Higgs Physics Lecture
Exercise sheet for Students

The purpose of this exercise sheet is to guide you through the simple calculations that you may want to do to recap the lectures

Exercise 1 (slide 5) : compute the degenerate minimum of the Higgs potential v.

Exercise 2 (slide 5) : Develop the Lagrangian near the translated minimum and show how the mass term of the ξ field disappears.

Exercise 3 (slide 9) : Develop the Lagrangian near the translated minimum using the specific gauge that allows to absorb the ξ field.

Exercise 4 (slide 12) : What is the hypercharge of the Higgs filed ?

Exercise 5 (slide 12) : Develop the full Lagrangian near the translated minimum, using only the covariant derivative and the Higgs potential. Diagonalize the neutral gauge bosons mass matrix.

Exercise 6 (slide 19) : Develop all the Yukawa couplings in such way as to introduce the CKM matrix. How do fermion masses relate to the Yukawa couplings?

Exercise 7 (slides 21 and 22) : Make sure that you know how the major breakthroughs that are mentioned in these transparencies were made.

Exercise 8 (slides 29 and 30) : Solve the two simplified differential equations (Renormalization Group Equations in the two specific regimes of Higgs boson mass).

Exercise 9 (slide 30) : Solve the differential RGE in the case where a few more terms are taken into account.

$$32\pi^2 \frac{d\lambda}{dt} = 24(\lambda^2 + \lambda y_t^2 - y_t^4)$$

Exercise 10 (slide 34) : Write the contributions to the mass term from each of the feynman diagrams illustrated in the slide.

For a far more complete description of the standard model Higgs sector and for instance the chiral symmetry, the Cheng and Li "Gauge Theory of Elementary Particle Physics" text book is highly recommended.