Fatigue (SE2137) 2020 – 6 credits

The learning objectives for the participants are to understand the fatigue process, to be able to use tools and methods to design against fatigue and to determine the expected component life when subjected to fatigue and environmental loads.

After course completion, the participants should be able to:

- Identify fatigue as the cause of failure.
- Use stress- and strain-based methods to design against fatigue at uniaxial and multiaxial loadings where multiaxial loads can be proportional or non-proportional.
- Design for finite life and at variable amplitude with damage accumulation.
- Use statistical methods to determine the risk of failure of a component.
- Use linear fracture mechanics to determine the crack growth rate and predict the expected life of a component.
- Describe different mechanisms for the origin of fatigue.
- Describe different mechanisms for environmental failure and how the environment may affect the resistance to fatigue failure.
- Use a computer tool for fatigue evaluation.

Responsible teachers

Bo Alfredsson (examiner), phone: 790 7667, e-mail: alfred@kth.se
Pål Efsing (lectures on environmental effects), e-mail: efsing@kth.se

Literature

R.I. Stephens, A. Fatemi, R.R. Stephens, H.O. Fuchs, *Metal Fatigue in Engineering*, 2010 (2nd) (Available on-line at KTH library)

Handbook of Solid Mechanics, 2010 or
Handbok och formelsamling i Hållfasthetslära, 2016, KTH Solid Mechanics.
Sold at the department's student office, 250 kr.

Handouts, notes and slides.

Opening hours for the student office is: Monday – Friday 12.00 – 15.00.

Schedule

Schedule for lectures are found on the KTH web-page (www.kth.se/student/schema).

Course registration

Remember to register for the course on My Services/Mina tjänster on KTH web-page.

Course web-page

The course web-page is located in Canvas. Register for the course for access.

Course start

Monday August 24 2020 at 8.15 – 10.00 on zoom https://kth-se.zoom.us/j/68819798307.

Course requirements

Home assignments (HEM1; 6 hp)

This course requirement includes:
- attendance and active participation in all seminars 1 – 6 and
- passed grade on all home assignments 1 – 6.

The home assignments can be done and handed in individually or in groups of two. There is no set format or evaluation of the format. The assignments can be hand written as long as they are transcribed. (These will be your main course notes.)

Each home assignment comprise a series of tasks which are awarded the letter E or C, where E tasks are basic and C are more advanced or comprehensive. There will be a 3 step hand in and evaluation sequence for the home assignments:
1) preliminary hand in (dates specified on the assignments sheets),
2) seminar on the assignment solution and
3) final hand in.

To pass a home assignment with grade E all tasks with letter E must have a correct solution at the final hand in. Grade D requires in addition the correct solution of 40% of the C tasks. Grade C requires all E tasks and 80% of the C tasks.

Each passed HA task will be awarded 1 bonus point for the final examination, *e.g.* HA1 contains 5 tasks numbered 1 to 5, passing all will give 5 bonus points for the examination.

Written examination (TEN1; 0 hp)

The examination is voluntary. You do not need to do it to pass the course.

The written examination is on October 16 at 8–13. Registration on My services/Mina tjänster. The examination will be graded F, E, D, C, B or A.

Course grade

If you have passed the home assignments (E–C) then you have passed the course with at least this grade.

The course grade will be the highest of the home assignment grade (E–C) and the examination grade (E–A).

Course evaluation

All course participants will be asked to participate in a web-based course evaluation at course ending.

Course program

All lectures, seminars and the tutorial will be on-line through Zoom, see link on course web-page.

No.	Date	Time	Topic	Ch Book
L1	24/8	8-10	Introduction. Classic 1D fatigue	-
L2	25/8	10-12	High cycle fatigue	4.2-4.8
L3	27/8	13-15	Low cycle fatigue	5;7
L4	31/8	Cancelled	Variable amplitude, load analysis (Discussed in L5)	-
L5	1/9	10-12	Fatigue mechanisms. Fatigue testing	3
L6	3/9	13-15	Multi-axial fatigue: proportional loading	10
L7	7/9	8-10	Multi-axial fatigue: non-proportional loading	10
L8	8/9	10-12	Multi-axial fatigue: non-proportional loading	10
Tt	10/9	13-17	Tutorial: Comsol HA3 multi-axial fatigue	-
X	14/9	8-10	Extra lecture time (See course-page if needed)	
L9	15/9	10-12	Environment (This lecture may be moved to 17-19)	
L10	16/9	10-12	Environment (This lecture may be moved to 17-19)	
L11	17/9	13-15	Statistical methods - Background	-
L12	21/9	8-10	Statistical methods - Parameter estimates	-
L13	22/9	10-12	Statistical methods - Weakest link	-
L14	24/9	13-15	Fatigue crack growth at constant amplitude	6
L15	28/9	8-10	Fatigue crack growth at variable amplitude	6; 9.8
L16	29/9	10-12	Crack closure, short cracks etc.	6; 9.8
L17	5/10	8-10	Special topics	-
L18	6/10	10-12	Design against fatigue - course end	1; 2; 8
X	8/10	13-15	Extra lecture time - to be decided	
E	16/10	8-13	Examination (See KTH schedule for room)	
EX	17/12	8-13	Re-examination (See KTH schedule for room)	