Materialvetenskap, KTH

Mechanical Properties of Materials, MH2032, 6hp

Course PM for 2021

Teachers

Examiner:	Stefan Jonsson	(SJ)	070-290 84 04	jonsson@kth.se
Administrator:	Anders Eliasson	(AE)	08-790 72 55	anderse@kth.se
Assistent:	Nader Heshmati	(NH)	073-928 03 12	nader2@kth.se

Schedule (updated 2021-11-03), Le = Lecture, Ex = Exercise

All lectures will be possible to follow through ZOOM and will be recorded. In addition, there are recordings available from last year. All recordings will be found at play.kth.se. The first lecture will be physical, then we find out how many physical lectures we should have.

Lectures/Exercises/Zoom meetings start 15 min past the full hour.

Table 1 Activities in chronological order

Date	Time	Place	Meeting ID	Activity	Subject
Nov 2	10-12	B22	634 2393 3359	Le1	Plastic deformation
Nov 4	13-15	B23	654 2651 4962	Le2	Plastic deformation
Nov 11	14-16	V12	626 2644 2608	Le3	Dislocation theory
Nov 12	13-15	B23	637 8825 3060	Le4	Dislocation theory
Nov 16	10-12	B21	684 5260 4075	Le5	Hardening mechanisms
Nov 19	13-15	B22	642 4260 4273	Le6	Hardening mechanisms
Nov 24	**08-10**	**Canvas**	**611 5606 5123**	**Quizz**	**Quiz on Canvas, Zoom for questions**
Nov 25	13-15	B23		Ex1	
Nov 26	13-15	B23	610 4651 3186	Le7	Static fracture
Nov 30	10-12	B23		Ex2	
Dec 2	13-15	B23	677 9421 7302	Le8	Fatigue
Dec 6	10-12	B23		Ex3	
Dec 9	13-15	B24	641 9336 0770	Le9	Creep
Dec 10	**24.00**				**Hand in report for seminar**
Dec 14	13-15	B23	630 7688 7989	Le10	Questions from students
Dec 17	**13-16**	**B23**	644 8545 9529	**SEM**	**Seminar**
Jan 17	**08-13**	**Canvas**	**617 7670 3870**	**TENA**	**Exam on Canvas, Zoom for questions**

An updated schedule is found at:
https://www.kth.se/social/course/MH2032/calendar/

Materialvetenskap, KTH

Syllabus

The course covers basic concepts of the mechanical properties of *metals*. Plastic deformation, from continuum- and crystal plasticity perspectives, are followed by basic descriptions of dislocation properties, which are used for describing the hardening mechanisms. Then, follows; basic knowledge of static fracture, ductile and brittle fracture which is developed further in a chapter on fatigue. Finally, strain ageing and creep are covered.

Course goals (CG)

After the course, the students should be able to:

1. Explain the basic principles of deformation of metals
2. Explain the basic principles of fracture in metals and recognize typical fracture surfaces.
3. Apply basic models for the description of mechanical properties.
4. Evaluate the impact of mechanical properties of metals.

Course goal 1	"Theory", includes plastic deformation, deformation mechanisms, dislocation theory, hardening mechanisms.
Course goal 2	"Application", includes static fracture, fatigue, strain ageing and creep.
Course goal 3	"Modelling", includes modelling of mechanical properties.
Course goal 4	includes the seminar.

Examination (According to LADOK)

• INLA	Voluntary hand-in problems, 0hp	Grades: E, FX, F
• KON1	Voluntary quiz, 0hp	Grades: A, B, C, D, E, FX, F
• SEM1	Seminar, 2.0 hp	Grades: P,F
• TENA	Exam, 4.0 hp	Grades: A, B, C, D, E, FX, F

INLA examines the basic level for modelling and is voluntary. If you have passed INLA you have grade E on CG3, modelling. There is no time limit for INLA. Even after the exam it is OK.

KON1 (quiz) examines CG1, theory, and is voluntary. The results can be improved at the exam, TENA. If CG1 is passed at KON1, it is not necessary to answer questions Q1-Q3 at the exam. If a question, like Q1, is answered both at KON1 and TENA, the best result is counted.

SEM1 is examined at a seminar when a chosen task is presented. The presentation should include relevant information and be correct. A written report should be handed in 1 week before the presentation showing what is going to be presented. Normally, this includes a few pages of text and some figures. *In order to pass*, it is necessary that the student (or group of students) understands the task, is prepared and presents the issue clearly. Relevant figures should be included in the presentation and written report. The assignment requires that necessary sources of information are searched and studied. The most relevant information about the subject should be presented to the class. It is very nice if you could put the context of your subject into a relevant example, or show examples of observations or plausible effects of the studied phenomenon.

TENA consists of two parts, written after each other. Part 1, 2h, is without aids and examines CG1, *Theory*, and CG2, *Application*. Part 2, 3h, includes aids and examines CG3, *Modelling*. The approved aids of part 2 include material that is generally available for an engineer, i.e.

calculator, books (including the course compendium), formula handbooks (including the course's collection of formulae). However, it is *not allowed* to bring solutions to exercises, old exams, hand-in problems and so on, or private notes.

Digital examination in Canvas will be used for KON1 and TENA. It will then be possible to use programs like Excel and Matlab to construct diagrams and make calculations. It will also be possible to solve the problems and to make sketches on a piece of paper. Then the papers are to be photographed by a mobile phone and uploaded.

The course grade is given when all course goals (1-4) are passed and is based on the number of points received from course goals 1-3. The situation is explained from the table below. There are 9 questions, Q1-Q9 divided on the different course goals.

KON1 and TENA(1) (closed part of exam) have Q1-Q3 and the best result is counted. Hence, a good result of KON1 makes it unnecessary to answer Q1-Q3 in the exam. The sum, S1, is tested against the requirements of FX and E.

Q4-Q6 are only tested at TENA(1) and their sum, S2, is tested against the requirements of FX and E.

CG3 can be passed (E) in two ways: 1) by handing in solutions to five problems (5x5=25p) or 2) by getting the sum, S3≥ 25, of Q7-Q9 in the closed part of the exam, TENA(2), where aids are allowed.

CG4 is passed when an appropriate report has been handed in and the selected subject has been presented during a seminar.

When course goals 1-4 are passed, the course is passed with grade E.

The grades will be given as a percentage of the maximum points, 96, as indicated in the bottom row of the table. It should be emphasized that slight adjustments may be needed, for instance when a question is misleading or in error, or if the questions appear to have been a bit too difficult.

Table 2 Examination overview showing the maximum points

	CG1, theory			CG2, application			CG3, modelling			CG4
Questions	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	
KON1	8	8	8							
INLA							5x5=25			
SEM										P
TENA(1)	8	8	8	8	8	8				
TENA(2)							16	16	16	
	Best of KON1 and TENA									
Sums	S1			S2			S3			P
Limits	E=12, FX=11			E=12, FX=11			E=25, FX = 22			
	Fulfilling all above CGs gives grade E									
Max	24			24			48			P
Grand tot	24 + 24 + 48 = 96									
Grade	A 90%, B 80%, C 70%, D 60 % (A86p, B77p, C67p, D58p)									

The points will not be reported, but rather used for creating a grade. They will be communicated to the course participants.

Complimentary work

It is possible to hand in hand-written (scanned and Emailed is OK) solutions to the exam problems where FX was given. If F is received on SEM1, you have to hand in a new report and make an agreement with the examiner for a new presentation.

Seminar

Each student, or a small group of students (2-3), choses a subject from the list available on Canvas. A written report should be handed in by Email to jonsson@kth.se. Note the dead line for handing in the report, listed in the schedule, above. Naturally, the expectations of the report and presentation are bigger for a group of students, than for a single student. As we have 3h for the seminar, a one-person presentation must be limited to about 6min.

Course material

Compendium Paper copies available on request	Mechanical Properties of Metals and Dislocation Theory from an Engineer's Perspective, S. Jonsson. (Free of charge)
Canvas	Compendium and all other materials

Any other business

Suggestions for improving the course are most welcome. Please tell me about errors or ambiguities that you find in the course material by sending an email to Stefan Jonsson, jonsson@kth.se.

With reservations for typing errors. Please, tell me about any ambiguities in the text.

Stefan Jonsson