**Nazwa przedmiotu:**

Polymer Composites Technology

**Koordynator przedmiotu:**

Prof. Andrzej Garbacz,D.Sc. Eng., Tomasz Piotrowski, Ph.D., Eng., Kamil Załęgowski M.Sc., Eng.

**Status przedmiotu:**

Obowiązkowy

**Poziom kształcenia:**

Studia I stopnia

**Program:**

Civil Engineering

**Grupa przedmiotów:**

Obligatory

**Kod przedmiotu:**

1080-BU000-ISA-0607

**Semestr nominalny:**

7 / rok ak. 2021/2022

**Liczba punktów ECTS:**

2

**Liczba godzin pracy studenta związanych z osiągnięciem efektów uczenia się:**

Total 55 h = 2 ECTS: lecture - 10h,
laboratories - 10h,
exercises - 10h,
preparation to laboratories and exercises - 5h,
read the literature - 5h,
preparation and defense of laboratory reports - 5h,
preparation and presentation of a term paper (paper, presentation) - 5h,
preparation for the exam and exam - 5h.

**Liczba punktów ECTS na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich:**

Total 30 h = 1 ECTS: lecture - 10h,
laboratories - 10h,
exercises - 10h.

**Język prowadzenia zajęć:**

angielski

**Liczba punktów ECTS, którą student uzyskuje w ramach zajęć o charakterze praktycznym:**

Total 30h = 1 ECTS: laboratories - 10h,
exercises - 10h,
preparation to laboratories and exercises - 5h,
preparation and defense of laboratory reports - 5h.

**Formy zajęć i ich wymiar w semestrze:**

|  |  |
| --- | --- |
| Wykład: | 10h |
| Ćwiczenia: | 10h |
| Laboratorium: | 10h |
| Projekt: | 0h |
| Lekcje komputerowe: | 0h |

**Wymagania wstępne:**

Knowledge of basic chemistry of polymers.
Knowledge of basic materials in concrete technology.
Knowledge of research methodology of quality ingredients and concrete strength tests of composite.
Ability to perform sampling of mortars and concretes for laboratory analysis.
Ability to analyze statistical data collection and presentation of the results and draw conclusions.
Passed courses: Building Chemistry, Building Materials I and II.

**Limit liczby studentów:**

max 2 x laboratory group of 12-16 students

**Cel przedmiotu:**

The objectives of the course are:
- Knowledge of basic issues related to the construction technology of polymer composites;
- Design, manufacture, use, disposal;
- Aware of the safety rules when working with the building polymeric composites;
- Ability to design selected polymer composite materials;
- Ability to use selected experimental techniques;
- Ability of the statistical treatment of laboratory tests results;
- Ability to present a chosen topic in the form of paper and presentation

**Treści kształcenia:**

Lectures: General characteristics, the basic ingredients and polymers division. The reactions occurring during polymerization. Principles of occupational health and safety when using polymers. Plastics. Concrete-like polymer composites (PC) and polymer-cement composites (PCC); division, composition, methods of preparation, the scope of application. Forming the structure of the manufacturing processes. Technical characteristics of individual types of polymer composites. The prefabricated elements of concrete and artificial marble resin - types, manufacturing technologies. The use of polymer composites in strengthening, repairing and protecting structures from corrosion: impregnation, injection, protective coatings, linings, fiber reinforced polymers (FRP). Selection of composites and guidelines for their use of the principle of compatibility. Technological aspects of the use of polymer composites on site. Evaluation of the usefulness of polymer composites for construction; standardization documents and research methodology. Development trends.
Laboratories: Designing the composition of the composite PCC and PC .; performing samples of composites of PCC and PC; strength tests in the laboratory. Statistical analysis of the results. Analysis and characterization of the polymerization process - the study of electrical conductivity, viscosity and setting time.

**Metody oceny:**

Lectures: Written exam - test.
Laboratory: continuous assessment - the presence and active participation in the laboratory, defense of laboratory reports, term paper - paper presentation

**Egzamin:**

tak

**Literatura:**

[1] Chanda M., Roy S.K., Industrial polymers, speciality polymers and their applications, Plastics Eginnering Series, CRC Press Taylor & Francis Group, 2009;
[2] EN 1504 - Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity;
[3] Peter H. Emmons, Brandon W. Emmons, Concrete repair and maintenance illustrated;
[4] Michael Raupach, Till Büttner, Concrete Repair to EN 1504: Diagnosis, Design, Principles and Practice;
[5] Czarnecki L., Garbacz A., Łukowski P., Clifton J.R., Optimization of Polymer Concrete Composites. NIST Report no. NISTIR 6361, United States Department of Commerce, National Institute of Standards and Technology, Gaithersburg, USA, 1999, 59s., available on www.nist.gov
[6] Czarnecki L., Garbacz A., Łukowski P., Clifton J.R.: Polymer Composites for Repairing of Portland Cement Concrete: Compatibility Project. NIST Report no. NISTIR 6394, United States Department of Commerce, National Institute of Standards and Technology, Gaithersburg, 1999, 84s., available on www.nist.gov
[7] Garbacz A., Sokołowska J.: Concrete-like polymer composites with fly ashes - Comparative study, Construction and Building Materials, 38, 2013, 689-699

**Witryna www przedmiotu:**

http://pele.il.pw.edu.pl/moodle/course/view.php?id=72

**Uwagi:**

no commments

## Charakterystyki przedmiotowe

### Profil ogólnoakademicki - wiedza

**Charakterystyka W1:**

He has knowledge of basic issues related to the technology of polymer composites. Can present classification of building polymeric composites, describe their basic properties, identify the appropriate application (utility), taking into account sustainability and ecology.

Weryfikacja:

Exam - written test.

**Powiązane charakterystyki kierunkowe:** K1\_W05, K1\_W13, K1\_W08

**Powiązane charakterystyki obszarowe:** P6U\_W, I.P6S\_WG.o, III.P6S\_WG

**Charakterystyka W2:**

Knowledgeable about the selection of sources of information about construction polymer composites (standards, regulations, scientific publications, patents, guidelines for the design, construction and use).

Weryfikacja:

Evaluation team to prepare and submit a term paper.

**Powiązane charakterystyki kierunkowe:** K1\_W16, K1\_W15, K1\_W13

**Powiązane charakterystyki obszarowe:** P6U\_W, I.P6S\_WK, I.P6S\_WG.o, III.P6S\_WG

### Profil ogólnoakademicki - umiejętności

**Charakterystyka U1:**

Able to carry out laboratory experimental program at the level of engineering including: development of a program of research, to design the composition of the polymer composites research, execution of test samples, conducting research, summary and statistical analysis of test results, assessment of research results and draw conclusions.

Weryfikacja:

Rating engagement and efficiency of work in the laboratory; assessment of preparation and defense of individual reports and laboratory exercises.

**Powiązane charakterystyki kierunkowe:** K1\_U21, K1\_U15, K1\_U12, K1\_U03, K1\_U09, K1\_U23

**Powiązane charakterystyki obszarowe:** III.P6S\_UW.o, P6U\_U, I.P6S\_UW.o, I.P6S\_UO

**Charakterystyka U2:**

Student can prepare a team term paper on a chosen topic in the field of polymer composites technology in the form of paper and presented in the form of a presentation.

Weryfikacja:

Evaluation team to prepare and submit a term paper.

**Powiązane charakterystyki kierunkowe:** K1\_U19, K1\_U23, K1\_U21

**Powiązane charakterystyki obszarowe:** I.P6S\_UK, P6U\_U, I.P6S\_UO, I.P6S\_UW.o, III.P6S\_UW.o

### Profil ogólnoakademicki - kompetencje społeczne

**Charakterystyka K1:**

Student can work as a team during the execution of research tasks during the work in the laboratory. Should independently prepare and defend a report on the exercise and laboratory where will develop independently and fairly experimental results and present conclusions. Student is prepared for collaborative development of the theme within the term paper and present its results in a communicative and consistent with the standard principles.

Weryfikacja:

Rating engagement and efficiency of the team work in the laboratory; check whether all the members of the research team have demonstrated proficiency in all parts of the study; assessment of preparation and defense of individual reports of exercises and laboratory evaluation to prepare and submit a term paper.

**Powiązane charakterystyki kierunkowe:** K1\_K01, K1\_K05, K1\_K06, K1\_K07

**Powiązane charakterystyki obszarowe:** P6U\_K, I.P6S\_KR, I.P6S\_KO, I.P6S\_KK