PHYS421	Name:	*Mark* :	*Initials*: VF

Lancaster University Department of Physics

PHYS421 - Adv Solid State (magnetism) and Nanoscale Physics

Michaelmas Term 2006
Sheet 4 (total mark = 20)

1. [3] What are semiconductor heterostructures? Describe three methods of micro/nanotechnology used for the fabrication of ballistic wires starting from semiconductor heterostructures.

2. [6] Using lecture notes, repeat the derivation of the conductance of a ballistic adiabatic constriction between two two-dimensional electron gases. Estimate the conductance of a ballistic wire with the width of 100nm connecting two two-dimesional reservoirs with the sheet electron density $n_e = 10^{11}\text{cm}^{-2}$. Does the conductance of such a wire depend on its length?

3. [6] Folowing notes, derive the spectrum of Landau levels for two-dimensional electrons in a semiconductor heterostructure. Explain meaning of the following terms: 'magnetic length' and 'filling factor'.

4. [2] What are skipping orbits of electons in a magnetic field? What are edge states of electrons in a magentic field?

5. [3] Describe the phenomenon of the Quantum Hall Effect. How does one use the Quantum Hall Effect in metrology?

THIS SHEET MUST BE ATTACHED TO YOUR ANSWERS. Inserting your name in the appropriate place at the top of this page. Please ensure your work is clearly legible. Do not submit your work in folders or plastic sleeves. Your answers should be placed in the appropriate in-box in the Physics Foyer not later than 16:00 on Wednesday, 22 November 2006. Work handed in after the above time and before 11 am on the following Monday will be subject to a 50% reduction of mark. Work handed in later than this will not count towards your continuous assessment.

I declare that this submission is my own work. I have not submitted it in substantially the same form towards the award of a degree or other qualification. It has not been written or composed by any other person and all sources have been appropriately referenced or acknowledged.

Signed: