Math 142 Tentative Topics, August - September 2016

Hours	Technique/Topic	Example Models & Applications
1	Formulating Models	heat loads; turtle migration; ice ages
1	Linear Models	maximizing profit; springs; electrochemistry
1	Recurrence Equations	endowments; mortgages; host-parasite dynamics
1	Discrete to Continuum Limits	continuous interest streams; electric field due to many point charges; hash tables
1	Exponential Models	population growth; radioactive decay; memoryless systems; superconductors
1	Dimensional Analysis and Fermi Estimates	estimating ocean mass, the time to fall through the earth, profit margins, air resistance
1	Nondimensionalization	mass-spring systems; logistic growth
1	Taylor Series	relativistic consistency with Newtonian physics; simple pendulum; "rule of 70" for investments; price elasticity of demand
2	Scalar ODE Models	spreading rumors; neuron firing; building response to earthquake; LRC circuits; Newton's Law of Cooling
2	ODE Systems	predator-prey relations; human immune response; chemical kinetics; nonlinear pendulum
1	Numerical Methods for ODEs	population growth with gestation period; nonlinear pendulum with quadratic damping
1	Formal Asymptotic Series	logistic growth with perturbed capacity; nonlinear pendulum period; hemodialysis
2	Vector Calculus & Conservation	Euler and Navier-Stokes equations for fluids
2	Method of Characteristics	advective transport; traffic flow; gravity-driven flow of viscous fluids
1	Riemann Invariants for Linear(ized) Hyperbolic Systems	sound and linear acoustics; ocean waves and tsunamis
2	Expectations, Variances, Probabilities, and Markov Chains	genetics; investment portfolio management; Google PageRank algorithm
1	Heat/Diffusion Equation	smells; wind chill; heating/cooling metal bar ends
1	Similarity Solutions	flow of viscous fluids; diffusion in porous media
1	Wave Equation	wave propagation; motion of guitar string
1	Poisson and Laplace Equations	steady temperature distributions; electrostatics
1	Finite Differences for Partial Differential Equations	spatio-temporal population dynamics; incompressible potential flow
1	Variational Calculus	least action; shapes of bubbles due to surface tension and shapes of cables
1	Free-Boundary Problems	bubble compression; melting ice
1	Singular Perturbations	estimating roots of equations; shape of hanging cable undersea; heat flow past a plate
2	**Midterm**	**August 17**
2	**Review**	**September 6**
4	**Final Exam**	**September 8 & 9**