**S-104.1310 Additional course in physics 1 (SFT)** **exam** **January 11, 2008**

1. A parachutist is at the time $t$=0 at a position $z$=0 and moving downwards with a velocity $v_0$. In addition to the earth's gravity, there is a frictional force of $a_f = -\beta v$ $(\beta > 0)$ acting on the parachutist. Calculate a) the velocity of the parachutist as a function of time (4 p) and b) the terminal velocity, *i.e.*, the velocity attained by the parachutist during a long flight (2 p).

2. An object is moving horizontally on the surface of the Earth with the speed of $v$. How large is the horizontal component of the Coriolis acceleration, $a_H$, if the location of the object is at the latitude of $\lambda$? Calculate the value of $a_H$ when $v$ = 280 m s$^{-1}$ and $\lambda = 60°$ N.

3. A particle has a rest energy of $mc^2$. a) How large must the speed of the particle be for its momentum to be $mc$? b) Calculate the total energy of the particle in that case.

4. One end of a semiconductor rod is being illuminated constantly so that the electron concentration in a steady state at the surface is $n_0$. Calculate the concentration of electrons $n(x)$ as a function of distance $x$ from the surface. Diffusion equation taking into account the recombination of electrons is

$$\frac{\partial n}{\partial t} = D\frac{\partial^2 n}{\partial x^2} - \frac{n}{\tau},$$

where $D$ is the diffusion constant of the electrons and $\tau$ is the average lifetime of the electrons.

Write your name, student number, degree programme, course code, and date of the exam in each paper.