuilding, methods of testing materials and components, selection of materials and their processing methods, safety of people and the environment in material processing and operation. In order to develop the skills and competences for practical application of the acquired theoretical knowledge, the students work on practical laboratory and independent homework, including the complex work "Manufacture of ship machinery and equipment elements", as well as attend the annual exhibition "Techindustry".</p> <p>The study course complies with STCW Code Standards A-III/1 and A-III/2 and includes the relevant sections of IMO Module Courses 7.04 and 7.02.</p> <p>Part-time extramural studies are organized according to an individually developed study plan.</p>
Goals and objectives of the course in terms of competences and skills	<p>The aim of the study course is to provide students with a comprehensive overview of the materials used in shipbuilding and ship operation, their manufacture, construction, properties and performance improvement, grades, testing methods and processing technologies.</p> <p>Tasks of the study course:</p> <ol style="list-style-type: none"> <li>1) to provide students with knowledge of modern shipbuilding materials, their characteristics and testing/testing methods;</li> <li>2) to develop students' understanding of the interrelationship between material structure and properties, as well as the possibilities of improving properties;</li> <li>3) to provide students with knowledge of the main modern material processing technologies;</li> <li>4) to develop students' skills in materials testing/inspection;</li> <li>5) to develop students' practical skills in the design of technological processes for the manufacture and quality inspection of shipboard machinery and equipment components;</li> <li>6) to develop students' competence to make and justify a rational choice of component materials and processing technologies for specific ship operating conditions.</li> </ol>
Structure and tasks of independent studies	<p>During the study course, in addition to studying theoretical materials, as well as developing the theoretical part of the practical laboratory work, performing the necessary calculations and designing, students develop 5 independent works.</p> <p>Independent work tasks I semester:</p> <ol style="list-style-type: none"> <li>1. independent work - preparation of a presentation on the chosen topic in the field "Shipbuilding and Repair Materials - I";</li> <li>2. independent work - preparation of a presentation on the chosen topic in the field of "Materials Processing Technologies";</li> <li>3. independent work - targeted attendance of the annual international exhibition "Techindustry" and preparation of a report presentation.</li> </ol> <p>Independent work tasks in the II semester:</p> <ol style="list-style-type: none"> <li>4. independent work - preparation of a presentation on the chosen topic in the field of "Shipbuilding and Repair Materials - II";</li> <li>5. independent work - preparation of the complex independent work "Production of elements of ship machinery and equipment", incl: <ul style="list-style-type: none"> <li>- select a specific subassembly of a ship structure, machine or mechanism and one (1) item - part thereof;</li> <li>- investigate the compatibility of the selected component with other components of the subassembly, as well as the operating conditions;</li> <li>- determine the technical requirements for the selected component;</li> <li>- select and justify the material and make of the component;</li> <li>- select and justify the method of obtaining the part blank and demonstrate/describe it;</li> <li>- identify the surfaces to be machined by parting/cutting, select machining methods and demonstrate/describe them;</li> <li>- select and demonstrate/describe methods of improving the material properties and surface treatment/finishing of the part;</li> <li>- select and demonstrate/describe the means of quality control of the workmanship of the part.</li> </ul> </li> </ol> <p>Work organisation.</p> <p>As part of the study course, in accordance with the individual task, the students develop four independent works on modern materials of shipbuilding and repair and their processing technologies, as well as a complex work on the manufacturing process of the selected ship machine or equipment part</p> <p>The projects are developed in cooperation with the teacher both during practical classes and individual consultations. Students present their independent work during practical classes.</p>

Recommended literature	<p>Obligātā / Obligatory:</p> <ol style="list-style-type: none"> <li>Vērdiņš G., Dukulis I. Materiālu mācība: mācību līdzeklis. – Jelgava: LLU, 2008. – 240 lpp.</li> <li>Ozoliņš J., Geriņš Ē., Muižnieks G. Inženiermateriālu īpašības un marķēšana. – Rīga: RTU, 2008. – 60 lpp.</li> <li>Ozoliņš J., Straume I., Muižnieks G. Inženiermateriālu struktūra un īpašības. Laboratorijas darbu praktikumš. – Rīga: RTU, 2009. – 42 lpp.</li> <li>S.S.Kalpajian, S.R.Schmid. Manufacturing Engineering and Technology. 6 Edition, Pearson, 2009. – 1180 p.</li> <li>Kees Kuiken. Diesel Engines. Part I, II, III. 3rd ed., Target Global Energy Training, Noorderhooiidijk, 2016.</li> <li>Materials Science and Engineering: An Introduction, 10th Edition. ISBN: 978-1-119-40549-8, Wiley&amp;Sons, 2018.</li> </ol> <p>Papildu / Additional:</p> <ol style="list-style-type: none"> <li>V.Priednieks. Kuģu būves materiāli / Lekciju un praktisko-laboratorijas darbu izdales materiāli PowerPoint.ppt formātā (tekošā gada versija)</li> <li>V.Bērenfelds. Tehniskais minimums metālapstrādē. Rokasgrāmata. – Rīga: Avots, 1989. – 263 lpp.</li> <li>A.Urbahs, K.Savkovs, V.Ļesterovskis. Transportmašīnu materiāli. Metodiskie norādījumi laboratorijas darbiem. – Rīga: RTU izdevniecība, 2008. – 94 lpp.</li> <li>A.Urbahs u.c. Gaisa kuģu konstrukciju nesagraujošā kontrole. Zinātniskā monogrāfija. Rīga: RTU izdevniecība, 2017., 310 lpp.</li> <li>G.Bunga, Ē.Geriņš. Apstrādes ar atdalīšanu tehnoloģijas. – Rīga: RTU, 2007. – 85 lpp.</li> <li>G.Bunga, Ē.Geriņš. Inženierizstrāžu materiāli un apstrādājošie sakausējumi. – Rīga: RTU, 2011. – 66 lpp.</li> <li>O.Pētersons. Metālu metināšana. – Rīga: Mācību apgāds, 1999. – 187 lpp.</li> <li>J.W.Martin. Materials for Engineering. 3rd ed., Woodhead Publishing Ltd, Cambridge, 2006. – 252 p.</li> <li>L. Volker u.a. Werkstofftechnik Maschinenbau. 6.Auflage, Verlag Europa-Lehrmittel, 2017 – 703 S.</li> <li>J.Dillinger u.a. Fachkunde Metall. 56. Auflage, Verlag Europa-Lehrmittel, 2010 – 624 S.</li> <li>M.F. Ashby. Materials Selection in Mechanical Design. 5.Edition, Published by Elsevier Ltd., 2017. – 646 p.</li> <li>Composite materials in maritime structures. Volume 1: Fundamenta Aspects. Edited by R.A.Shenoi and J.F. Wellicome. – Cambridge: Cambridge University Press, 2008, 351 p.</li> <li>Mikell P.Groover. Fundamentals of Modern Manufacturing. Materials, Processes, and Systems. 3rd ed. John Wiley &amp; Sons, Inc., 2007. – 1022 p</li> <li>Inspection, repair and maintenance of ship structures. By P.A.Caridis a.o. London: Witherby &amp; Co Ltd., 2001, 473 p.</li> <li>Paul E.Mix. Introduction to Nondestructive testing. A Training Guide, Second Edition. – New Jersey, Hoboken: by John Wiley &amp; Sons, Inc., 2005, - 681 p.</li> </ol> <p>Citi informācijas avoti / other sources of information:</p> <ol style="list-style-type: none"> <li>Germanischer Lloyd rules and guidelines</li> <li>LVS EN standarti: 573-2:2000; 1560:2011; 1561:2012; 4957:2001; 10020:2014; 10027-1:2005; 10027-2:2015. LVS CEN/TS 13388:2015</li> </ol>
Course prerequisites	Physics, Chemistry (secondary school).

### Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
INTRODUCTION	3	0	3	0
PART I	0	0	0	0
1.Shipbuilding and operating materials	0	0	0	0
1.1 Iron-based metals - steel and cast iron, their production (IMO 7.04 - 3.1.1.1)	6	4	6	4
1.2 Non-ferrous metals (IMO 7.04 - 3.1.1.1, 3.1.1.2)	3	3	3	3
1.3 Metal alloys and their condition charts (IMO 7.04 - 3.1.1.2)	12	8	12	8
1.4 Plastics and other non-metallic materials (IMO 7.04 - 3.1.1.3)	4	3	4	3
1.5 Ceramic and metallic materials, composites, nanomaterials, smart/intelligent and other advanced materials (IMO 7.04 - 3.1.1.3)	4	2	4	2
2. Structure and properties of materials	0	0	0	0
2.1 Structure and properties of materials, their interrelationships; basic material properties (IMO 7.04 - 3.1.1.2)	10	7	10	7
2.2 Mechanical properties of materials under static, dynamic and cyclic loading and at low and high temperatures; methods of testing materials (IMO 7.04-3.1.1.2; 3.1.3.1; IMO 7.02-1.2.7.1)	18	14	18	14
2.3 Vibration and its effect on the properties of materials (IMO 7.04-3.1.3.2)	3	2	3	2
2.4 Surfaces of machine parts and workpieces: structure and properties	1	0	1	0
3. Materials processing technologies	0	0	0	0
3.1 Casting (IMO 7.04-3.1.1.1; IMO 7.02-1.2.7.2)	4	3	4	3
3.2 Pressure treatment (IMO 7.04-3.1.1.1; IMO 7.02-1.2.7.2)	6	4	6	4
3.3 Fabrication and bending of pipes (IMO 7.04-3.1.3.7)	4	2	4	2
3.4 Separation treatment, cutting (IMO 7.02 -1.2.7.2)	10	8	10	8
3.5 Material handling machinery, equipment and tools, including measuring equipment and instruments	8	6	8	6
PART II	0	0	0	0
4. Improving material properties and surface treatments	0	0	0	0

4.1 Heat treatment of materials, surface strengthening techniques including heat treatment of non-alloy steels (IMO 7.04 - 3.1.2.1; 3.1.2.2; 3.1.3.7)	7	4	7	4
4.2 Surface finishes and coatings, corrosion and protection of machinery and its components (IMO 7.04 - 3.1.1.2)	2	1	2	1
5. Joining and fabrication of machinery and mechanical parts, including - Non-disassembled joints; Welding; Soldering; Gluing; Joining of plastics; Self-locking joints (IMO 7.04 - 3.1.3.3; 3.1.3.4; 3.1.3.5; 3.1.3.6; 3.1.3.7 ; IMO 7.02 -1.2.7.2)	11	4	11	4
6. Shipbuilding and Operating Materials - II	0	0	0	0
6.1 Steels and cast irons, non-ferrous metals and their alloys - types, properties, designation systems (IMO 7.04-3.1.1.1; 3.1.1.2; IMO 7.02-1.2.7.2)	7	6	7	6
6.2 Materials and products used in the construction and operation of ships - Classification society directives; materials for hulls, propellers and propeller shafts; materials for ship machinery and equipment components (bearings, piping, anchors, chains, etc.) (IMO 7.04.-3.1.4.1.)	7	6	7	6
6.3 Destructive and non-destructive testing methods for materials and machinery components (IMO 7.04-3.1.3.7; IMO 7.02-3.2.3.1; 1.2.7.1; 1.2.7.2)	8	6	8	6
6.4 Selection of materials and methods of processing (IMO 7.04 - 3.1.1.2; 3.1.4.1)	4	5	4	5
6.5 Material Handling and Operations - Safety of Man and the Environment (IMO 7.04 - 3.1.3.6)	2	1	2	1
<b>Total:</b>	<b>144</b>	<b>99</b>	<b>144</b>	<b>99</b>

### Learning outcomes and assessment

Learning outcomes	Assessment methods
<p>Knowledge.</p> <p>1) Able to demonstrate a basic knowledge of modern shipbuilding materials, their characteristics and test/test methods.</p>	<p>Methods: presentations, control work, exam.</p> <p>Criteria: knowledge of modern shipbuilding materials, their characteristics and test/inspection methods.</p>
<p>2) Able to demonstrate a basic understanding of the interrelationship between the structure of materials and their properties, as well as techniques for improving the properties of materials.</p>	<p>Methods: laboratory and practical work, control work, examination.</p> <p>Criteria: understanding of the interrelation between the structure of materials and their properties, as well as techniques to improve the properties of materials.</p>
<p>3) Able to demonstrate a basic knowledge of the main modern material processing technologies.</p>	<p>Methods: presentations, control work, exam.</p> <p>Criteria: knowledge of the main modern technologies of material processing.</p>
<p>Skills.</p> <p>1) Able to carry out tests/inspections on materials and components.</p>	<p>Methods: laboratory and practical work.</p> <p>Criteria: ability to carry out tests/tests on materials and components.</p>
<p>2) Able to design technological processes for the manufacture and quality inspection of shipboard machinery and equipment components.</p>	<p>Methods: independent complex work.</p> <p>Criteria: ability to develop technological processes for the manufacture and quality inspection of ship machinery and equipment components.</p>
<p>Competences.</p> <p>1) Able to critically analyse independently the operating conditions of ship machinery and equipment components and to select the most appropriate component material for the particular conditions and justify their proposals.</p>	<p>Methods: independent complex work.</p> <p>Criteria: ability to critically analyse independently the operating conditions of ship machinery and equipment components and to select the most appropriate component material for the specific conditions, and justify their proposals.</p>
<p>2) Able to critically analyse the technical possibilities on board a ship independently and to select the most appropriate machining technology for the ship's machinery and equipment and to justify their proposals.</p>	<p>Methods: independent complex work.</p> <p>Criteria: Ability to critically analyse independently the technical possibilities on board and to select the most appropriate machining technology for the particular conditions of the ship's machinery and equipment and to justify the proposals.</p>

### Evaluation criteria of study results

Criterion	%
Developing and defending an independent complex thesis	30
Presentations, laboratory and practical work, control work	30
Exam	40
<b>Total:</b>	<b>100</b>

### Study subject structure

Part	CP	Hours			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	6.0	52.0	22.0	22.0		*	
2.	3.0	26.0	12.0	10.0		*	