

## Course guide

# Ergonomics in Challenge Driven Product Development, HN2023 KTH 2019

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For updated information about the course, consult the course's CANVAS-platform

## Objective

The overall objective of the course is that the students shall be able to contribute to the development of solutions to meet the UN Sustainable Development Goals (SDGs). This is to a large extent achieved by acquiring experience-based knowledge and skills by applying Design Thinking methodology and Ergonomics methods on open-ended societal challenges.

After fulfilling the course requirements, each student shall be able to:

1. In own words explain fundamental concepts, areas, and methods addressed in the course, e.g. the UN sustainability goals, challenge-driven development, product development, ergonomics, human physical and cognitive possibilities and constraints, the Human-Technology-Organisation (HTO) perspective, personal injuries, and ergonomics methods, and reflect upon them
2. Explain and practically use some methods used in Challenge driven projects and in Ergonomics, e.g. Design Thinking, subjective rating scales and risk assessment methods
3. Methodically and in a structured way work in a project aiming at finding a solution to a societal challenge, including formulating, planning, leading part of, and carrying out a development project, collaborating and communicating with stakeholders and intended end-users, develop a prototype, let intended users test it, and evaluate it from the SDGs, challenge driven, and ergonomics perspectives
4. Document and communicate the development process and the results of the work orally and in writing; study, judge and exchange feedback on the project work in a structured way, and reflect on their own development and learning process.

## Eligibility

For KTH students the following eligibility conditions are applied: ECTS 180 university credits (hp), or equivalent, in engineering or natural sciences, and documented proficiency in English corresponding to English B/English 6.

## Course main content

Lectures, workshops, seminars, laboratory work, supervision, reflections and other assignments, and an applied project, which together provide theoretical knowledge and experience-based knowledge and skills on solving challenge based problems with focus on the SDGs and ergonomics in product development.

Topics include:

- The sustainability concept, SDGs, and challenge-driven development
- Physical, system, and cognitive ergonomics, the HTO-perspective, Injury risks and their effects, and risk management,
- Design Thinking and Ergonomics methods
- Creativity, group dynamics, collaboration, project management, and evaluation methods

## Language of instruction

The course is held in English.

## Literature

- Rose, L & Eklund, J (2019) *Ergonomics in Product and Production Development*. Course compendium, KTH. Downloadable from CANVAS.
- Bohgard, M, Karlsson, S, Lovén, E, Mikaelsson, L-Å, Mårtensson, L, Osvalder, A-L, Rose, L, & Ulfvengren, P (Eds) (2009) *Work and technology on human terms*. Prevent (Work environment in association with the Confederation of Swedish Enterprise, LO & PTK). ISBN 978-91-7365-058-8, Stockholm, Sweden.

**Note: If you register to the PREVENT course “onhumanterms” via Prevent**

**(<https://www.prevent.se/onhumanterms/>), you will be able to download all book chapters free of charge.**

- Institute of Design at Stanford (unknown publishing year) *Design thinking toolkit*. Downloadable from CANVAS.
- United Nations (UN) (2015) *Resolution adopted by the General Assembly on 25 September 2015*. Document A7RES/70/1. Downloadable from CANVAS.
- Material provided during the course.

## Reading instructions

### Work and technology on human terms (abbreviated in Table 1 as OT):

*The whole book, but mainly the following chapters are part of the course material:*

Chapter 1: Designing work and technology on human terms

Chapter 4: Physical load

Chapter 5: Physical factors

Chapter 7: Human-technology systems

Chapter 9: Methods

Chapter 10: Design processes

Chapter 11: Occupational injuries

Chapter 12: Work environment and economics

### Ergonomics in Product and Production Development (Abbreviated in ED):

*The whole compendium.*

### Additional course material, provided via CANVAS:

*E.g. the UN Resolution listed above.*

## Lectures, workshops and seminars

The lectures give an overview of the fields of and method in ergonomics and challenge driven development towards the United Nations Sustainable Development Goals (SDGs). The lectures are often combined with applied examples and workshops. Examples used are mostly connected to the students' projects or from authentic industrial or research cases. The course also includes seminars and workshops on relevant topics. In order to 'pass' a seminar or workshop, the students are expected to prepare themselves as required prior to the seminar, e.g. by reading certain material or/and submitting an assignment, when applicable, as well as be actively participating in the seminar or workshop.

## Laboratory work

In order to gain experience and understanding of different measurement, calculation and estimation methods, the students, in groups of 4-5, carry out two laboratory exercises. Each laboratory session lasts about two hours. In order to participate in each laboratory session the students have to:

1. Prepare themselves by reading the lab manual and the assigned literature stated in the lab manual.
2. Have passed a web-based test (Quiz) no later than 17:00 the day before the lab. To pass the test 100% correct answers is required. The student has 5 attempts to pass the test. In the case of a non-approved test, the student has to book time for an extra lab and has then 5 new attempts to pass the test prior to the lab.
3. Arrive in time (a review of the laboratory work takes place at the lab start). The labs all start at full hour. In case of delay, a written supplement is required.
4. Bring a print-out of the lab manual. Each student is encouraged to fill out the lab manual, which when completed, is viewed as a short lab report. This can become handy during the written exam.
5. At the end of each lab, the group presents and discusses the results to and with the supervisor. The assessment of pass/fail is done by the supervisor after this oral presentation and discussion.

## Written Exam

One course examination form is a written exam. This will take place January 10, 2020 at KTH Campus Flemingsberg and simultaneously at Botho University Campus Gaborone. For KTH students, the registration for the

exam shall be done as stated by the “anvisningar på utbildningsenheten”. For the Botho University students following the course from Botswana the written exam is optional, and passing the exam leads to a more advanced certificate from KTH. The grade ‘Fx’ opens for the possibility to supplement/complete within a certain time (see below). The re-examination is done during an examination period in the spring (date determined later) Approved written exam gives 3 credits (TEN1). The exam is plagiarism controlled.

The exam must be done individually. During the exam you may use course literature, distributed material (that which is on Canvas) and your own notes. **Bring a calculator!** Completion of the exam can be done if the student is close to (in the order of 1-2 points, depending on the exam) the limit for ‘pass’ (grade E). In that case, the students must contact the examiner to determine the time for completion. Completion then takes place orally with the examiner after agreement with the examiner, however, no later than four weeks after the exam. It may result in the grade E on the exam, but no higher grade.

Mainly Botho students, but also KTH students may follow two massive open online courses (MOOCs), which can be useful. These are the 1<sup>st</sup> RAMP MOOC “Assessment of Work-Related Injury Risks using RAMP I” available via Edx (<https://www.edx.org/course/assessment-of-work-related-injury-risks-using-ramp-i-2>). If you want to follow this course free of charge (for free), choose the **audit** track. **Note that the RAMP course will end October 8<sup>th</sup>**. The other course is the ‘onhumanterms’ (<https://www.prevent.se/onhumanterms/>) provided by Prevent, and in that course, the chapters 1, 4, 5, 7, 9, 10, 11, 12. Both these courses can be helpful to gain a better understanding for and knowledge in ergonomics.

## Project

An important part of the course is the project, where students work on a challenge, and from that challenge define a project, which they work on throughout the course. Here the objective is to try to ‘solve’ an ergonomics problem that also is linked to at least one of the UN sustainable development goals (SDGs). Passing the project equals to 3 ECTS (PRO 1). The project shall result in a prototype that has been tested by users and evaluated from several perspectives, such as subjective and objective ergonomics methods and SDG perspectives. The project shall be carried out in a structured, methodological way and the process has to be documented. Make sure you have measurable objectives in your project, so you can evaluate to what extent you reach them. A developed, tested, evaluated, illustrative prototype is one of the objectives in the project. Another objective is to present the project results both orally and in writing. Make sure that each group member is active in the oral seminar. Reflections on one’s own learning is also a part of the course, and also of the project.

There are a number of deliverables in the project, such as writing a project plan, a draft of the final report, a final report, an impact plan, an oral presentation at the final seminar, giving and receiving feedback from others, and managing part of the project. Peer feedback and teacher supervision is provided in the project work. All project assignments submitted via CANVAS can be on the [format doc, docx, pdf, or txt.](#)

At KTH students will be offered to use Makerspace facilities, which provide e.g. a crafting studio for prototype development. When the course starts, (2019-08-29) more information on this will be given, as well as on the safety courses students have to take and pass to be permitted to use these facilities. Passing the project grants the student with 3 ECTS.

## Course activities and deliverables

As Table 1 shows, the a detailed plan for course activities. Most assignments are specified in, and to be handed in via CANVAS, while some are delivered orally during seminars and suchlike. In the table:

LR = Linda Rose; AR= Anders Rosén; ME = Mats Ericson; JE = Jörgen Eklund; LM = Leungo Motsilanyane; DJ = Denis Jumbam; IM= Ivy Rose Mathew; SN = Susanne Nilsson; YO = Ylva Orrenius; Linus R = Linus Remahl

**Table 1: Detailed plan for course activities. (OT=Work and Technology...; ED= Ergonomics in Product and Production Development; DT = Design Thinking Toolkit).**

Date	Who	Activity	Duration (h)	Lecture	Workshop	Prepare by reading
<b>Day 1, 29/8</b>		<b>Course start</b>				
08:15-10:00	LR	Course start: Welcome and introduction. Survey 1.	2	X		
10:15-12:00	AR&LR, LM&IM	UN SDGs, Challenge presentaiion, SDG Workshop	2	X	X	
12:00-13:00		Lunch				
13:15-14:45	LR	Ergonomics and product development. Design Thinking. Belbin exercrise.	2	X	X	
15:00-17:00	Linus R, SN, LR	Visit to makerspace/labs. Group work. Summary and reflection.	2		X	
<b>Day 2, 5/9</b>		<b>Methods focus</b>				<b>OT: 1, 4, 5; PD: 1, 4, 6; DT; UN Resolution</b>
08:15-12:00	LR	Methods in ergonomics and product development. Design Thinking (DT). Finding relevant information. Project discussion.	3	X		
11:15-12:00	LR	Team work	1		X	
12:00-13:00		Lunch				
13:15-17:00	LR	Team work. Design Thinking. Project work. Discussion with supervisor. Summary and reflection.	4	X	X	
<b>Day 3, 12/9</b>		<b>Ergonomics focus</b>				<b>OT: 7, 9, 10.3; ED: 2, 3, 5</b>
08:15-9:00	LR, students	Project disucssion.	1	X	X	
9:15-12:00	JE & LR	HTO concept. Biomichanics.	3	X	X	
12:00-13:00		Lunch				
13:15-14:00	Stud.	Present work distribution in the groups. Discussion and Reflection.	1		X	
14:15-15:30	ME&LR	Human prerequisites.	1.5	X	X	
16: 00-17:00	LR	Supervision and project work. Summary and Reflection.		X	X	

<b>Deadlines</b>						
<b>Sept. 13</b>	Groups	<b>Group Rules Agreement</b>				
<b>Sept. 20</b>	Groups	<b>Project Plan</b>				
<b>Sept. 20</b>	Groups	<b>Stakeholder Visit Report</b>				
<b>Sept. 25</b>	Individ.	<b>Lab Quiz 1</b>				
<b>Sept. 25</b>	Individ.	<b>Lab Quiz 2</b>				
<b>Day 4, 26/9</b>						
		<b>Lab focus</b>				<b>Lab manuals; PD: 4, 6</b>
08:15-10:00	Stud.	Present project plan and video/ppt from project visit. General discussion.	2		X	
10:15-12:00	LR & LM	LAB 1/LAB 2	2		X	
12:00-13:00		Lunch				
13:15-15:00	LR & LM	LAB 2/LAB 1	2		X	
15:15-17:00	LR	Methods and discussion. Summary and Reflection.	2	X	X	
<b>Deadlines</b>						
<b>Sept. 27</b>	Groups	<b>Project Plan Feedback</b>				
<b>Day 5, 10/10</b>						
		<b>Innovation and core values focus</b>				<b>OT: 11, 12</b>
08:15-9:00	LR	Product development and examples.	1	X		
09:15-10:00	DJ	Innovation.	1	X		
10:15-12:00	LR	Key competences and collaboration.	2	X	X	
12:00-13:00		Lunch				
13:15-14:00	LR	WEE	1	X		
14:15-15:00	IM	Quality aspects. Employability. Discussion.	1	X		
15:15-17:00	LR	Workshop, Project work. Supervision and Reflection.	2		X	
<b>Oct. 21 &amp; 22</b>						
	LR	<b>LR at Botho Campus - extra lect. day</b>				<b>Suitable material</b>
Oct 21	LR, LB, Botho Stud.	Interviews with KTH teacher and researcher				
Oct 22	LR, LB Botho stud.	Interviews with KTH teacher and researcher				

<b>Day 6, 31/10</b>		<b>Project, impact &amp; communication focus</b>				<b>Suitable material</b>
08:15-10:00	LB & LR	Focusgroup interviews & meeting supervisor (only KTH stud.)	2			
10:15-12:00	LR	Presentation of project results & prototypes. Discussion.	2		X	
12:00-13:15		Lunch				
13:15-15:00	LO	Team work in multicultural contexts	2	X	X	
15:15-16:00	LR	Impact model. Summary & reflection.	1	X	X	
16:15-17:00	LR	Meeting supervisor (only KTH stud.)	1			
<b>Date</b>	<b>Who</b>	<b>Activity</b>	<b>Dura- tion</b>	<b>Lec- ture</b>	<b>Work shop</b>	<b>Prepare by reading</b>
<b>Deadlines</b>						
<b>Nov. 1</b>	Induvid	<b>Individual Midterm Assignment</b>				
<b>Nov. 7</b>	Group	<b>Project Report Draft</b>				
<b>Nov. 12</b>	Group	<b>Project Report Draft Feedback</b>				
<b>Day 7, 14/11</b>		<b>Midterm project Presentation focus</b>				<b>Suitable material</b>
08:15-10:00	All	Project presentations, if possible also for stakeholders. Feedback. Discussion.	2			
10:15-12:00	LR	Impact plan. Workshop, presentation & discussion.	2		X	
12:00-13:00		Lunch				
13:15-16:00	LR	SDGs, project work and supervision. Summary and reflection.	3	X	X	
<b>Deadline</b>						
<b>Nov. 26</b>	Group	<b>Impact plan</b>				

<b>Day 8, 28/11</b>		<b>Project focus</b>				<b>Suitable material</b>
08:15-12:00	LR	Short presentation of the state of project including video, prototypes & Impact plan. Discussion. Supervision. DT , ergonomics and product develeopment revisited.	4		X	
12:00-13:00		Lunch				
13:15-16:00	LR & stud.	Project work and supervision. Possible individual meeting with supervisor. Summary and reflection.	3			
<b>Deadline</b>						
<b>Dec. 5</b>	Group	<b>Final report</b>				
<b>Day 9,</b>		<b>Final seminar day</b>				
09:15-11:00	Stud.	Final Project Presentation - video, prototype, relation to SDGs & Impact.	2			
11:15-12:00	All	Feedback from stakeholders, peers and course management.	1			
12:00-13:00		Lunch				
13:15-14:00	LR	Information about written exam, course certificate & feedback-meeting	1			
14:15-15:00	All & Individ.	Final reflection, course evaluation and time assesment.	1			
<b>Deadline</b>						
<b>Dec. 13</b>	Individ.	<b>Individual Final Assigment</b>				
<b>Jan. 10</b>		<b>Written exam 08:00-12:00</b>				



## Finding relevant literature

In addition to the provided course material we suggest that you search literature from different sources, e.g. your university library. In the ergonomics domain you may want to use, for example, MedLine (PubMed), Scopus or Science Direct. Ask a university Librarian if you are unsure on how to perform such a literature search.

An example of a book that may be relevant when designing a prototype to fit humans from anthropometric perspectives is **Bodyspace** Anthropometry, Ergonomics and the Design of Work (2005) by Pheasant & Haslegrave, published by Taylor & Francis.

## Feedback meeting

In the course an optional feedback meeting after the course has ended is offered to discuss the course and the project between the students in each group and the teachers. Such a meeting is then booked by the students with the examiner and are held three weeks after the exam.

## Examination

PRO1 - Project, 3.0 credits (ECTS), grading scale: A, B, C, D, E, FX, F

TEN1 - Examination, 3.0 credits (ECTS), grading scale: A, B, C, D, E, FX, F

ÖVN1 - Exercises, 1.5 credits (ECTS), grading scale: P, F

Requirements for final grade:

Written exam (TEN1; 3 ECTS), grading scale A-F

Passed project (PRO1; 3 ECTS), oral and written presentation, grading scale A-F

Labs, workshops, seminars, assignments (ÖVN1; ECTS), grading scale P/F

Final course grade according to grading scale A-F

The examiner, in consultation with the KTH Disability Coordinator (Funka), decides on any adapted examination for students with documented permanent impairment. The examiner may grant another examination form for reexamination of single students.

## Details on grading criteria and examination of learning outcomes

### Overall grading criteria

To pass the course the student has to fulfil the course requirements, passing PRO1, TEN1 and ÖVN1. The grading is based on assessing the student's knowledge and skills in relation to the four intended learning outcomes.

**To reach Grade E** the student has to demonstrate sufficient level of knowledge and abilities in relation to the learning outcomes. **To reach grade A** the student has to demonstrate excellent level of knowledge and abilities in relation to the learning outcomes, and the ability to apply them both in an independent manner, and in collaboration with others.

In Table 1 below, the grading criteria and points are specified, as well as where the learning outcomes are examined. **To pass the course the student has to have at least one point for each of the four learning outcomes stated in Table 1.** The grades are decided on the following point system:

Grade E: 4 points (ps); Grade D: 6 ps; Grade C: 8 ps; Grade B: 10 ps; Grade A: 12 ps; FX: 3 ps with 1 point for three of the learning outcomes; F: Less than 3 ps.

**Table 1: Points, detailed grading criteria and the examination of learning outcomes**

Points	Learning outcomes (1-4 )and grading criteria			
	1	2	3	4
<b>1</b>	Show basic ability to explain these, as well as demonstrating basic ability to describe their applicability	Show basic abilities in describing and using methods, as well as demonstrating basic ability to account for their applicability	Show basic abilities in these and in contributing to the project by working towards reaching the project objectives	Show basic abilities in these including: a structured, written report, oral presentation of the project; sufficient ability to discuss own results and review others work using a check-list
<b>2</b>	Show good ability to explain these also in detail, demonstrate good ability to describe their applicability also in detail, and in addition demonstrate: the ability to explain some advantages and disadvantages using them	Show good abilities in describing and using the methods, demonstrate more detailed ability to account for their applicability, and in addition demonstrate: skills in motivating the choice of methods; and in the ability to reflect on the results after using the methods	Show good abilities in these and in contributing to the project by systematically working towards reaching the project objectives, and in addition demonstrate: basic ability to discuss the own results, also in relation to others work	Show good abilities in these including: a well-structured and well-written report, a structured oral presentation of the project; good ability to discuss own results, and to review others work using a checklist as well as different perspectives, and in addition demonstrate: basic ability to reflect over own and others work
<b>3</b>	Show excellent ability to explain and account for these both in a comprehensive and detailed way, demonstrate good ability to describe their applicability and advantages and disadvantages using them, and reflect on them and their use	Show excellent abilities in describing, choosing, using, and motivating the choice of, methods and demonstrating excellent ability to account for their applicability both comprehensively and in detail, and in the ability to reflect on the results when using the methods, and in addition: demonstrate abilities of independent use of some of them, to account for the methods strengths and weaknesses, and the ability to reflect on the different methods use	Show excellent abilities in these and in contributing to the project by skilfully and systematically working towards reaching the project objectives, demonstrate good ability to discuss the own results from different perspectives, also in relation to others work, and in addition: demonstrate skills in working independently as well as abilities collaborating and communicating with different stakeholders and suchlike, and in leading part of the project, as part of a team	Show excellent abilities in these including: a well-structured and written report, a well-structured oral presentation; excellent ability to discuss own results and to reflect over own and others work, and to review others work constructively in a structured and to part independent way, and in addition show excellent ability to: illustrate and demonstrate the project results as well as possible improvements, reflect over own learning, and judge others work
<b>Exam- nated in</b>	TEN1, ÖVN1, PRO1	TEN1, ÖVN1, PRO1	PRO1	PRO1