

Testing Techniques in Solid Mechanics (SE2123) 2020 – 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 department's student office, Teknikringen 8 D. Opening hours are: Monday - Friday 12.00 – 15.00.

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 are held in the seminar room at the Department of Solid Mechanics, Teknikringen 8 D. **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 15, 10.15–12.00 in the seminar room at the Department of Solid Mechanics, Teknikringen 8 D.

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 leave it in Armins mailbox at the Department 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.** 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

In-plane visual measurement of deformation using Speckle. Experimental determination of elastic properties for the material and the stress concentration at a hole. ARAMIS measuring and data analysis system. Comparing and analysing experimental results with FE- and handbook solutions.

Laboratory work 5

Experimental measurements of vibration spectrum, strains and acceleration. Analysis of vibration spectrum and its use for fatigue life assessment.

Laboratory works 1 to 4 are performed in the department's laboratory, Teknikringen 8 D, and laboratory work 5 at Scania research and development laboratory in Södertälje. After laboratory works 1, 2 and 5, the results should be analyzed and summarized in a laboratory report, written according to instructions available on the course web-page. After laboratory works 3 and 4, the results should be summarized in a data sheet. Reports and data sheets should be handed in no later than the dates below (placed in Armins mailbox at the Department or to his email). **Only paper versions, signed by all participants, is accepted.**

Course requirementsLaboratory work (LAB1; 3 hp)

The laboratory requirements are: **1)** Participation in laboratory group works 1 – 5 and **2)** passed grade on laboratory reports 1, 2 and 5 and on data sheets pertinent to laboratory works 3 and 4.

Test (KON1; 0 hp)

You do the **compulsory** tests together with your laboratory group before each laboratory work. The test must be passed before a laboratory time can be booked. The test dates are stated on each test sheet.

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 each data sheet the maximum is 10 points and 5 points are required for passing. If the grade 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.** Passed grade on all laboratory reports and on all data sheets and the course grade is at least E. If the sum of points given on laboratory reports and data sheets exceeds 54 then your course grade will at least be D. If the sum of points given on laboratory reports and data sheets exceeds 67 then your course grade will at least be C. If one or more of the reports or data sheets have been complemented for passing or if one or more of the laboratory works 1 to 4 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	Wed 15/1	10.15-12.00	Lecture 1: Introduction. Measurement systems and standards. Strain measurements.
	Thu 16/1	15.15-17.00	Lecture 2: Strain measurements continued. The uniaxial tensile test.
4	Mon 20/1	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 21/1	10.15-12.00	Lecture 4: The uniaxial tensile test continued.
	Thu 23/1 - Fri 24/1	Individually booked time	Laboratory work 1: Strain gage and strain measurements. Laboratory report handed in at the latest Mon 3/2 (17.00).
5	Mon 27/1	13.15-15.00	Lecture 5: Hardness testing.
	Tue 28/1	10.15-12.00	Lecture 6: The uniaxial compression test.
	Thu 30/1 - Fri 31/1	Individually booked time	Laboratory work 2: Uniaxial elastic-plastic tension test and hardness test. Laboratory report handed in at the latest Mon 10/2 before 17.00.
6	Mon 3/2	13.15-15.00	Lecture 7: Crack propagation.
	Tue 4/2	10.15-12.00	Lecture 8: Statistical methods in solid mechanics.
	Thu 6/2 - Fri 7/2	Individually booked time	Laboratory work 3: Fatigue crack growth. Data sheet handed in at the latest Mon 17/2 before 17.00.
7	Mon 10/2	13.15-15.00	Lecture 9: Deformations and strains measurement with Speckle.
	Tue 11/2	10.15-12.00	Lecture 10: Fatigue testing of materials. Fatigue at spectrum load.
	Thu 13/2 - Fri 14/2	Individually booked time	Laboratory work 4: Speckle. Data sheet handed in at the latest Mon 24/2 before 17.00.
8	Mon 17/2	13.15-15.00	Lecture 11: Industrial testing at Scania (guest lecture).
	Wed 19/2	13.00-16.00	Laboratory work 5: Vibration scatter measurement, industrial testing and tour of Scania research and development test facilities. Laboratory report handed in at the latest Mon 2/3 before 17.00.
9	Mon 24/2	13.15-15.00	Lecture 12: Course repetition.
	Fri 28/2	13.15-16.00	Extra laboratory time. A laboratory group that wants to perform one of the laboratory works 1 to 4 on this extra time 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.
11	Fri 13/3	8.00-13.00	Written examination.
23	Thu 4/6	8.00-13.00	Written reexamination.