

**PLAN I PROGRAM NASTAVE / COURSE SYLLABUS**

Naziv predmeta: **ENERGETSKI EFIKASNAARHITEKTURA**  
 Course title: **ENERGY EFFICIENCY ARCHITECTURE**

| Šifra predmeta /<br>Course code | Status predmeta /<br>Course type | Semestar /<br>Semester | ECTS kredita /<br>ECTS credits | Fond časova /<br>Number of classes |
|---------------------------------|----------------------------------|------------------------|--------------------------------|------------------------------------|
| <b>8.1.</b>                     | <b>obavezan /<br/>required</b>   | <b>VIII</b>            | <b>5.0</b>                     | <b>2P+2V</b>                       |

**Studijski program:** ARHITEKTURA. Akademске studije  
 Dužina trajanja: 10 semestara i 300 kredita.

**Study programme:** ARCHITECTURE. Academic studies  
 Duration: 10 semesters and 300 credits.

**Uslovljenost drugim predmetima:**

Položeni ispiti iz: Arhitektonske fizike i Bioklimatske arhitekture

**Prerequisites:**

Passed exams: Architectural Physics and Bioclimatic architecture

**Ciljevi izučavanja predmeta:**

Usvajanje znanja o konceptu i sadržaju energetske efikasnosti zgrade; evropska i nacionalna regulativa, energetski model zgrade - energetske gubici i dobici; primjena i analiza toplotne izolacije - evropski i nacionalni standardi; zastakljeni dijelovi omotača; grijanje i hlađenje; sanitarna topla voda; rasvjeta; algoritam proračuna potrošnje energije u zgradama; nacionalni pravilnici.

**Course aims:**

Adoption of knowledge about the concept and content of the energy efficiency in buildings; European and national legislation, energy model of the building - energy losses and gains, application and analysis of thermal insulation - European and national standards; glazed parts of envelope; heating and cooling; Sanitary hot water; lighting; algorithm calculation of energy consumption in buildings; national regulations.

**Predmetni nastavnik – Lecturer /  
Saradnici u nastavi – teaching assistants**

Prof. dr Dušan Vuksanović

AF \_ 2 saradnika

**Metode nastave i savladavanje gradiva:**

Predavanja i izrada seminarskog rada (projektovanje energetske efikasnosti zgrade)

**Teaching methods and learning activities:**

Lectures and preparation of the seminar work (design of the energy efficiency of the building)

**SADRŽAJ PREDMETA:**

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| Pripremna nedjelja | Priprema i upis semestra.                                                                                                                                                                       |
| I nedjelja         | Uvodno predavanje: pojmovi, ciljevi, evropska legislativa i regulativa: direktive i standardi (EN i ISO)                                                                                        |
| II nedjelja        | State of the art u nacionalnim okvirima: uspostavljeni nivo primjene toplotne zaštite u praksi, nacionalna legislativa i regulativa za energetske efikasnosti (EE)                              |
| III nedjelja       | Koncept energetske efikasnosti zgrade: karakteristike omotača zgrade i energetske potrebe za grijanjem i hlađenjem; ostali oblici potrošnje energije u zgradama: sanitarna topla voda, rasvjeta |
| IV nedjelja        | Energetski model zgrade - energetske gubici i dobici: transmisioni i ventilacioni gubici, dobici kroz omotač (solarni dobici) i unutrašnji dobici                                               |
| V nedjelja         | Toplotna izolacija elemenata omotača - koeficijent prolaza toplote (EN ISO 6946), specifični aspekti: toplotni mostovi, evropski i                                                              |

**SUBJECT CONTENT:**

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| Preliminary week     | Preparation and enrollment of semester.                                                                                                                                                                     |
| 1 <sup>st</sup> week | Introductory lecture: concepts, objectives, European legislation and regulation: directives and standards (EN and ISO)                                                                                      |
| 2 <sup>nd</sup> week | State of the art at the national level: established level of the application of thermal protection in practice, national legislation and regulations for energy efficiency (EE)                             |
| 3 <sup>rd</sup> week | The concept of energy efficiency of buildings: the characteristics of the building envelope and energy needs for heating and cooling, the other forms energy use in buildings: Sanitary hot water, lighting |
| 4 <sup>th</sup> week | Energy model of the building - energy losses and gains: transmission and ventilation losses, gains through envelope (solar gains) and internal gains                                                        |
| 5 <sup>th</sup> week | Thermal insulation of envelope elements - heat transfer coefficient (EN ISO 6946), the specific aspects: thermal bridges, European and national                                                             |

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| VI nedjelja        | nacionalni standardi (EN,ISO i MEST)<br>Zastakljeni djelovi omotača - prozori i vrata;<br>infiltracija, propustljivost zračenja; stakla niske emisije (Low E) |
| VII nedjelja       | Energetski model zgrade: klima i klimatske zone u CG, srednja meteorološka godina, stepen_dan, grijanje i hlađenje                                            |
| VIII nedjelja      | KOLOKVIJUM I                                                                                                                                                  |
| IX nedjelja        | Sanitarna topla voda                                                                                                                                          |
| X nedjelja         | Rasvjeta, osnovni parametri rasvjete, jedinice, vrste svjetiljki                                                                                              |
| XI nedjelja        | Algoritam izračunavanja potrošnje energije u zgradama prema EN 12379                                                                                          |
| XII nedjelja       | Pravilnici za energetske efikasnost u zgradarstvu                                                                                                             |
| XIII nedjelja      | Programski paketi - software                                                                                                                                  |
| XIV nedjelja       | KOLOKVIJUM II                                                                                                                                                 |
| XV nedjelja        | Završni ispit.                                                                                                                                                |
| XVI nedjelja       | Ovjera semestra i upis ocjena.                                                                                                                                |
| XVII nedjelja      |                                                                                                                                                               |
| XVIII-XXI nedjelja | Dopunska nastava i popravni ispitni rok.                                                                                                                      |

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| 6 <sup>th</sup> week                    | standards (EN, ISO and MEST)<br>Glazed parts of envelope - windows and doors and infiltration, leakage radiation, low emission glass (Low E) |
| 7 <sup>th</sup> week                    | Energy model of the building: climate and climatic zones in Montenegro, the average meteorological year, degree - day, heating and cooling   |
| 8 <sup>th</sup> week                    | 1 <sup>st</sup> TEST (colloquium)                                                                                                            |
| 9 <sup>th</sup> week                    | Sanitary hot water                                                                                                                           |
| 10 <sup>th</sup> week                   | Lighting, basic lighting parameters, units, types of lamps                                                                                   |
| 11 <sup>th</sup> week                   | The algorithm of calculating of energy consumption in buildings according to EN 12379                                                        |
| 12 <sup>th</sup> week                   | Regulations for Energy Efficiency in Buildings                                                                                               |
| 13 <sup>th</sup> week                   | Software packages - Software                                                                                                                 |
| 14 <sup>th</sup> week                   | 2 <sup>nd</sup> TEST (colloquium)                                                                                                            |
| 15 <sup>th</sup> week                   | FINAL EXAM.                                                                                                                                  |
| 16 <sup>th</sup> week                   | Verification of the semester and mark enrollment.                                                                                            |
| 17 <sup>th</sup> week                   |                                                                                                                                              |
| 18 <sup>th</sup> -21 <sup>st</sup> week | Additional lessons and exam term.                                                                                                            |

### Opterećenje studenata:

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| <u>Nedjeljno</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>5.0 kredita x 40/30 = 6 sati i 40 minuta</b><br>struktura:<br>2 sata predavanja<br>2 sata vježbanja<br>2 sat i 40 min –samostalni rad, uključujući i konsultacije                                                                                                                                                                                                                                                                                                                                                                             |
| <u>U toku semestra</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Nastava i završni ispit:</b> (6 sati i 40 minuta) x 16 = <b>106 sati i 43 minuta</b><br><b>Neophodne pripreme</b> (administracija, upis, ovjera prije početka semestra): 2x (6 sati i 40 minuta)= <b>13 sati i 20 minuta</b><br><b>Ukupno opterećenje za predmet :</b> 5.0 x 30 = <b>150 sati</b><br><b>Dopunski rad: preostalo vrijeme od prve dvije stavke do ukupnog opterećenja za predmet: 31 sat i 57 minuta</b><br><b>Struktura opterećenja:</b> 106 sati i 43 min. (nastava) + 13 sati i 20 min. (prip.) + 21 sati i 57 min. (dop.r.) |

### Student workload:

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| <u>Weekly</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>5.0 credits x 40/30 = 6 hours and 40 minutes</b><br>Structure:<br>2 hours of lectures<br>2hour for tutorial<br>2 hours and 40 minutes of individual work, including consultations                                                                                                                                                                                                                                                                                                                                      |
| <u>During the semester</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Teaching and the final exam:</b> (5 hours and 33 min) x 16 = <b>106 hours and 43 minutes</b><br><b>Necessary preparations</b> before the start of the semester (administration, registration, certification) 2 x (5 hours and 33 min) = <b>13 hours and 20 minutes</b><br><b>Total hours for the course:</b> 5.0x30 = <b>150 hours</b><br><b>Additional hours: 31 hours and 57 minutes</b><br><b>Structure of workload:</b> 106 h and 43 min (lectures )+ 13 h and 20 min (preparation) + 21 h and 57 min (add. hours) |

### Literatura / Literature:

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| <ul style="list-style-type: none"> <li>- Pravilnici za energetske efikasnost, Ministarstvo ekonomije CG, Podgorica, 2013.</li> <li>- "Energetska efikasnost zgrada - Metodologija energetskog pregleda i proračuna indikatora EE, Mašinski fakultet i Arhitektonski fakultet, Podgorica 2011.</li> <li>- Zbašnik Senegačnik M.: "Pasivna kuća", SUN ARH doo, Zagreb, 2009.</li> <li>- Neufert E.: "Arhitektonsko projektovanje", Građevinska knjiga, Beograd, 1996.</li> </ul> |
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### Oblici provjere znanja i ocjenjivanje:

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| <p>* Uredno pohađanje nastave : ukupno 10 poena (svaki izostanak manje 1 poen), maksimalno 3 izostanka</p> <ul style="list-style-type: none"> <li>- I kolokvijum : maksimum 15 poena</li> <li>- II kolokvijum : maksimum 15 poena</li> <li>- Seminar radi : maksimum 40 poena</li> <li>- Završni ispit : maksimum 20 poena</li> </ul> <p>** Prelazna ocjena se dobija ako student ostvari najmanje 51 poen.</p> <ul style="list-style-type: none"> <li>- Ocjene: A (91-100); B (81-90); C (71-80); D (61-70); E (51-60); F (manje od 51 poen).</li> </ul> |
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### Forms of Assessment:

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| <p>* Regular attendance of classes: 10 points (each one less cause failure point), maximum 3 absences</p> <ul style="list-style-type: none"> <li>- First test: maximum 15 points</li> <li>- Second test: maximum 15 points</li> <li>- Seminar work: maximum 40 points</li> <li>- Final exam: maximum 20 points</li> </ul> <p>** Passing grade is obtained if the student achieved at least 51 points.</p> <ul style="list-style-type: none"> <li>- Rating: A (91-100) B (81-90) C (71-80) D (61-70) E (51-60), F (below 51 points).</li> </ul> |
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### Očekivani ishodi učenja:

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| <p>Očekuje se da student, nakon položenog ispita Energetske efikasnosti zgrada:</p> <ol style="list-style-type: none"> <li>1. Pozna načine održivog razvoja i metode postizanja unutrašnjeg komfora i zaštitenosti arhitektonskih objekata;</li> <li>2. Pozna načine savremene tendencije i tehnologije u domenu</li> </ol> |
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### Expected learning outcomes:

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| <p>It is expected that the student after passing the exam Bioclimatic architecture:</p> <ol style="list-style-type: none"> <li>1. Has knowledge the principles of sustainable development and methods of achieving inner comfort and protection of architectural buildings;</li> </ol> |
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energetske efikasnosti.

**Metode za ocjenu kvaliteta i obezbjeđivanje željenih rezultata učenja:**

Kontrola od strane Univerziteta, kontrola nastavnog procesa od strane Fakulteta, spisak prisustva studenata, analize stepena prolaznosti (sistem upravljanja kvalitetom u skladu sa ISO 9001).

**Napomena:**

Vježbe se izvode za grupe od 3 - 4 studenta. Po potrebi predavanja se mogu izvoditi i na engleskom jeziku. Dodatne informacije o predmetu mogu se dobiti kod predmetnog nastavnika.

2. Has knowledge the contemporary trends and technologies in the field of energy efficiency

**Methods for assessing the quality and ensuring preferred learning outcomes:**

Control by the University, the control of the teaching process by the faculty, the list of presence of students, analysis of the degree of transience (quality management system in accordance with ISO 9001).

**Admonishment:**

The tutorials are performed in groups of 3 - 4 students. If it is necessary, classes might be taught in English. Further information about the subject can be obtained from the course teacher.