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.

Prerequisits:

- 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, absopcijski 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.

kondenzatorji, uparjalniki, elementi hladilnega kroga, elektromotorji, merilna, krmilna in regulacijska oprema.
- **Hladilni sistemi:** splošno, direktno hlajnje, 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:** namestitev, sistemi za prenos hladu, skupine hladiv, predpisi o vgradnji, prostor strojnice, nastanek in izvori hrupa.
- **Predpisi in norme v hladilni tehniki, okoljski vplivi.**

- **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.**

Temeljni literatura in viri / Readings:

Temeljna literatura/Basic literature

Recknagel–Sprenger–Schramek–Čeperković (2011) *Grejanje i klimatizacija, Interklima*. Vrnjačka Banja.

Priporočljiva literatura/Recommended

ASHRAE Handbook (2017) *Fundamentals*. Atlanta: Ashrae.
ASHRAE Handbook (2018) *HVAC Systems and Equipment*. Atlanta: Ashrae.
ASHRAE Handbook (2015). *HVAC Applications*. Atlanta: Ashrae.
ASHRAE Handbook (2016) *Refrigeration*. Atlanta: Ashrae.
Recknagel–Sprenger–Schramek (2016/2017) *Taschenbuch für Heizung + Klima Technik*. Oldenburg Verlag, München, Wien.
ARI (1997) Refrigeration and Air Conditioning, 3th. Ed.
Greeno, R. (1997) *Building Services, Technology and Design*. Edinburg, UK: Longman.
Standardi CEN in ISO.

Cilji in kompetence:

Objectives and competences:

Učna enota prispeva predvsem k razvoju naslednjih splošnih in specifičnih kompetenc: • sposobnost obvladanja standardnih razvojnih metod, postopkov in procesov, • 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 learning unit mainly contributes to the development of the following general and specific competences:* • the ability to master standard development methods, procedures and processes, • 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:	**Intended learning outcomes:**
Znanje in razumevanje: *Študent/študentka:* • spozna in doume potek hladilnih procesov • pridobi znanje o metodah izračunov hladilnih naprav, • seznani se z osnovnimi principi projektiranja hladilnih sistemov • seznani 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.	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 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:	**Learning and teaching methods:**
• *predavanja* z aktivno udeležbo študentov (razlaga, diskusija o problemih, razvijanje ustvarjalnosti),	• *lectures* with active participation of students (explanation, discussion of problems, development of creativity),

• *vodeni individualni študij* za uporabo simulacijskih metod, • *projekt* za utrjevanje znanja in njegovo praktično uporabo, • *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.	• *guided individual study* for the use of simulation methods, • *a project* for consolidating knowledge and its practical application, • *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): • pisni izpit • ustni izpit • projektno in seminarsko delo Ocenjevalna lestvica: ECTS.	 25% ocene 50% ocene 25% ocene	Type (examination, oral, coursework, project): • written exam • verbal exam • project and seminar work Grading scale: ECTS.