

Testing Techniques in Solid Mechanics (SE2123) 2021 – 6 hp

After the course, the participants will be able to perform some solid mechanical experiments and interpret the results. You will learn the theoretical background and will be able to determine parameters defined in the standards as well as parameters in material models. You will acquire practical, hands on, experience from use of experimental equipment including servo-hydraulic test machines at the department.

Responsible teachers

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Literature

Course compendium: *Testing techniques in solid mechanics – 2019*, 150 SEK, is sold at the Student Office, Teknikringen 8 D. Opening hours are: Monday - Friday 10.00 – 13.00.

Schedule

Schedule for lectures is found on the KTH web-page and the content of each session is detailed below together with overall dates for the laboratory works. All lectures and laboratory works 4 and 5 are given online (ZOOM). **Note that the laboratory works start 15 min. past the hour and the duration is maximum 2 hours and 45 min.**

Course sign-up

Due to the extensive use of the laboratory equipment including continuous supervision, the number of course participants is limited to 24. The KTH course selection procedure in November is the basis for course participation. If there are more than 24 students signing up for the course, then participation follows the priority described in the course plan. If no other arrangements have been made with the examiner, then your course selection is valid until the first lecture when actual participation will be checked for. Up to this point, late course selection is possible given that space exist.

Course start

January 18, 13.15–15.00 on ZOOM.

Laboratory works

Five compulsory labs, to be performed in groups of three. Participants are requested to study the theory prior to each lab and shall be able to pass a short test. The procedure is as follows. Each Friday before the labweek, the test for “the lab of next week” will be available on the website. Answer the test questions together in your group and send it to Armin (arminh@kth.se) by the following Tuesday no later than 12.00. He will correct them promptly and book a lab time for your group if you pass the test, and you will be notified at 17.00 the same day. **It is important that you also carefully study the preparatory exercises written in the laboratory instructions before the lab session starts. These questions will be discussed during the laboratory and you will be asked to present your answers. Note that your performance during the laboratory will also be graded (applies to laboratory work 1, 2 and 3).** Reports shall be written and submitted following the dates below.

Laboratory work 1

Strain gauges and strain measurements. The Wheatstone bridge. Determination of Young’s modulus and eigenfrequency. Temperature compensation.

Laboratory work 2

Uniaxial tension test of an elastic-plastic material. Data acquisition and requirements for the measurement system. Corrections for inhomogeneous deformation. True stress-strain behaviour. Brinell hardness test.

Laboratory work 3

Paris law parameters. Determination of the linear-elastic plane strain fracture toughness, K_{IC} .

Laboratory work 4

Demolaboratory work about DIC measurements.

Laboratory work 5

Demolaboratory work about classical fatigue testing.

Laboratory works 1 to 3 are performed in the department's laboratory, Teknikringen 8 D, and laboratory works 4 and 5 are given on ZOOM. After laboratory works 1, 2 and 3, the results should be analyzed and summarized in a laboratory report, written according to instructions available on the course web-page. After laboratory works 4 and 5, no laboratory report is required but attendance is compulsory. Reports should be sent no later than the dates below to Armin (arminh@kth.se).

Course requirementsLaboratory work (LAB1; 3 hp)

The laboratory requirements are: **1)** Participation in laboratory group works 1 – 3 and **2)** attendance and passed pre-laboratory test at laboratory works 4 and 5 and **3)** passed grade on laboratory reports 1 – 3.

Test (KON1; 0 hp)

You do the **compulsory** tests together with your laboratory group before each laboratory work. For laboratory works 1 – 3 the test must be passed before a laboratory time can be booked.

Written examination (TEN1; 3 hp)

The written examination is voluntary. Examination date is Friday, March 15 at 8–13. Registration on MINA SIDOR is required. The examination grades are: 12 - 15 give E; 16 - 19 give D; 20 - 22 give C; 23 - 26 give B; 27 - 36 give A, out of possible 36 examination points.

Course grade

Each laboratory report and data sheet is graded with pass or fail according to following point scoring: Each laboratory report can give a maximum of 20 points and 10 points are required for passing. For laboratory works 4 and 5 attendance and passed pre-laboratory tests can give a maximum of 4 points for each laboratory work. If the grade on the laboratory reports is fail, the students are given one chance to complement the reports and data sheets up to the grade pass. **Final due date for complements of reports is March 31 before 17.00.** With passed grade on all laboratory reports and attendance on laboratory work 4 and 5, the course grade is at least E. If the sum of points exceeds 46 then your course grade will at least be D. If the sum of points exceeds 57 then your course grade will at least be C. If one or more of the reports have been complemented for passing or if one or more of the laboratory works 1 to 3 is performed on the extra laboratory time, the course grade from the laboratory reports is at most E. If your examination grade exceeds the course grade from the laboratory reports, then the examination grade is the course grade.

Course evaluation

All students will be asked to participate in a course evaluation at the end of the course.

Course web-page

The course web-page is available on **Canvas**.

Preliminary course program

Week	Day	Time	Content
3	Mon 18/1	13.15-15.00	Lecture 1: Introduction. Measurement systems and standards. Strain measurements.
	Tue 19/1	10.15-12.00	Lecture 2: Strain measurements continued. The uniaxial tensile test.
4	Mon 25/1	13.15-15.00	Lecture 3: The uniaxial tensile test continued (13.15-14.00). Writing the laboratory reports and report grading (14.15-15.00).
	Tue 26/1	10.15-12.00	Lecture 4: The uniaxial tensile test continued.
	Wed 27/1 - Fri 29/1	Individually booked time	Laboratory work 1: Strain gage and strain measurements. Laboratory report sent in at the latest Mon 8/2 (17.00).
5	Mon 1/2	13.15-15.00	Lecture 5: Hardness testing.
	Tue 2/2	10.15-12.00	Lecture 6: The uniaxial compression test.
	Wed 3/2- Fri 5/2	Individually booked time	Laboratory work 2: Uniaxial elastic-plastic tension test and hardness test. Laboratory report sent in at the latest Mon 15/2 before 17.00.
6	Mon 8/2	13.15-15.00	Lecture 7: Crack propagation.
	Tue 9/2	10.15-12.00	Lecture 8: Statistical methods in solid mechanics.
	Wed 10/2 - Fri 12/2	Individually booked time	Laboratory work 3: Crack propagation. Laboratory report sent in at the latest Mon 22/2 before 17.00.
7	Mon 15/2	13.15-15.00	Lecture 9: Deformations and strains measurement with Speckle.
	Tue 16/2	10.15-12.00	Lecture 10: Fatigue testing of materials.
	Wed 17/2	13.15-16.00	Laboratory work 4: DIC measurements. This is a demolaboratory work on ZOOM. No report should be sent in.
8	Mon 22/2	13.15-15.00	Lecture 11: Fatigue at spectrum load.
	Wed 24/2	13.15-16.00	Laboratory work 5: Fatigue testing. This is a demolaboratory work on ZOOM. No report should be sent in.
	Thu 25/2- Fri 26/2	Individually booked time	Extra laboratory times. A laboratory group that wants to perform a laboratory work on one of these extra times must request this to the examiner prior to the date scheduled for the particular laboratory work. The examiner then approves or denies this request. If the extra laboratory time is used, the course grade from the laboratory reports is at most E.
9	Mon 1/3	13.15-15.00	Lecture 12: Course repetition.
	Wed 3/3- Fri 5/3	Individually booked time	Extra laboratory times. See above (week 8) for details.
11	Thu 18/3	8.00-13.00	Written examination.
23	Fri 11/6	8.00-13.00	Written reexamination.