Fatigue (SE2137) 2018 – 6 hp

The aim for the participants to understand the onset of fatigue, the damage process for fatigue and environment, be able to use different tools and methods to design against fatigue, determine the risk for failure and 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 and a fatigue database 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

J. Schijve, *Fatigue of Structures and Materials*, Springer, 2009 (2nd) (KTHB on-line)
Handbook of Solid Mechanics, 2010 or Handbok och formelsamling i Hållfasthetslära, 2016, Department of Solid Mechanics at KTH. Sold at the 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 27 2018 at 8.15 – 10.00 in room 4303, the department's seminar room.

Course requirements

Home assignments (HEM1; 6 hp)

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

The home assignements 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 26 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.

The course grade will be the higest 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 and seminars will be in the department's seminar room, Teknikringen 8D, floor 1. The tutorial on September 9 will be in the track room.

No.	Date	Time	Topic	Ch J.S.
L1	27/8	8-10	Introduction. Classic 1D fatigue	3,6,7
L2	29/8	13-15	Low and high cycle fatigue	
L3	30/8	13-15	Low and high cycle fatigue	
L4	3/9	8-10	Variable amplitude, load analysis	9,10
L5	5/9	13-15	Fatigue mechanisms. Fatigue testing	2,13
S1	6/9	13-15	Sem 1: Constant amplitude fatigue	
L6	10/9	8-10	Multi-axial fatigue: proportional loading	-
L7	12/9	13-15	Multi-axial fatigue: non-proportional loading	
L8	13/9	13-15	Multi-axial fatigue: non-proportional loading	
S2	14/9	10-12	Sem 2: Variable amplitude fatigue	
T9	17/9	8-10	Tutorial: Comsol HA3 multi-axial fatigue (In track room)	
L10	19/9	13-15	Statistical methods - Background	12
L11	20/9	13-15	Statistical methods - Parameter estimates	
L12	24/9	8-10	Statistical methods - Weakest link	
S3	26/9	13-15	Sem 3: Multi-axial fatigue	
L13	27/9	13-15	Fatigue crack growth	5,8
L14	28/9	10-12	Fatigue crack growth at variable amplitude	11
L15	1/10	8-10	Crack closure, short cracks etc.	
L16	3/10	13-15	Environment	16
L17	4/10	13-15	Environment	
S4	5/10	10-12	Sem 4: Statistical methods	
L18	8/10	8-10	Sem 5: Crack growth	
S5	10/10	13-15	Fatigue in other materials. Special fatigue topics	4,14,15,17-21
S6	11/10	13-15	Sem 6: Environment	
E0	26/10	8-13	Examination (See KTH schedule for room)	
R0	18/12	8-13	Re-examination (See KTH schedule for room)	