

## MATH 1360: Fall 2011

### Exam II Review Topics

**Reading:** Chapters: 4 and 5 excluding 5.5, 5.7

#### **Theory:**

##### *PDE models*

- Definition of partial derivatives
- Derivation of reaction-diffusion equations, flux
- Solution of first-order PDEs with constant coefficient
- Solution of PDEs by separation of variables
- Definition and properties of the fundamental solutions of diffusion equation
- Definition and properties of Dirichlet and Neumann boundary conditions
- Definition and properties of stationary solutions
- Definition and properties of traveling waves

##### *Stochastic models*

- Basic concepts and definitions in probability theory, conditional probability, mean, variance, etc.
- Definition and properties of Markov Chains
- Existence and uniqueness of equilibrium distributions for Markov Chains (Theorem 5.1)
- Definition and properties of a diffusion process
- Definition and properties of a birth and death process

#### **Methods**

##### *PDE models*

- Formulation of PDE for age-structured population model
- Formulation of a reaction-diffusion PDE problem
- Solution of diffusion problem in infinite domain using the fundamental solution
- Finding stationary solutions of PDE problems using phase-plane analysis for various boundary conditions
- Finding the smallest domain size for existence of a non-constant steady state
- Finding traveling waves for PDE problems using phase-plane analysis

##### *Stochastic models*

- Formulation and solution of Markov Chain model.
- Finding equilibrium distributions for Markov Chains.
- Derivation of PDE for a diffusion process in one dimension
- Derivation of Master equation for birth and death process
- Derivation of equation for the mean and variance of birth and death process and its solution.