

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Hladilna tehnika
Course title:	Refrigeration Technologies

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Tehnologije in sistemi – prva stopnja	/	tretji	peti
Technologies and Systems – 1st cycle	/	third	fifth

Vrsta predmeta / Course type izbirni/elective

Univerzitetna koda predmeta / University course code: TS IP UN 6

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Laboratorijske vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
45		15	15		100	6

Nosilec predmeta / Lecturer: prof. dr. Ivan Bajsić

Jeziki / Languages:	Predavanja / Lectures:	Slovenski/Slovenian
	Vaje / Tutorial:	Slovenski/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

- vpis v tretji letnik študija,
- znanje vsaj enega tujega jezika (angleščina, nemščina),
- študent/študentka mora imeti izpit iz termodinamike, mehanike.

Prerequisites:

- enrollment in the third year of study,
- knowledge of at least one foreign language (English, German),
- the student must pass an exam in thermodynamics, mechanics.

Vsebina:

- **Teoretične osnove:** parni hladilni proces, hladilni proces z zrakom, absorpcijski hladilni proces, absorpcijski hladilni proces, ejektorski hladilni proces, termoelektrični, akustični in drugi novi hladilni procesi.
- **Hladilne snovi:** hladiva, absorpcijski hladilni pari, olja v hladilnih napravah, slanice.
- **Elementi hladilnih naprav:** batni kompresorji, turbokompresorji,

Content (Syllabus outline):

- **Theoretical basics:** vapor cooling process, air
- **Theoretical foundations:** vapor cooling process, air cooling process, absorption cooling process, absorption cooling process, ejector cooling process, thermoelectric, acoustic and other new cooling processes.
- **Refrigerants:** coolants, absorptive cooling vapors, oils in cooling devices, brines.

<p>kondenzatorji, uparjalniki, elementi hladilnega kroga, elektromotorji, merilna, krmilna in regulacijska oprema.</p> <ul style="list-style-type: none"> • Hladilni sistemi: splošno, direktno hlajenje, indirektno hlajenje, pogonski stroji, daljinsko hlajenje, cevovodi v hladilni tehniki, cevovodi s hladno vodo. • Preračun hladilnih sistemov za hlajenje zraka: dimenzioniranje hladilne naprave, obratovanje hladilnih strojev pri delnih obremenitvah, projektiranje hladilnih naprav, hranilniki hladu, vračanje toplote/toplotne črpalke. • Regulacija hladilnih naprav: Regulacija pri direktnem hlajenju, regulacija pri indirektnem hlajenju, regulacija sistemov s hladno vodo, regulacija hladilnikov vode. • Instaliranje hladilnih naprav, strojnice, šumnost: namestitvev, sistemi za prenos hladu, skupine hladiv, predpisi o vgradnji, prostor strojnice, nastanek in izvori hrupa. • Predpisi in norme v hladilni tehniki, okoljski vplivi. 	<ul style="list-style-type: none"> • Elements of cooling devices: reciprocating compressors, turbocompressors, condensers, evaporators, cooling circuit elements, electric motors, measuring, control and regulation equipment. • Cooling systems: general, direct cooling, indirect cooling, drive machines, remote cooling, pipelines in refrigeration technology, pipelines with cold water. • Recalculation of cooling systems for air cooling: dimensioning of cooling devices, operation of cooling machines at partial loads, design of cooling devices, cold stores, heat recovery/heat pumps. • Regulation of cooling devices: Regulation of direct cooling, regulation of indirect cooling, regulation of cold water systems, regulation of water coolers. • Installation of cooling devices, engine room, noise: installation, cooling transfer systems, refrigerant groups, installation regulations, engine room space, generation and sources of noise. • Regulations and standards in refrigeration technology, environmental impacts.
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Temeljni literatura in viri / Readings:

<p>ASHRAE Handbook (2017) <i>Fundamentals</i>. Atlanta: Ashrae. ASHRAE Handbook (2018) <i>HVAC Systems and Equipment</i>. Atlanta: Ashrae. ASHRAE Handbook (2015). <i>HVAC Applications</i>. Atlanta: Ashrae. ASHRAE Handbook (2016) <i>Refrigeration</i>. Atlanta: Ashrae. Recknagel–Sprenger–Schramek (2016/2017) <i>Taschenbuch für Heizung + Klima Technik</i>. Oldenburg Verlag, München, Wien. Recknagel–Sprenger–Schramek–Čeperković (2005) <i>Grejanje i klimatizacija, Interklima</i>. Vrnjačka Banja. ARI (1997) <i>Refrigeration and Air Conditioning</i>, 3th. Ed. Greeno, R. (1997) <i>Building Services, Technology and Design</i>. Edinburg, UK: Longman. Standardi CEN in ISO.</p>
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Cilji in kompetence:

<p><i>Učna enota prispeva predvsem k razvoju naslednjih splošnih in specifičnih kompetenc:</i></p> <ul style="list-style-type: none"> • sposobnost obvladanja standardnih razvojnih metod, postopkov in procesov,
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Objectives and competences:

<p><i>The learning unit mainly contributes to the development of the following general and specific competences:</i></p> <ul style="list-style-type: none"> • the ability to master standard development methods, procedures and processes,
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- sposobnost uporabe pridobljenega teoretičnega znanja v praksi,
- sposobnost obvladovanja razvoja in napredka,
- kooperativnost, usposobljenost za timsko delo,
- sposobnost razumevanja in uporabe sodobnih teorij s področja tehniških, tehnoloških in naravoslovnih ved,
- sposobnost interdisciplinarnega povezovanja znanja,
- sposobnost reševanja konkretnih delovnih problemov na področju tehnologij in sistemov z uporabo standardnih strokovnih metod in postopkov.

- the ability to use acquired theoretical knowledge in practice,
- the ability to manage development and progress,
- cooperativeness, teamwork skills,
- the ability to understand and apply modern theories in the field of technical, technological and natural sciences,
- the ability to integrate knowledge in an interdisciplinary manner,
- the ability to solve concrete work problems in the field of technologies and systems using standard professional methods and procedures.

Predvideni študijski rezultati:

Znanje in razumevanje:

Študent/študentka:

- spozna in doume potek hladilnih procesov
- pridobi znanje o metodah izračunov hladilnih naprav,
- seznaneni se z osnovnimi principi projektiranja hladilnih sistemov
- seznaneni se z metodami matematične analize hladilnih procesov
- spozna pravno regulativo (standarde), ki ureja to področje in je osnova za projektno delo,
- spozna pomebnost hladilne tehnike za prehrano prebivalstva in njen vpliv na okolje.

Intended learning outcomes:

Knowledge and understanding:

Student:

- learns and understands the operation of cooling processes
- acquires knowledge of calculation methods for cooling devices,
- gets acquainted with the basic principles of design of cooling systems
- becomes familiar with the methods of mathematical analysis of cooling processes
- gets acquainted with legal regulations (standards), which regulate this field and are the basis for the project work,
- becomes familiar with the importance of refrigeration technology for the population's nutrition and its impact on the environment.

Metode poučevanja in učenja:

- *predavanja* z aktivno udeležbo študentov (razlaga, diskusija o problemih, razvijanje ustvarjalnosti),
- *vodeni individualni študij* za uporabo simulacijskih metod,
- *projekt* za utrjevanje znanja in njegovo praktično uporabo,

Learning and teaching methods:

- *lectures* with active participation of students (explanation, discussion of problems, development of creativity),
- *guided individual study* for the use of simulation methods,
- *a project* for consolidating knowledge and its practical application,

- *seznanjanje z merilnimi instrumenti*, uporabnimi za kontrolo prenosa in snovi,
- *uporaba spletnih virov* in seznanjanje s široko strokovno literaturo in praktično uporabo dosegljive dokumentacije (knjig, revij, arhivov itd.),
- *strokovne ekskurzije* in ogledi izbranih in pomembnih gradbenih objektov.

- *familiarization with measuring instruments* useful for control of transfer and substances,
- *use of online resources* and familiarization with a wide range of professional literature and practical use of available documentation (books, magazines, archives, etc.),
- *professional excursions* and tours of selected and important construction facilities.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt): <ul style="list-style-type: none"> • pisni izpit • ustni izpit • projektno in seminarsko delo Ocenjevalna lestvica: ECTS.	25% ocene 50% ocene 25% ocene	Type (examination, oral, coursework, project): <ul style="list-style-type: none"> • written exam • verbal exam • project and seminar work Grading scale: ECTS.