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Courses I Took at The Ohio State University, Columbus, Ohio, USA 25 October 2020

PHYSICS COURSES GPA 4.000 / 4.000

Physics 2300 Intermediate Mechanics I Autumn 2017 **Grade: A**
Instructor: Dr. Gregory Kilcup Credit Hours: 4
Textbook: D. Morin, *Introduction to Classical Mechanics* (Cambridge University Press, 2008).
Main topics covered: Dimensional analysis, various Newtonian mechanics problems, collision, various central force problems, Kepler's orbit, moment of inertia, angular impulse. Problem solving strategies.

Physics 2301 Intermediate Mechanics II Spring 2018 **Grade: A**
Instructor: Dr. Gregory Kilcup Credit Hours: 4
Textbook: D. Morin, *Introduction to Classical Mechanics* (Cambridge University Press, 2008).
Main topics covered: Inertia tensor, principal axes, Euler angles, top and gyroscope, various rigid-body rotation problems; accelerating frames, translation, centrifugal, Coriolis, and azimuthal forces, tides; damped, driven, coupled oscillation; Lorentz transformation, Doppler effect, rapidity, velocity, acceleration, energy-momentum, and force 4-vectors, $E^2 = p^2c^2 + m^2c^4$, uniformly accelerating frame. Problem solving strategies.

Physics 3700 Experimental Physics Instrumentation and Data Analysis Laboratory Spring 2018 **Grade: A**
Instructor: Prof. Kock Kiam Gan Credit Hours: 3
Materials: J. Taylor, *An Introduction to Error Analysis* (University Science Books, 1997).
Lectures notes written by instructor.
Main topics covered: Basic statistics and error analysis through various physical experiments. Expectation, variance, binomial, Gaussian, Poisson distribution, Poisson approximation, central limit theorem, propagation of errors, maximum likelihood method, χ^2 distribution and least squares fitting, hypothesis testing, confidence intervals.

Physics 5300 Theoretical Mechanics Spring 2020 **Grade: A**
Instructor: Prof. Richard Furnstahl Credit Hours: 4
Textbook: J. Taylor, *Classical Mechanics* (University Science Books, 2005).
Main topics covered: Driven damped oscillations and resonance; nonlinear mechanics and chaos (period doubling, Liapunov exponent, Poincaré sections, bifurcation diagram, logistic map); calculus of variations; Lagrangian and Hamiltonian mechanics (generalized coordinates; constrained system, holonomic system, action, Lagrange's and Hamilton's equations); conservation and symmetry, Noether's theorem; central-force problem; coupled oscillators and normal modes; classical collision theory; continuum mechanics (wave equation, stress and strain tensors and decomposition, generalized Hooke's Law, Navier equation).

Physics 5400H Honors Advanced Electricity and Magnetism I Autumn 2018 **Grade: A**
Instructor: Prof. Ciriyam Jayaprakash Credit Hours: 4
Textbook: D. Griffiths, *Introduction to Electrodynamics*, 4th ed. (Cambridge University Press, 2017).
Main topics covered: Electrostatics (Poisson's and Laplace's equations, boundary conditions, uniqueness theorems, electrostatic energy, multipole expansion); electric fields in matter (polarization, bound charges, electric displacement, boundary conditions, dielectrics boundary value, energy, and force); magnetostatics (Biot-Savart Law, Ampère's Law, boundary conditions, multipole expansion of the vector potential); magnetic fields in matter (magnetization, bound current, H field, boundary conditions, ferromagnetism); electrodynamics (electromotive force, Faraday's law, mutual and self inductance, energy in magnetic fields).

Physics 5401H Honors Intermediate Electricity and Magnetism II Spring 2019 **Grade: A**
Instructor: Prof. Ciriyam Jayaprakash Credit Hours: 4
Textbook: D. Griffiths, *Introduction to Electrodynamics*, 4th ed. (Cambridge University Press, 2017).
Main topics covered: Energy, momentum, and angular momentum (Poynting's theorem, Maxwell's stress tensor); electromagnetic wave in vacuum and in matter (wave equation, reflection and transmission coefficient, Fresnel's equations, Brewster's angle, absorption and dispersion coefficients, skin depth, TE/TM/TEM mode, transmission line); classical field theory (gauge transformation, d'Alembertian operator, Lorentz force law in potential form, retarded time and retarded potential, Liénard-Wiechert potentials and fields of a moving charge); radiation (of electric and magnetic dipole, Larmor formula, Abraham-Lorentz formula of reaction force).

Physics 5500H Honors Quantum Mechanics I Autumn 2018 **Grade: A**
Instructor: Prof. Robert Perry Credit Hours: 4
Textbook: D. Griffiths and D. Schroeter, *Introduction to Quantum Mechanics*, 3rd ed. (Cambridge University Press, 2018).
Main topics covered: Spin (Stern-Gerlach experiment, Pauli matrices), One dimensional problem (Infinite square well, finite square well, harmonic oscillator, free particle, delta-function potential), formalism (Hilbert space, Hermitian, generalized statistical interpretation, generalized uncertainty principle), three dimensional problem (spherical harmonics, angular momentum theory, hydrogen atom, Lorentz force, Aharonov-Bohm effect), Identical particles (spin statistics, Helium, free electron gas).

Physics 5501H Honors Quantum Mechanics II Spring 2019 **Grade: A**
Instructor: Prof. Robert Perry Credit Hours: 4
Textbook: D. Griffiths and D. Schroeter, *Introduction to Quantum Mechanics*, 3rd ed. (Cambridge University Press, 2018).
Main topics covered: time-independent perturbation theory (first order, second order, degeneracy), fine structure of hydrogen, Zeeman effect (weak-, strong-, intermediate-field), hyperfine structure, variational principle (hydrogen ion, hydrogen molecule), scattering theory (partial wave analysis, Born approximation, integral form of Schrödinger equation, Born series), time-dependent perturbation theory (emission and absorption of radiation, incoherent perturbation, Einstein's A and B coefficients, selection rules, Fermi's golden rule, adiabatic theorem).

Physics 5600 Statistical Mechanics Autumn 2019 **Grade: A**
Instructor: Prof. Michael Poirier Credit Hours: 4
Textbook: D. Schroeder, *An Introduction to Thermal Physics* (Addison Wesley Longman, 2000).
Main topics covered: Ideal gas; equipartition theorem; Einstein solid; Stirling's approximation; thermal identities involving energy, enthalpy, Helmholtz free energy, Gibbs free energy, and grand free energy; heat engines and refrigerators; chemical thermodynamics; Boltzmann statistics; Mexwell speed distribution; Gibbs factor; Partition and grand partition functions; Fermi gases (density of states, Sommerfeld expansion); Planck distribution (photons); blackbody radiation; Debye solids (phonons); Bose-Einstein condensation; Ising model

Physics 5700 Advanced Physics Laboratory Autumn 2019 **Grade: A**
Instructor: Prof. Daniel Gauthier Credit Hours: 3
Materials: Experiments guidances written by instructors and laboratory demonstrators and administrators.
Main topics covered: (1) Fourier optics: Fresnel and Fraunhofer diffraction, calculation of intensity distribution, diffraction of single-slit, double-slit, sine grating, step function, and mesh; (2) Muon decay and its lifetime: decay model, lifetime of μ^+ and μ^-, usage of photomultiplier, optical discriminator, delay box, and others, technique of time calibration; (3) electrical oscillation in resistor-inductor-capacitor circuit, period doubling, chaos, and bifurcation in resistor-inductor-diode circuit, analysed sensitive data.

Physics 6810 Topics in Computational Physics Spring 2019 **Grade: A**
Instructor: Prof. Ralf Bundschuh Credit Hours: 4
Materials: Lectures notes and slides written by instructor and Prof. Richard Furnstahl
M. Hjorth-Jensen, *Computational Physics*, lecture notes (2015).
R. Laudau, M. Páez, and C. Bordeianu, *Computational Physics, Problem Solving with Computers*, 2nd ed. (WILEY-VCH Verlag GmbH & Co KGaA, 2007).
Main topics covered: representation of integer and decimal number, subtractive cancellation, numerical differentiation, numerical integration (Lagrange interpolation, Newton-Cote's formula: Simpson, Milne rules, Romberg integration, Gaussian quadrature), multiplicative errors and random walks, numerical solution of Schrödinger equation (diagonalization, eigenvalue problem), OpenMP and parallel computing, ordinary differential equation (Euler, Runge-Kutta methods), application to damped, driven oscillator, Segmentation faults and optimization in C++, makefile, Python scripts to run C++, multidimensional minimization, Ising model

MATHEMATICS COURSES GPA 3.972 / 4.000

Mathematics 2255 Differential Equations and Their Applications Summer 2018 **Grade: A**
Instructor: Dr. Nathan Broaddus Credit Hours: 3
Textbook: W. E. Boyce, R. C. Diprima, and D. B. Meade, *Elementary Differential Equations and Boundary Value Problems*, 11th ed. (John Wiley & Sons, Inc., 2017).
Main topics covered:

Mathematics 2568 Linear Algebra Spring 2018 **Grade: A**
Instructor: Prof. Martin Golubitsky Credit Hours: 3
Textbook: M. Golubitsky and M. Dellnitz, *Linear Algebra and Differential Equations Using MATLAB* (Brooks/Cole Pub. Co., 1999).
Main topics covered:

Mathematics 3345 Foundations of Higher Mathematics Spring 2018 **Grade: A**
Instructor: Prof. Roy Joshua Credit Hours: 3
Textbook: Lecture Notes by Dr. Neil Falkner
Main topics covered:

Mathematics 4181H Honors Analysis I Autumn 2018 **Grade: A**
Instructor: Prof. Zbigniew Fiedorowicz Credit Hours: 5
Textbook: M. Spivak, *Calculus*, 4th ed. (Publish or Perish, 2008).
Main topics covered:

Mathematics 4182H Honors Analysis II Spring 2019 **Grade: A**
Instructor: Prof. Zbigniew Fiedorowicz Credit Hours: 5
Textbook: G. Folland, *Advanced Calculus* (Pearson, 2001).
Main topics covered:

Mathematics 4552 Complex Analysis Summer 2018 **Grade: A**

Instructor: Prof. Andrzej Derdzinski Credit Hours: 3

Textbook: J. W. Brown and R. V. Churchill, *Complex Variables and Applications*, 9th ed. (McGraw-Hill Education, 2014).

Main topics covered: Roots; limits; continuity and derivatives; Cauchy-Riemann Equations; analytic functions; exponential, logarithm, trigonometric, and hyperbolic functions; contour integral; Cauchy integral formula; Liouville's Theorem; Laurent series; Cauchy's residue theorem; removable, essential singular point, and pole; Riemann's theorem and Casorati-Weierstrass theorem; indefinite integral; Jordan's lemma; argument and winding number.

Mathematics 4557 Partial Differential Equations Autumn 2018 **Grade: A**

Instructor: Dr. Maritza Sirvent Leon Credit Hours: 3

Textbook: W. Strauss, *Partial Differential Equations*, 2nd ed. (John Wiley & Sons, Inc., 2008).

Main topics covered: Wave and diffusion equations on whole line, half line, and with a source; characteristic lines and domain of dependence; Dirichlet, Neumann, and Robin boundary conditions; uniform, L^2, and pointwise convergence of Fourier series; Parseval's equality; expansion and shifting data methods for inhomogeneous boundary conditions; Laplace's equation (invariance under rigid motions, maximum, uniqueness), Poisson's formula; Green's first and second identities (mean value, maximum, uniqueness), Green's function for half space and ball.

Mathematics 5540H Honors Differential Geometry Spring 2020 **Grade: A**

Instructor: Dr. Neil Falkner Credit Hours: 5

Textbook: R. Millman and G. Parker, *Elements of Differential Geometry* (Prentice-Hall, Inc., 1977).
M. do Carmo, *Differential Geometry of Curves and Surfaces*, 2nd ed. (Dover Publications, 2016).
and lecture notes from the instructor.

Main topics covered: Local curves theory (Frenet–Serret formulae, osculating, normal, and vetifying plane, helix and Lancret's theorem, canonical representation, fundamental theorem), general topology (subspace topology; open and close; connect, compact, Hausdorff space), algebraic topology (homotopy, homeomorphism, loop, winding number, fundamental group), Jordan curve theorem, local surface theory (first and second fundamental form, embedded submanifold, Weingarten map, principal, normal, mean, Gaussian, Riemannian curvatures, geodesic, Gauss's *Theorema Egregium*, fundamental theorem), global surface theory (Gauss-Bonnet theorem).

Mathematics 5590H Honors Abstract Algebra I Autumn 2019 **Grade: A–**

Instructor: Prof. Alexander Leibman Credit Hours: 5

Textbook: D. Dummit and R. Foote, *Abstract Algebra* (John Wiley & Sons, Inc., 2004).

Main topics covered: Group theory (symmetric and alternating group, group of symmetry, Lagrange's theorem, Sylow theorem, semidirect product, classification of finite group, simplicity and solvability, lower and upper central series, commutator), ring theory (prime ideal; rings of matrices, fractions, and polynomials; Chinese remainder theorem; Euclidean, principal ideal, and unique factorization domain; Noetherian ring; Eisenstein's irreducibility criterion).

Mathematics 5591H Honors Abstract Algebra II Spring 2020 **Grade: A**

Instructor: Prof. Alexander Leibman Credit Hours: 5

Textbook: D. Dummit and R. Foote, *Abstract Algebra* (John Wiley & Sons, Inc., 2004).

Main topics covered: Module theory (universal property; $\text{rank}M = \dim(F \otimes M)$; tensor product of modules, algebras, and homomorphisms; flat module; exact sequence; graded algebra; exterior algebra; contravariant and covariant functors; double duality homomorphism; rational, Smith, Jordan canonical form; Cayley–Hamilton theorem), field and Galois theory (finite field, separable extension, splitting field, Galois extension, cyclotomic

polynomials, fundamental theorem of Galois theory, insolvability of the quintic, straightedge and compass constructions, transcendental extensions).

Mathematics 5756 Mathematical Methods in Relativity Theory I Autumn 2020 **in progress**
Instructor: Prof. Ulrich Gerlach Credit Hours: 3
Textbook: C. W. Misner, K. S. Thorne, and J. A. Wheeler, *Gravitation* (Princeton University Press, 2017).
Main topics covered:

Mathematics 5757 Mathematical Methods in Relativity Theory II Spring 2021 **will take next spring**
Instructor: Prof. Ulrich Gerlach Credit Hours: 3
Textbook: C. W. Misner, K. S. Thorne, and J. A. Wheeler, *Gravitation* (Princeton University Press, 2017).
Main topics covered:

STATISTICS COURSES

Statistics 4201 Introduction to Mathematical Statistics I Autumn 2020 **Grade:**
Instructor: Dr. David Sivakoff Credit Hours: 4
Textbook: I. Miller and M. Miller, *John E. Freund's Mathematical Statistics with Applications*, 8th ed. (Pearson Education, 2014).
Main topics covered: Mean, expectation, variance, covariance, probability mass and density function, marginal distribution; xx inequality, xx inequality, law of rare events, binomial, ... distribution , law of large number,

Statistics 4202 Introduction to Mathematical Statistics II Spring 2021 **Grade:**
Instructor: Dr. Credit Hours: 4
Textbook: I. Miller and M. Miller, *John E. Freund's Mathematical Statistics with Applications*, 8th ed. (Pearson Education, 2014).
Main topics covered: