Course Calendar
Unit IV: Particle Physics and Cosmology

Friday, April 22 **Topic:** "Elementary Particles and Conservation Laws"

(OLIN 254) **Objectives:** 4.0, 4.1, 4.2, 4.3, 4.4, 4.5

Read: Supplementary Reading Chapter 4;
Chap. 41: Introduction, Sec. 41-1 thru 41-4

Assigned Problems: **Supp. CH 4:** 1, 2, 6, 7, 8, 9, 10, 11, 12, 13, 14abc, 15; **CH 41:** 15

Monday, April 25 **Problem Session**

(CARN 210)

Tuesday, April 26

Hand-In Set #12 due by 4:30 pm (outside Olin 260)
Supp. CH 4: 4.3, 4.4, 4.14def, 4.16; **CH 41:** 18ab (assume τ^-)

Wednesday, April 27

Group Project #3 Preliminary Report
due by 5 pm (outside Olin 260)

Wednesday, April 28	**Topic:**	"Fundamental Forces and Interactions"
(OLIN 254)	**Objectives:**	4.0, 4.6, 4.7, 4.8, 4.9, 4.10
Read:	Supplementary Reading Chapter 5; Chap. 41: Sec. 41-5	
Assigned Problems:	**Supp. CH 5:** 5.1, 5.2, 5.3, 5.6, 5.7, 5.8, 5.9, 5.10	

Thursday, April 29	**Topic:**	"Forces and Interactions II"
(OLIN 451)	**Objectives:**	4.0, 4.11, 4.12, 4.13
Read:	Supplementary Reading Chapter 6	
Assigned Problems:	**Supp. CH 6:** 6.1, 6.3, 6.4, 6.5, 6.7, 6.8, 6.9, 6.11	

Friday, April 30

(OLIN 254)

Problem Session

Friday, April 30

Lab Critiques & Checkout Questions
due by 5 pm (outside Olin 260)

Monday, May 02	**Topic:**	"Cosmology"
(CARN 210)	**Objectives:**	4.0, 4.14, 4.15, 4.16
Read:	Supplementary Reading Chapter 7	
Assigned Problems:	**Supp. CH 7:** 7.2, 7.4, 7.6, 7.8, 7.9	

Tuesday, May 03

Hand-In Set #13 due by 4:30 pm (outside Olin 260)
Supp. CH 5: 5.4, 5.11, 5.12; **Supp. CH 6:** 6.2, 6.6, 6.10, 6.12;
Supp. CH 7: 7.5

Wednesday, May 04

Group Project #3 Follow-Up Report
due by 5 pm (outside Olin 260)

Monday, May 09
(BIOL 101) **Final Exam**
(comprehensive & lab)

Answers to Selected Problems from Supplementary Reading

Chapter 4

4.1: Baryons made of quarks (or anti-quarks) & participate in strong interaction; leptons do not participate in strong interaction. **4.2:** Mesons are bosons; baryons are fermions. **4.6:** (a) K^+; (b) ν_e; (c) K^+. **4.7:** Strangeness conserved in (a) and (d) only, so these two can proceed via strong interaction. **4.9:** No, would violate conservation of charge, lepton number (by flavor), and the Fermion rule. **4.10:** Would violate charge conservation and the Fermion rule. **4.11:** $S = -2$. 4.12: (a) uds; (b) dss; (c) $u\bar{d}$. **4.13:** Would require two strange quarks to get the required overall strangeness, which would contribute $-\frac{2}{3}$ to the overall charge. Need one more quark for a baryon, but no single quark has the required $+\frac{5}{3}$ charge. **4.14:** (a) n; (b) Σ^+ or Σ^{*+}; (c) K^0.

Chapter 5

5.2: (a) 1.022 MeV; (b) 6.5 x 10^{-22} s. **5.3:** (a) 96 GeV; (b) 7 x 10^{-27} s; (c) 2.1 x 10^{-18} m. **5.8:** anti-green.

Chapter 6

6.3: About two protons should decay. **6.4:** Only $\Sigma^- \to n + \pi^-$. **6.5:** (a) strong; (b) electromagnetic; (c) weak. **6.7:** (a) There are no lighter baryons with $S = -3$; (b) must be weak, since strangeness must not be conserved; (c) weak interaction is slower than strong or electromagnetic interactions. **6.8:** $\Xi^-(1530)$ decays fastest via strong interaction: $\Xi^-(1530) \to \Xi^-(1318) + \pi^0$; it's also more massive. The lighter $\Xi^-(1380)$ must decay via weak interaction. **6.9:** Photons or leptons. However, the charged pions must decay via the weak interaction, and the weak decay to leptons is much slower than the electromagnetic decay to photons.

Chapter 7

7.2: about 2 x 10^{-7} s. **7.4:** $E = 10^6$ eV = 1 MeV very close to $2m_e c^2 = 1.02$ MeV! **7.6:** 100 MeV, a pion. **7.8:** 10^{10} to 10^{12} s (or ~ 300 to 30,000 years). **7.9:** (a) 5730 quarks, 330 leptons, 5460 anti-quarks, 300 anti-leptons; (b) 1910 baryons, 1880 anti-baryons; (c) 30 baryons, 30 leptons, 2180 photons; (d) 73:1.