

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

<b>Predmet:</b>	Osnove KGH
<b>Course title:</b>	Basic of HVAC

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

**Vrsta predmeta / Course type** Modularni/modular

**Univerzitetna koda predmeta / University course code:** TS M3 UN1

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

**Nosilec predmeta / Lecturer:** prof. dr. Ivan Bajsić

<b>Jeziki / Languages:</b>	<b>Predavanja / Lectures:</b>	slovenski, angleški/ slovenian, english
	<b>Vaje / Tutorial:</b>	slovenski, angleški/ slovenian, english

**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.

**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.

**Vsebina:**

**Fizikalne osnove ugodja v prostoru**  
**Grelni sistemi.** Lokalno gretje. Centralno gretje. Daljinsko gretje. Solarni sistemi.

- *Elementi grelnih sistemov. Generatorji toplote. Gorilniki. Dimniki. Cevovodi in pribor. Stroji in aparati. Regulacijske naprave. Ogrevala. Sprejemniki sončne energije. Varstvo pred korozijo in kamnom.*

**Content (Syllabus outline):**

**The physical basis of comfort in space**  
**Heating systems.** Local heating. Central heating. Remote heating. Solar systems.

- *Elements of heating systems. Heat generators. Burners. Chimneys. Piping and fittings. Machines and appliances. Control devices. Heaters. Solar energy receivers. Protection against corrosion and scale.*

- *Izračun grelnih naprav. Izračun generatorjev toplote. Izračun ogreval(radiatorji, konvektorji, sevalno in ploskovno gretje). Izračun cevovodov in regulacijskih armatur.*
- *Izvedba grelnih naprav in sistemov. Izbira grelnih sistemov. Stanovanjske stavbe. Poslovne stavbe. Šole. Bolnišnice. Športni objekti.*
- *Priprava stavb za vgradnjo grelnih sistemov. Razpis in oddaja del. Prezemni preizkusi. Ekonomičnost gretja. Pogon grelnih naprav. Predpisi.*

#### **Prezračevalni in klimatizacijski sistemi.**

Delitev. Prezračevalni sistemi. Procesi klimatizacije. Klimatizacijski sistemi. Zračni sistemi. Zračno vodni sistemi.

- *Elementi sistemov. Ventilatorji. Prenosniki toplote. Filtri. Ovlaževalniki, sušilniki. Razdelitev zraka (končni elementi in kanali). Dušenje zvoka. Regulacija. Rekuperacija toplote. Požarna varnost.*
- *Aparati za obdelavo zraka. Aparati za prezračevanje. Končne enote. Klimatske centrale. Zračne zavese.*
- *Izračun naprav in sistemov. Končne enote. Kanali. Klimatske centrale. Dušilniki zvoka.*
- *Izvedba prezračevalnih in klimatizacijskih naprav. Izbira sistemov. Stanovanjske stavbe. Poslovne stavbe. Šole. Bolnišnice. Športni objekti. Trgovine. Proizvodne stavbe. Posebni prostori in zgradbe.*
- *Priprava stavb za vgradnjo prezračevalnih in klimatizacijskih sistemov. Razpis in oddaja del. Prezemni preizkusi. Ekonomičnost klimatizacije. Pogon klimatizacijskih naprav. Predpisi.*

**Hladilna tehnika.** Teoretične osnove. Hladiva. Hladilni sistemi. Elementi hladilnih sistemov. Kompresorji. Prenosniki toplote. Regulacija. Izračun hladilnih sistemov. Ekonomičnost.

**Daljinsko gretje in hlajenje.** Sistemi daljinskega gretja – kogeneracija . Sistemi daljinskega hlajenja – trigeneracija. Osnove dimenzioniranja.

- *Calculation of heating devices. Calculation of heat generators. Calculation of heaters (radiators, convectors, radiant and surface heating). Calculation of pipelines and control fittings.*
- *Implementation of heating devices and systems. Choice of heating systems. Residential buildings. Commercial buildings. Schools. Hospitals. Sports facilities.*
- *Preparation of buildings for the installation of heating systems. Tendering and awarding of works. Acceptance tests. Economy of heating. Drive of heating devices. Regulations.*

#### **Ventilation and air conditioning systems.**

Division. Ventilation systems. Air conditioning processes. Air conditioning systems. Air systems. Air-water systems.

- *Elements of the systems. Fans. Heat exchangers. Filters. Humidifiers, dryers. Air distribution (end elements and ducts). Sound attenuation. Regulation. Heat recovery. Fire safety.*
- *Air treatment devices. Ventilation devices. End units. Air conditioning units. Air curtains.*
- *Calculation of devices and systems. End units. Channels. Air conditioning units. Silencers.*
- *Implementation of ventilation and air conditioning devices. Choice of systems. Residential buildings. Commercial buildings. Schools. Hospitals. Sports facilities. Shops. Production buildings. Special premises and buildings.*
- *Preparation of buildings for the installation of ventilation and air conditioning systems. Tendering and awarding of works. Acceptance tests. Economy of air conditioning. Air conditioning drive. Regulations.*

**Refrigeration technology.** Theoretical bases. Coolers. Cooling systems. Elements of cooling systems. Compressors. Heat exchangers. Regulation. Calculation of cooling systems. Economic efficiency.

**District heating and cooling.** District heating systems - cogeneration. District cooling systems - trigeneration. Basics of dimensioning.

### Temeljni literatura in viri / Readings:

ASHRAE Handbook (2005) *Fundamentals*. Atlanta: Ashrae.  
ASHRAE Handbook (2004) *HVAC Systems and Equipment*. Atlanta: Ashrae.  
ASHRAE Handbook (2003). *HVAC Applications*. Atlanta: Ashrae.  
ASHRAE Handbook (2006) *Refrigeration*. Atlanta: Ashrae.  
Recknagel–Sprenger–Schramek (2005/2006) *Taschenbuch für Heizung + Klima Technik*. Oldenburg Verlag, München, Wien.  
Recknagel–Sprenger–Schramek–Čeperković (2005) *Grejanje i klimatizacija, Interklima*. Vrnjačka Banja.  
Greeno, R. (1997) *Building Services, Technology and Design*. Edinburg, UK: Longman.  
Todorović, B. (1998) *Klimatizacija*. Beograd: SMEITS,.  
Standardi CEN in ISO.

### Cilji in kompetence:

*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.

### Objectives and competences:

*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,
- willingness to cooperate and work in a team,
- the ability to understand and apply modern theories in the fields of technical, technological and natural sciences,
- the ability to integrate knowledge in an interdisciplinary manner,
- the ability to solve specific 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 vpliv prehoda toplote in snovi v stavbah za kakovost bivanja,
- pridobi znanje o metodah izračunov toplotnih bilanc v stavbah,
- seznaneni se z osnovnimi pogoji za dobro bivalno okolje,

### Intended learning outcomes:

Knowledge and understanding:

*Student:*

- learns and understands the impact of heat and matter transfer on housing quality,
- acquires knowledge of the methods used to calculate heat balances in buildings,
- becomes familiar with the basic requirements for a good living environment,

- seznanjeni se z metodami matematične analize nestacionarnega prenosa toplote v stavbah,
- spozna pravno regulativo (standarde), ki ureja to področje in je osnova za projektno delo,
- doume vpliv toplotne zaščite stavb za rabo energije in kakovost bivanja,
- spozna drugo tehnično disciplino – arhitekturo in gradbeništvo z osnovnimi materiali,
- pridobi osnovno znanje za uporabo različnih simulacijskih metod.

- becomes familiar with the methods of mathematical analysis of non-stationary heat transfer in buildings,
- gets acquainted with the legal regulations (standards) that regulate this area and are the basis for the project work,
- understands the impact of thermal protection of buildings on energy consumption and quality of life,
- gets acquainted with another technical discipline – architecture and construction with basic materials,
- acquires basic knowledge for the use of various simulation methods.

#### 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,
- *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.

#### 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,
- 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"> <li>• pisni izpit</li> <li>• ustni izpit</li> <li>• projektno in seminarsko delo</li> </ul> Ocenjevalna lestvica: ECTS.	25% ocene 30% ocene 45% ocene	Type (examination, oral, coursework, project): <ul style="list-style-type: none"> <li>• written exam</li> <li>• verbal exam</li> <li>• project and seminar work</li> </ul> Grading scale: ECTS.