

Course description

Course abbreviation:	KKS/ZKMA	Page:	1 / 5
Course name:	System Design Engineering		
Academic Year:	2023/2024	Printed:	03.06.2024 08:22

Department/Unit /	KKS / ZKMA			Academic Year	2023/2024
Title	System Design Engineering			Type of completion	Exam
Long Title	System Design Engineering of Technical Products				
Accredited/Credits	Yes, 5 Cred.			Type of completion	Combined
Number of hours	Lecture 2 [Hours/Week] Tutorial 2 [Hours/Week]				
Occ/max	Status A	Status B	Status C	Course credit prior to	YES
Summer semester	0 / -	0 / -	1 / -	Counted into average	YES
Winter semester	0 / -	0 / -	3 / -	Min. (B+C) students	10
Timetable	Yes			Repeated registration	NO
Language of instruction	English			Semester taught	Winter, Summer
Optional course	Yes			Internship duration	0
Evaluation scale	1 2 3 4			Ev. sc. – cred.	S N
No. of hours of on-premise					
Auto acc. of credit	No				
Periodicity	K				
Substituted course	None				
Preclusive courses	KKS/ZKM				
Prerequisite courses	N/A				
Informally recommended courses	N/A				
Courses depending on this Course	N/A				

Course objectives:

The aims of the course are to provide students with grounds of the knowledge system of Engineering Design Science (EDS) about and for system management and creative design engineering and evaluation of technical products considered as technical systems (TS) which are based on complex requirements resulting from their operational process and other phases of their life cycle. EDS knowledge are unlike traditional instructive oriented methodologies for design engineering of TS structured into systematically interconnected 'map' of:

- descriptive (teoretical) knowledge related to TS and engineering design process,
 - prescriptive (metodical) knowledge related to TS and engineering design process,
- both interconnected with both technical and other supported science and practice fields as well as computer and experimental tools, which brings important synergy effects.

Requirements on student

Continuous assessment:

- minimal 75% active participation in seminars (only for presence studies)
- fulfilment of the semestral project assignment until the limit deadline at the latest

Final assessment - combined examination (written and oral):

- successful continuous assessment
- acquired knowledge given by course curricula and its creative application in semestral project.

Content

Transformation and technical systems and processes; technical products as technical systems enabling transformation processes; properties and quality of technical systems; structures of technical systems; main principles of achieving the required properties of technical systems: "Design for X "; engineering design activities and their rationalization; engineering design of machines as a transformation process the aim of which is a technical system with the required properties. The acquired theoretical knowledge is creatively applied to examples taken from practice.

Lectures:

1. Basic information about the subject. Transformation system (TrfS) and transformation process (TrfP). General model of TrfS with TrfP. Techniccal products/systems (TS) in TrfS. TS life stages as TrfS.
2. TS properties. Relationships among TS properties. TS quality and its evaluation. Assessment of compliance with TS requirements and evaluation of constructional (engineering design & industrial design) competitiveness of TS. TS structures.
3. Engineering design system (DesS) as TrfS and Engineering design process (DesP) as TrfP. Engineering design. Influence of DesS factors on DesP. Risk sources.
4. General basic operations (A-G), methodical stages (I-IV) engineering design phases (1-6) DesP - overview. Clarification of requirements and their elaboration according to TS life stages (1). Case Study.
5. Engineering designing of TS functional structure from TrfP. Case Study.
6. Engineering design of TS organ structure using morphological matrices (3a). Case Study.
7. Evaluation of engineering design task and decision making - application on evaluation and selection of optimal variant of TS organ structure (3b). Case Study.
8. Engineering designing of the rough TS constructional structure (4) and definitive TS constructional structure (5). Case Study.
9. Detailing, description and transmission of information about designed TS. (6). Case Study. Working with information, representation and checking when solving an engineering design task.
10. Technical processes as technical transformation processes TTrfP. "Internal" technical transformation processes in TS (ITP). TS taxonomy. Methodical knowledge to TP, ITP and TS. Basic DfX knowledge to TS properties. TS development in time. Development of TS properties in time.
11. Structure of DesP activities / operations. Computer in DesS and its influence on DesP.
12. Strategies and tactics in DesP. Metodical knowledge on DesP. General procedural model of engineering designing of TS - recapitulation.
13. Purpose, aim and importance of systemic approaches. Systematic structure of knowledge about and for design. Developmental changes and tendencies in TS engineering design processes.

Fields of study

Guarantors and lecturers

- **Guarantors:** Prof. Ing. Stanislav Hosnedl, CSc. (100%)
- **Lecturer:** Prof. Ing. Stanislav Hosnedl, CSc. (100%)
- **Tutorial lecturer:** Prof. Ing. Stanislav Hosnedl, CSc. (100%)

Literature

- **Basic:** System Design Engineering of Technical Products. (Hosnedl, S.)
- **Recommended:** Eder, Wolfgang Ernst; Hosnedl, Stanislav. *Design engineering : a manual for enhanced creativity*. Boca Raton : CRC Press, 2008. ISBN 978-1-4200-4765-3.
- **Recommended:** Hubka, V., Eder, E. E. *Engineering Design*. Zürich: Heurista, 1992. ISBN 3-85693-026-4.
- **Recommended:** Eder, Wolfgang Ernst; Hosnedl, Stanislav. *Introduction to Design Engineering: Systematic Creativity and Management..* CRC Press / Balkema, Taylor & Francis Group, Leiden, The Netherlands, 2010.

Time requirements

All forms of study

Activities	Time requirements for activity [h]
Contact hours	52
Team project (50/number of students)	12
Undergraduate study programme term essay (20-40)	20
Preparation for an examination (30-60)	30
Presentation preparation (report in a foreign language) (10-15)	15
Preparation for comprehensive test (10-40)	10
Total:	139

assessment methods**Knowledge - knowledge achieved by taking this course are verified by the following means:**

- Combined exam
- Group presentation at a seminar
- Mutual evaluation of team members

Skills - skills achieved by taking this course are verified by the following means:

- Skills demonstration during practicum
- Project
- Continuous testing of partial results

Competences - competence achieved by taking this course are verified by the following means:

- Combined exam
- Seminar work
- Continuous assessment
- Assessment according to the consulted problems and defends of the results

prerequisite**Knowledge - students are expected to possess the following knowledge before the course commences to finish it successfully:**

- sketch, describe and explain the basic properties of general machine parts, and of the basic functional groups of machines and equipment
- describe and explain basic engineering calculations for predicting the properties of general machine parts and basic functional groups of machines and equipment
- describe and explain basic engineering knowledge about standard SW for computer aided design work

Skills - students are expected to possess the following skills before the course commences to finish it successfully:

- recognize and apply engineering design of general machine parts and basic functional groups of machines and equipment, analyze them using calculations and design their alternatives
- apply basic engineering knowledge of material science, manufacturing technology, mechanics, elasticity and strength, and other supporting engineering disciplines
- perform basic engineering calculations for prediction of properties of general machine parts and basic functional groups of machines and equipment

Competences - students are expected to possess the following competences before the course commences to finish it successfully:

- N/A
- N/A
- N/A
- Sense of systematic creative work and documentation of results

teaching methods**Knowledge - the following training methods are used to achieve the required knowledge:**

- Lecture supplemented with a discussion
- Self-study of literature
- Individual study
- Examples and applications from the environment and student experiences

Skills - the following training methods are used to achieve the required skills:

- Students' portfolio
- Project-based instruction
- Collaborative instruction
- Use online forms of teaching

Competences - the following training methods are used to achieve the required competences:

- Self-study of literature

Individual study

Consult, present and defend the partial and final results of own creative work

learning outcomes

Knowledge - knowledge resulting from the course:

describe and explain the technical product as a heterogeneous technical system for the realization of required transformations, its life cycle, engineering design structures and system of their properties, incl. their mutual relationships

describe and explain the systematic process of creative engineering designing of a technical product understood as a heterogeneous technical system with flexible integrated use of all standard engineering design strategies

describe and explain systematic creative engineering designing of alternatives of conceptual and constructional structures of technical product

describe and explain systematic evaluation of suitability of technical products incl. analyses and decision making about their quality and competitiveness

Skills - skills resulting from the course:

design technical product by decomposing it into the general basic phases of the solution

elaborate creatively a systematic comprehensive requirements specification on the designed technical product throughout its life cycle, incl. use of provided SW support

design systematically and creatively alternatives of conceptual and constructional structures of a technical product

evaluate systematically weak and strong properties and the resulting quality and competitiveness of alternatives of designed technical product using the available SW support

manage systematically the engineering design project of a technical product and combine theoretically based, instructive, intuitive and experimental engineering design methods suboptimally

document, present and justify systematically and comprehensibly the engineering design process and resulting designed technical product

Competences - competences resulting from the course:

N/A

N/A

N/A

N/A

N/A

Critically evaluate and implement further knowledge in the subject matter

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Design of Power Machines and Equipment	Postgraduate Master	Full-time	Digital Manufacturing	1	2021	2023	Compulsory courses	A	1	ZS
Design of Power Machines and Equipment	Postgraduate Master	Full-time	Manufacturing Machines and Technologies	1	2021	2023	Compulsory courses	A	1	ZS
Design Engineering of Machines and Technical Devices	Postgraduate Master	Combined	Design Engineering of Manufacturing Machines and Equipment	1	2020	2023	Doporučené výběrové předměty v AJ	C	1	ZS
Design Engineering of Machines and Technical Devices	Postgraduate Master	Full-time	Design Engineering of Manufacturing Machines and Equipment	1	2020	2023	Doporučené výběrové předměty v AJ	C	1	ZS
Design Engineering of Machines and Technical Devices	Postgraduate Master	Full-time	Design Engineering of Vehicles and Handling Machinery	1	2020	2023	Doporučené výběrové předměty v AJ	C	1	ZS
Design Engineering of Machines and Technical Devices	Postgraduate Master	Combined	Design Engineering of Vehicles and Handling Machinery	1	2020	2023	Doporučené výběrové předměty v AJ	C	1	ZS
Design of Power Machines and Equipment	Postgraduate Master	Full-time	Design of Power Machines and Equipment	1	2020	2023	Doporučené výběrové předměty v AJ	C	1	ZS

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Industrial Engineering and Management	Postgraduate Master	Full-time	Industrial Engineering and Management	1	2020	2023	Doporučené výběrové předměty v AJ	C	1	ZS
Industrial Engineering and Management	Postgraduate Master	Combined	Industrial Engineering and Management	1	2020	2023	Doporučené výběrové předměty v AJ	C	1	ZS
Machining, Additive Technology and Quality Assurance	Postgraduate Master	Full-time	Machining, Additive Technology and Quality Assurance	1	2020	2023	Doporučené výběrové předměty v AJ	C	1	ZS
Materials Science and Manufacturing Technology	Postgraduate Master	Combined	Materials Science and Manufacturing Technology	1	2020	2023	Doporučené výběrové předměty v AJ	C	1	ZS
Materials Science and Manufacturing Technology	Postgraduate Master	Full-time	Materials Science and Manufacturing Technology	1	2020	2023	Doporučené výběrové předměty v AJ	C	1	ZS