K. Aniol, BS347 konradaniol@kaniol.org, kaniol@calstatela.edu
textbook - "An introduction to the Standard Model of Particle Physics", 2nd edition, W.N.Cottingham and D.A.Greenwood
Final exam date TBD, Most likely it will be a take home exam.

PHYS 5440 Particle and Nuclear Theory
Introduction to the symmetries underlying the electroweak and strong interactions.

Principles of symmetry play an important role in the construction of models of particle physics. Group theoretic ideas expressed in a relativistic frame work are powerful tools describing the interactions of particles and fields. The role of gauge fields, first introduce in classical electricity and magnetism, is now a significant element in current particle theory.

We will, optimistically, go through all the chapters in the schedule of lectures. Our aim is to get a good understanding of the mathematical tools used for the Weinberg-Salam theory and quantum chromodynamics.

Grades will be based on two midterm exams and the final exam. These will be take home exams. Exams will cover the material we discussed in class and not material which we have not yet reached. Recommended homework from the text book is in the schedule. There may be independently assigned homework during the semester that can be included in the grade. Approximate grading scheme: midterm exams 20% each, final exam 40% to 60% depending on HW assigned up to 20%.

Kinematics tutorial Particle Data Group

Spring Semester, 2022, Phys5440

Lecture	Dates Tues/Thur	Sections in Cottingham & Greenwood	Recommended problems
1	01/25/22	ch.1, fermions(quarks, leptons) and Bosons 1.1->1.5 Emmy Noether Colloquium ch1.C.G.pdf	hw0.pdf
2	01/27/22	ch.1 1.6->1.10, discovery of color, research equipment origin of isospin	
3	02/01/22	ch.2, Lorentz Transformations, relativistic notation, ch2.C.G.pdf tensors_mathpages, Hagedorn.Jackson.pdf	2.3, 2.6
4	02/03/22	ch.3, Lagrangian formulation for quantum field theory ch3.C.G.pdf	3.5
5	02/08/22	ch.4, Electromagnetism in Lorentz invariant form, 4.1->4.3 Who is Lorentz? ch4.C.G.pdf	4.3 hw1.pdf
6	02/10/22	ch.4 properties of the photon, massive vector fields,4,4->4.9	4.5
7	02/15/22	ch.5 The Dirac equation and the Dirac Field ch5.C.G.pdf appendixB.pdf boostLT.pdf me1.p5440.pdf (handed out, Mar. 1, due Mar. 10)	5.5 hw2.pdf
8	02/17/22	ch.6 Free space solutions of the Dirac equation ch6.C.G.pdf	6.2
9	02/22/22	ch.7 Electrodynamics for Dirac particles and antiparticles	7.5

		ch7.C.G.pdf	
10	02/24/22	ch.8, Quantising Fields:QED, Appendix C, 8.1, 8.2, ch8.C.G.pdf	8.1 hw3.pdf
11	03/01/22	ch.8, 8.3->8.6,perturbation theory, renormalisation, magnetic moment of electron,	8.2
12	03/03/22	ch.9, The Weak Interaction: low energy phenomenology, example of an effective Lagrangian density ch9.C.G.pdf	9.3 hw4.pdf
13	03/08/22	ch.10, Symmetry breaking in model theories, Local symmetry breaking and the Higgs Boson ch10.C.G.pdf	10.2 hw5.pdf
14	03/10/22	ch.11, Massive gauge fields, 11.1, 11.2	11.1
15	03/15/22	ch. 11, 11.3, 11.4	11.5
16	03/17/22	ch. 12, Weinberg-Salam electroweak theory for leptons, 12.1	12.2
17	03/22/22	ch.12, 12.2, 12.3	12.3
18	03/24/22	ch.12, 12.4, 12.5, 12.6	12.4
	03/29/22	Spring Break	
	03/31/22	Spring Break	
19	04/05/22	ch.13, Experimental test of the Weinberg-Salam theory	13.1
20	04/07/22	ch.14, The electromagnetic and weak interactions of quarks, 14.1, 14.2 cosmic tau neutrinos	14.1
21	04/12/22	ch.14, 14.3, 14.4, 14.5	14.3
22	04/14/22	ch.15, Hadronic decays of the Z and W bosons	15.1
23	04/19/22	ch.16, The theory of strong interactions: quantum chromodynamics, 16.1, 16.2, 16.3	16.1
24	04/21/22	ch.16, 16.4, 16,5, 16.6 16.7	16.3
25	04/26/22	ch.17, Quantum Chromodynamics: calculations	
26	04/28/22	ch. 18, The Kobayashi-Maskawa matrix	18.1
27	05/03/22	ch. 19, Neutrino masses and mixing	
28	05/05/22	ch. 20, Neutrino masses and mixing:experimental results	
29	05/10/22	ch. 21, Majorana neutrinos	21.1
30	05/12/22	ch. 22, Anomalies	