MAT 285 DIFFERENTIAL EQUATIONS - BUNKER HILL COMMUNITY COLLEGE

Course: Mat 285 Differential Equations (4 credits)
Meeting: D214 Tuesday and Thursday 3:55-5:35
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Office hours: Tuesday and Thursday 5:40-6:40

Co-requisite: Mat 283 Calculus III
Text Required: A First Course in Differential Equations with Modeling Applications 8th Ed. Dennis G. Zill
Text Recommended: Student Solution Manual to *A First Course in Differential Equations 8th* Ed. By Zill

Course Description: Differential Equations will serve as the 4th semester mathematics course. Topics covered will include first and higher order differential equations and applications, series solutions of differential equations, Laplace transforms, systems of linear first order differential equations and numerical solutions of ordinary differential equations. Emphasis will be placed on analytical techniques and engineering applications aided by the use of computer software. Material on linear systems will be used.

Homework: Homework will be assigned after each lecture and will be collected once per week in the beginning of class. Late homework will be accepted at most one class late; do not abuse this policy. You are encouraged to work on homework assignments together but <u>you must write up your own homework solutions</u>. Your homework will be marked either √+,√,√- or 0. A √+ inverts a √- so that they equate to two √s. Your homework score is defined by the variable P, where P(x)=x-10 and x is the total number of √s you receive for the semester.

Evaluation: There will be two in class exams and a final exam. Your final average is defined by G, where

$$G = P + \frac{\sum(ExamI, ExamII, 2Final\ Exam) - MIN\{ExamI, ExamII, Final\ Exam\}}{3}$$

Attendance: Attendance is required and will be taken at the beginning of each class. If you must miss a class it is your responsibility to contact me to get your assignments.

In Progress Grade: An IP grade will only be awarded to those students that have at most two absences and have completed at least 70% of the semester's material.

Teaching procedure: Each class will begin with a brief review of material from the previous lecture. Students are encouraged to ask homework questions at this time. Our class will be an interactive lecture where you the student will often be prompted to complete a calculation either in class or for homework. Many of our course objectives will be computer interactive where a demonstration is done in class and you are asked to follow up with a homework question using a campus computer or PC. Participation in the form of questions and related dialogue is always encouraged.

Tentative Objective Dates

Date:	01/24	01/26	01/31	02/02	02/07	02/09	02/14	02/16	02/21	02/23
Objectives:	01-07	08-10	11-16	17-21	22-23	24-25	26-28	29	30	31-33
Date:	02/28	03/02	03/07	03/09	03/21	03/23	03/28	03/30	04/04	04/06
Objectives:	34-35	Exam	36-37	38	39-40	41-42	43-44	45-46	47-48	49-50
Date:	04/11	04/13	04/18	04/20	04/25	04/27	05/02	05/04	05/09	05/11
Objectives:	Exam	51	52	53	54-55	56-59	60-62	63-67	68	69-70

Exam I will cover objectives 1-31 and Exam II will cover objectives 32-48.
No classes will be held on 03/14 or 03/16 for spring break.

OBJECTIVES

Unit 1

01) Identify differential equations as ordinary/partial, linear/nonlinear and by order.
02) Define the solution of an ordinary differential equation (ODE).
03) Verify the solution of an ODE.
04) Identify explicit and implicit solutions to an ODE.
05) Define an n-parameter family of solutions to an ODE.
06) Define particular and singular solutions to an ODE.
07) Define an integral curve.
08) Define initial value problems (IVP).
09) Apply Existence of a unique Solution-Theorem for first order ODE.
10) Find differential equations that model the following problems; radioactive decay, Newton's law of cooling, tank mixing and draining, series circuits.

Unit 2

11) Use computer software to obtain a direction field.
12) Use direction fields to sketch a solution to an IVP.
13) Identify autonomous and non-autonomous ODEs.
14) Find critical, equilibrium and stationary points to an autonomous ODE.
15) Identify asymptotically stable, unstable and semi-stable critical points.
16) Find phase portraits to an autonomous ODE.
17) Solve a first order separable ODE.
18) Solve a first order linear ODE.
19) Define homogeneous and non-homogeneous linear ODEs.
20) Utilize the error function as a solution to a first order linear ODE.
21) Use computer software to evaluate the error function.
22) Solve exact ODEs.
23) Use integrating factors to produce exact ODEs
24) Solve homogeneous ODE by substitution.
25) Solve a Bernoulli Differential equation.
26) Use Euler's method to approximate the solution of an IVP.
27) Use computer software to facilitate computation of Euler's method.
28) Calculate absolute and relative error.

Unit 3

29) Solve linear models for the following problems; bacterial growth, half-life of a chemical substance, Newton's law of cooling, mixture and series circuit problems.
30) Solve variations of the logistic equation.
31) Find a system of differential equations that model predator-prey, series circuit and mixing applications.

Unit 4
32) Apply the Existence of a Unique Solution Theorem for an nth order linear IVP.
33) Contrast Initial Value Problems (IVP) with Boundary Value Problems (BVP).
34) Define a system of linearly independent functions on an interval.
35) Understand the form of the general solution to a linear ODE.
36) Use reduction of order techniques to solve second order linear homogeneous ODEs.
37) Solve linear homogeneous ODEs with constant coefficients.
38) Apply the method of undetermined coefficients to find a particular solution to a non-homogeneous ODE.
39) Use undetermined coefficients-annihilator approach to find a particular solution to a non-homogeneous ODE.
40) Use variation of parameter technique to solve second order linear ODEs.
41) Solve Cauchy-Euler equations by variation of parameter and undetermined coefficient techniques.
42) Use computer software to solve linear ODEs.
43) Solve systems of linear ODEs by elimination.
44) Use computer software to solve a system of linear ODEs.
45) Solve non-linear ODEs with either independent or independent variable missing.
46) Find the Taylor series solution to a nonlinear ODE.

Unit 5
47) Solve higher order linear applications in spring/mass systems and series circuit analogue.
48) Solve applied non-linear models.

Unit 6
49) Apply the Existence of a Power Series Solution Theorem for second order linear ODEs.
50) Solve second order linear ODEs by Power Series.
51) Apply Frobenius' theorem to second order linear ODEs.
52) Solve applications of Bessel's and Legendre's equations.

Unit 7
53) Apply the definition of Laplace transform.
54) Apply inverse Laplace transforms.
55) Solve IVP and BVP using Laplace transforms.
56) Use derivatives of transforms to solve ODEs.
57) Use convolution theorem to solve ODEs.
58) Solve Volterra integral equations using Laplace transforms.
59) Use computer software to compute Laplace and inverse Laplace transforms.
60) Find the Laplace transform of periodic functions.
61) Find the Laplace transform of the Dirac Delta function.
62) Use Laplace transforms to solve a system of ODEs.

Unit 8
63) Use computer software to review basic operations of linear systems.
64) Apply Existence of a Unique Solution theorem for a first order linear system (FOLS).
65) Use the Wronskian to test independence of solution vectors to a FOLS.
66) Understand the form of the general solution to a FOLS.
67) Use computer software to calculate eigenvalues.
68) Use eigenvalues to solve a FOLS.
69) Use method of undetermined coefficients to solve a FOLS.
70) Use method of variation of parameters to solve a FOLS.