Examination questions for the lectures "Magnetic materials in nanoelectronics - properties and fabrication"

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- At the beginning you will be given four questions from the list shown below[1]
- The oral examination will be conducted in English but the language proficiency *will not* influence the grading
- After receiving the set of questions you will be given 5 minutes to prepare the answers
- You will be allowed to use paper and pen to prepare your answers and during the examination
- During the preparation of the answers you will be allowed to have two DIN A4 sheets (4 *numbered* pages) with *hand-written* notes (no copies; one set of notes per one examinee) which you should present to me for marking
- As the exam will not generate any written record you are encouraged to designate a person (not the examinee) who will observe the course of the examination as your representative

The questions:

1. Unpaired charges in conductors; surface charges as the source of internal electric field (1-D case). (lecture no. 1)
2. Potential of an electrode on a uniform, isotropic conductor occupying a half-space. (lecture no. 1)
3. Potential of two electrodes and a four point probe for thin conducting films. (lecture no. 1)
4. Accuracy, precision; Johnson noise. (lecture no. 1)
5. Magnetic dipole moment and magnetization. (lecture no. 2)
6. Magnetic flux density and magnetic field strength. (lecture no. 2)

[1] during the exam you will have to answer four questions from the list; no other questions from the list will appear in the exam although I may ask you some additional questions concerning the topic refereed to by the initial questions

7. Susceptibility, classification of magnetic and ferromagnetic materials. (lecture no. 2)
8. Vibrating sample magnetometer and lock-in principle. (lecture no. 2)
9. Magnetocrystalline anisotropy. (lecture no. 3)
10. Shape anisotropy. (lecture no. 3)
11. Surface and exchange anisotropy. (lecture no. 3)
12. Stress anisotropy. (lecture no. 3)
13. Dynamic effects in magnetic hysteresis - losses; static limit. (lecture no. 4)
14. Complex susceptibility and dissipation. (lecture no. 4)
15. Preisach model of hysteresis. (lecture no. 4)
16. Size effects in resistivity. (lecture no. 5)
17. Magnons and resistivity. (lecture no. 5)
18. Mott two current model. (lecture no. 5)
19. GMR - resistors network model. (lecture no. 5)
20. GMR - Boltzmann transport equation and results of Barnaś model; angular dependence. (lecture no. 5)
21. RKKY coupling; GMR systems with coupling (RKKY, exchange). (lecture no. 5)
22. Typical GMR systems (different coercivities of the layers, systems with coupling, alternating anisotropies, G^2MR). (lecture no. 5)
23. Various GMR sensors (field, angle, with memory); sensitivity versus RKKY-coupling energy. (lecture no. 6)
24. Magnetoresistive random-access memory (writing process, readout). (lecture no. 6)
25. Spin torque transfer switching. (lecture no. 6)
26. Boltzmann velocity distribution. (lecture no. 7)
27. Mean free path of gas molecules and quality of vacuum. (lecture no. 7)

28. Impingement rate, sticking coefficient, and monolayer formation time. (lecture no. 7)

29. Vapor pressure, evaporation rate (Hertz-Knudsen equation). (lecture no. 7)

30. Knudsen cell and thickness profile from a small surface source. (lecture no. 7)

31. Sputtering process (physical): yield, energy distribution of sputtered atoms, angular distribution etc. (lecture no. 7)

32. Evaporation versus sputtering. (lecture no. 7)

33. Potential of adatom on a crystal surface and surface diffusion. (lecture no. 8)

34. Epitaxy. (lecture no. 8)

35. Basic modes of thin film growth. (lecture no. 8)

36. Zone model of thin film growth. (lecture no. 8)