FYS3410, Spring 2016, final examination

The examination is oral and with external censorship. You will draw a question among those questions given in advance, and you will then have 30 minutes preparation time. The examination itself will take approximately 30 minutes. During the first 15 minutes of the examination you present your answer to the question which you have drawn; in the next about 10-12 minutes you will be asked additional questions related to the content of the course; the rest of the time is for internal discussion of your performance. Altogether your presence is required for approximately 1 hour (please choose an appropriate slot of time from those suggested below).

Note that 15 minutes is not a lot of time for making a presentation - you will have to be selective and you will also be evaluated on how well you have selected relevant materials. You can use any sort of notes during the presentation, for instance to copy a complex equation you need for the evaluation. However, please consider not to excaudate this possibility, since too excessive use of notes may be used against you.

The examination takes place at the MiNaLab (Gaustadallen 23c) at the UiO-meeting-room at the 3rd floor (the same level as you enter the building from the Gaustadallen).

Examination questions

1. **Periodic lattices** as a result of the interatomic force balance in solids: basic ideas and specific interpretation of the ionic bonding, e.g. in NaCl.
2. **Defects in crystals**; case of vacancies – reason to occur and equilibrium concentration.
3. **Interpretation of the x-ray diffraction in reciprocal space**; Laue condition; Bragg planes; Brillouin zones (BZ).
4. **Atomic vibrations in infinite periodic lattices**; dispersion relation - $\omega(k)$ and group velocity - $v_g(k)$ in the 1st BZ of 1D crystal.
5. **Quantization of atomic vibrations** = restrictions on k- numbers because of boundary conditions; phonon density of states (DOS) as a function of k and ω in 3D.
6. **Lattice heat capacity**; evaluation of different models.
7. **Lattice thermal conductivity**; analysis at “low” and “high” temperatures.
8. **Drude model** for electrons in solids - free electron gas: success and limitations.
9. **Free electron Fermi gas** (FEFG); energy dispersion and DOS in the ground state in 3D.
10. **FEFG DOS in quantum wells and quantum wires** in the ground state.
11. **FEFG at T>0** and its heat capacity in 3D.
12. **Origin of the energy band structure** in periodic lattices; “molecular orbital” and “electron wave diffraction” reasoning.
13. **Filling energy bands with electrons**; k_F vs k_{BZ} in typical metals, e.g. Na; metal vs insulators; reasons for the band overlap.
14. **Effective mass approximation** and its application for understanding “hydrogen-like” impurities in semiconductors
15. **Electrons and holes in semiconductors**; intrinsic and extrinsic carriers; variations in E_F.
16. **p-n junctions**; balance between diffusion and drift currents for electrons and holes; application of the forward or reverse external bias;

Schedule for the final oral examination in FYS3410, spring 2016

30/5/2016 **30/05/2016**

10.00-10.30	Sindre
10.30-11.00	

10.30-11.00	Alessio
11.00-11.30	

11.00-11.30	Mattia
11.30-12.00	

11.30-12.00	Giulio
12.00-12.30	

break

13.00-13.30	Giovanni
13.30-14.00	

13.30-14.00	Marius
14.00-14.30	

14.00-14.30	Ole Gunnar
14.30-15.00	

14.30-15.00	Lars
15.00-15.30	

15.00-15.30	Vegard
15.30-16.00	

31/05/2016 **31/05/2016**

09.00-09.30	Trude
09.30-10.00	

09.30-10.00	Heine
10.00-10.30	

10.00-10.30	Magnus
10.30-11.00	

10.30-11.00	Edward
11.00-11.30	

break

13.00-13.30	Martin
13.30-14.00	

13.30-14.00	Anisa
14.00-14.30	

14.00-14.30	Nicolai
14.30-15.00	

14.30-15.00	Kristian
15.00-15.30	

15.00-15.30	
15.30-16.00	