Part 1 – SEM/TEM microscopy

1. Describe the interaction of electrons with a solid specimen (as a particle and as a wave).
2. Define the point-spread function (PSF) and the optical transmission function (OTF).
3. Electron microscope spatial resolution - influence of aberration and diffraction effects
4. SEM microscope construction and operation principles.
5. Imaging with secondary electrons in SEM.
6. Imaging with backscattered electrons in SEM.
7. Describe which (and how) imaging parameters affect the depth of field and the magnification, and the useful magnification in the SEM microscopy.
8. Discuss the influence of the accelerating voltage and beam current on the high resolution imaging in SEM microscopy.
9. Discuss the physical principles of qualitative and quantitative elemental EDX analysis
10. TEM microscope construction and operation principles.
11. Discuss the types of image contrast in TEM microscopy.
12. Single and multiple beam imaging in TEM.
13. Contrast transfer function in coherent imaging (TEM), resolution limit and information limit.
14. Electron diffraction in TEM.
15. Determination of the interplanar distances.

Part 2 – atomic force microscopy and confocal fluorescence microscopy

1. Discuss the basic modes of surface topography imaging using the AFM technique.
2. Explain the principle of operation of the AFM microscope.
3. Describe the advantages and disadvantages of AFM microscopy in comparison to scanning electron microscopy
4. What material properties can be characterized/mapped using AFM microscopy?
5. Discuss the types of intermolecular interactions occurring during surface scanning with the AFM probe
6. Discuss the parameters describing the objectives in optical microscopy
7. Discuss the construction elements of the fluorescence microscope.
8. Explain the principles of measurements using confocal microscope.