

Course Calendar

Unit III: Quantum Mechanics

Friday, March 25 (OLIN 254)	Topic:	“Quantum Mysteries”
	Objectives:	3.0, 3.1, 3.2

Read: Chap. 34: Sec. 34-6;
Feynman Chapter 37: Quantum Behavior;
Computer Exercise #3: Part II – Localization of Waves

Assigned Problems: **None**

Monday, February 28 (CARN 210)	Topic:	“Wave-Particle Duality & the Uncertainty Principle”
	Objectives:	3.0, 3.1, 3.2

Read: No New Reading.

Assigned Problems: **E48, E49, E50; CH 34:** 49

Tuesday, March 29

Group Project #2 due by 4:30 pm (outside Olin 260)

Wednesday, March 30
(OLIN 254)

Topic: “Wave-functions and Probability”
Objectives: 3.0, 3.3, 3.4, 3.5, (3.9)

Read: Chap. 34: Sec. 34-3, Sec. 34-5, and Sec 34-7 thru 34-9

Assigned Problems: **E51, E52, E53, E54, E55; CH 34:** 53, 55, 59, 61, 80

Notes: For CH 34, #59, take advantage of symmetry; For CH 34, #80, it should refer to Figure 34.8 d, not 34.18d. E52: (a) $1/600$, (b) $1/6$, (c) $P_1 = 3/1000$, $P_2 = 1/1000$, (d) $8/10$; E53: (b) 0.141 nm, (c) 0.212 nm; E54: (a) outside well, K is negative, (b) 0.1495 , (d) 0.1495 , (f) 0.701 ; E55: 27.3 Hz; CH 34, #80: 2.52 keV

Thursday, March 31
(OLIN 254)

Topic: “Guest Speaker: David Schoepf –
Particle vs. Wave? The On-Going Saga
of the Photon”

Friday, April 01
(OLIN 254)

Topic: “The Schroedinger Equation”
Objectives: 3.0, 3.6, 3.7, 3.8, 3.9

Read: Chap. 35: Sec. 35-1 thru 35-5

Assigned Problems: **E56, E57, E58; CH 35:** 1, 3, 15, 17, 20

Notes: For CH 35, #20, you only need list the quantum numbers associated with the lowest 5 energy states; answers are in $(n_1, n_2, n_3; E)$ form: $(1, 1, 1; 49)$, $(1, 1, 2; 61)$, $(1, 2, 1; 76)$, $(1, 1, 3; 81)$, $(1, 2, 2; 88)$

Monday, April 04
(CARN 210)

Problem Session

Tuesday, April 05

Hand-In Set #9 due by 4:30 pm (outside Olin 260)
E59, E60, E61, E62, E63, E64, E65, E66
Computer Exercise #4

Wednesday, April 06
(OLIN 254)

Topic: “Discrete Quantum States and Spin”
Objectives: 3.0, 3.10, 3.11, 3.12

Read: Supplementary Reading Chapter 1;
Supplementary Reading Chapter 2: Sec. 2.1 thru 2.3

Assigned Problems: **E67; Supp. CH 1:** 1.1, 1.2, 1.3, 1.6, 1.8, 1.10, 1.11, 1.12; **Supp. CH 2:** 2.2

Notes: Answers to Supplemental Reading problems on last page of Course Calendar.
E67: average = 3.5

Thursday, April 07
(OLIN 451)

Topic: “Identical Particles, Lasers, and Atoms”
Objectives: 3.0, 3.13, 3.14, 3.15, 3.16

Read: Supplementary Reading Chapter 2: Sec. 2.4 thru 2.5;
Chap. 31: p. 1001 – 1005;
Chap. 36: Sec. 36-1 thru 36-2

Assigned Problems: **E68, E69; Supp. CH 2:** 2.5; **CH 31:** 1, 23; **CH 35:** 27, 33;
CH 36: 3, 5, 25

Friday, April 08
(OLIN 254)

Topic: “Guest Speaker: David Collins –
Strange Physics for Ordinary
Problems”

Monday, April 11
(CARN 210)

Problem Session

Tuesday, April 12

Hand-In Set #10 due by 4:30 pm (outside Olin 260)
E70, E71, E72, E73; Supp. CH 1: 1.7, 1.9, 1.13; **Supp. CH 2:** 2.3;
CH 35: 28; **CH 36:** 24

Notes: For Supp. CH 1, #1.7: should say “30% of the light is reflected”.

Wednesday, April 13
(OLIN 254)

Topic: “Quantum Theory of Atoms”
Objectives: 3.0, 3.17, 3.18, (3.19)

Read: Chap. 36: Sec. 36-3 thru 36-4 and Sec. 36-6;
Supplementary Reading Chapter 2: Sec. 2.6 thru 2.7

Assigned Problems: **CH 36:** 7, 9, 31, 33, 41, 49, 55, 57; **Supp. CH 2:** 2.4, 2.6

Thursday, April 14
(OLIN 451)

Topic: “Quantum Theory of Magnetism”
Objectives: 3.0, 3.19, 3.20

Read: No New Reading

Assigned Problems: No New Assigned Problems

Friday, April 15
(OLIN 254)

Topic: “Quantum Applications”
Objectives: 3.0, 3.21, 3.22, 3.23

Read: Supplementary Reading Chapter 3;
Magnetic Resonance Handout

Assigned Problems: **E74, E75, E76, E77, E78;** **Supp. CH 3:** 3.1, 3.2, 3.3, 3.4, 3.5

Notes: E74: 5.34 cm; E75: 0.0189 T; E76: a) 70.5 cm, b) 34 MHz, c) 1.41×10^{-7} eV;
E77: a) low energy = -2.99×10^{-7} eV, b) 9.97×10^{-8} eV

Monday, April 18
(CARN 210)

Problem Session

Tuesday, April 19

Hand-In Set #11 due by 4:30 pm (outside Olin 260)
E79, E80, E81, E82, E83; CH. 36: 32, 36, 40, 48; **Supp. CH 3:** 3.6

Wednesday, April 20
(OLIN 254)

Topic: “Quantum Mechanics Review”
Objectives: 3.0 thru 3.23

Read: No New Reading

Assigned Problems: No New Assigned Problems

Thursday, April 21
(Olin 451)

Exam III: Quantum Mechanics

Answers to Selected Problems from Supplementary Reading

Chapter 1

1.3: (a) $\frac{1}{2}$, (b) 0, (c) $\frac{1}{2}$, (d) $\frac{1}{2}$;

1.6: (a) 0.5625, (b) 0.4375, (c) ± 0.6614 , $\pm 0.6614i$;

1.8: $a = +1$, $\pm 1i$, $b = 0$;

1.10: (b) 4900, 2500, 1600, 900, 100, (c) -4.610 eV;

1.11: (a) zero, (c) P ;

1.12: (a) $|x\rangle$, (b) zero.

Chapter 2

2.2: (a) zero, (b) zero, (c) $\frac{1}{2}$, (d) $\frac{1}{2}$;

2.4: electrons \rightarrow fermions, exclusion principle applies;

2.5: won't work, neutrinos have spin $\frac{1}{2}$, can't be bosons.

Chapter 3

3.1: ^4He has total spin zero, so is a boson and can form a Bose-Einstein condensate. ^3He is a fermion, so under normal circumstances wouldn't have superfluidity. However, the Nobel Prize in 1996 was awarded for the discovery/explanation of superfluidity in ^3He , which occurs because the fermions can pair up to act like bosons, like electrons do in forming Cooper pairs in superconductors!

3.2: current in plate counterclockwise when viewed from above, repels magnet;

3.3: current in plate clockwise when viewed from above, still repels magnet;

3.4: (b) $B = \frac{\mu_0 I}{2\pi R}$, (c) 125 A.