Course Syllabus

MATHEMATICAL MODELS OF INFECTIOUS DISEASES

(BIO/MATH 321/521)

Description:	*An application of mathematical methods, such as differential equations and elementary matrix algebra, to the study of infectious diseases and the analysis of outbreaks and control methods (such as vaccinations).*
Credit Hours:	3
Frequency:	Usually offered online during the summer and in the spring semester of odd-numbered years.
Audience:	Elective for biology, math, and engineering majors, and for the analytics and modeling master's program.
Prerequisites:	MATH 131 and one of the following: STAT 140, STAT 240, IDS 205, PSY 201, or CE 202.
Format:	Online, or when offline, 2 lectures (75 min) per week.
Textbook:	None. Course materials will be provided by the instructor.
Software:	Use of *MATLAB* is required at the discretion of the instructor (available on campus computers; purchase of student version is recommended).
Internet:	Course material and grades are often maintained in Blackboard, at the discretion of the instructor.
Access & Accommodations:	The Access & Accommodations Resource Center (AARC) is the campus office that works with students to provide access and accommodations in cases of diagnosed mental or emotional health issues, attentional or learning disabilities, vision or hearing limitations, chronic diseases, or allergies. You can contact the office at aarc@valpo.edu or 219.464.5206. Students who need, or think they may need, accommodations due to a diagnosis, or who think they have a diagnosis, are invited to contact AARC to arrange a confidential discussion with the AARC office. Further, students who are registered with AARC are required to contact their professor(s) if they wish to exercise the accommodations outlined in their letter from the AARC.
Notice of Cancellation:	In the event class is cancelled, you will be notified through your Valparaiso University e-mail account.

Course Goals

A. Students understand fundamental concepts and limitations of mathematical modeling.
B. Students can apply standard models first to epidemiology and then extend them to other disciplines such as ecology, medicine, physics, etc.
C. Students can design new models of complex phenomena and implement them using computer programs.

D. Students will interpret and communicate results from simulations and their implications to the phenomena modeled.
E. Students will cooperate *when appropriate* (see section syllabus for details) to help each other understand the concepts of mathematical modeling and to learn how to function in a work group

Topical Objectives. Preface: *Students will be able to …*

1. understand the iterative modeling process
2. recognize and analyze differential equations models describing population dynamics
3. apply the Susceptible-Infective-Recovered model to outbreaks
4. design compartment models based on biological properties of a disease
5. incorporate method of controlling infections into their disease models
6. create a stochastic analogue of a differential equation model
7. build individual-based models
8. estimate model parameters using minimization techniques on an ordinary least squares cost function
9. use methods such as the Bayes Information Criterion to objectively perform model selection

General Objectives (with goals addressed). Preface: *Students will be able to …*

10. identify when certain theorems apply, and if not, identify what hypothesis is violated (A)
11. carry over and apply knowledge from Calculus and Differential Equations about derivatives and rates of change (A,B)
12. use computer software packages to generate solutions to and to simulate multiple types of mathematical models (B,C,E)
13. check results (produced both manually and with technology) and recognize those which are obviously false (A,B,C,D,E)
14. write clear and detailed solutions to assigned problems in both mathematical jargon and the jargon of the field of application (D,E)