

Department of Mathematics and Statistics  
MS 1042  
Texas Tech University  
Lubbock TX 79409-1042

Distance Education Courses offered through University College  
at Texas Tech University

**Bachelor of General Studies with an Area of Concentration in Mathematics**

The Bachelor of General Studies (B.G.S.) offered by Texas Tech University through the University College is a unique program for students who wish to study multiple fields in equivalent depth. **Instead of a major and a minor, the student selects three concentration areas in consultation with the B.G.S. advisor.** The three concentration areas jointly formulate a coherent specialization that is unavailable elsewhere in the university as an organized program of study. Through these self-selected areas, which form an integrated specialization, the B.G.S. degree can prepare a student to pursue graduate or professional study, an intellectual interest, or a career goal.

**Requirements for the Bachelor of General Studies.** Students must have a GPA of 2.0 or better to be admitted to the B.G.S. degree program. Continued enrollment requires a minimum 2.0 G.P.A. The student's official catalog will be the catalog current when the student officially enters the program. All coursework in the general degree requirements, the three concentration areas and electives must total a minimum of 120 semester hours. Each concentration area must include a minimum 9 hours of coursework at the junior-senior level. In two areas of concentration, a majority of the semester hours must be from disciplines related to departments in the College of Arts and Sciences.

## **Requirements for the Bachelor of General Studies with a concentration area in Mathematics**

The student is required to complete Math 1351, Math 1352, Math 2350 (or their transfer equivalents, according to Texas Tech University regulations). Further, nine credit hours (3 courses) in Mathematics must be completed at a level of Math 3000 or higher. A detailed description in sample syllabi for [Math 1351](#), [Math 1352](#), and [Math 2350](#)<sup>1</sup> is included below as well as a description of the 9 hour course electives at the level of Math 3000 or above.

The Director of Undergraduate Studies and the Mathematics Advisor are expected to work with the student in order to create a customized degree plan and identify which three courses at the junior-senior level best fit the student's background and other areas of concentration.

For the 9 hours of credit at the junior-senior level, students will be paired with instructors who will guide their home studies via e-mail, WeBWorK<sup>2</sup> and other Web-based Learning Resources. For Math 3350 and Math 3351, WeBWorK will be the primary resource for problem solving, homework, and testing, including the final examination.

### **Web-based Component:**

Each designated course comes with its own custom web-based learning tools. One of the most important tools used in this program by the Mathematics and Statistics Department at Texas Tech University is WeBWorK. For general information about this program, please refer to:

<http://webwork.maa.org/wiki/Introduction>

The departmental servers enable access to a wide selection of problems and tests available in the specific course-designated libraries, as well as national libraries. Such databases currently exists for numerous courses, including Math 1351, Math 1352, Math 2350, Math 3350, Math 3351.

### **Other possible areas of concentrations include:**

#### **For students with an area of concentration in Engineering:**

Math 3350, Math 3351, Math 3342. In specific cases, Math 2360 (Linear Algebra) together with another junior-senior level course in Mathematics or Statistics may replace the requirement for Math 3351.

#### **For students with an area of concentration in Life Sciences:**

Math 3350, Math 3351, Math 4000.

#### **For students with an area of concentration in Business Statistics, Actuarial Science or related fields:**

3342 or 4342 , 4343 and 4000.

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<sup>1</sup>Sample syllabi are also included for [Math 3350](#), [Math 3351](#) and [Math 1321](#)

<sup>2</sup>WeBWorK is a system designed for delivering individualized homework problems over the web.

**For students with an area of concentration in Education/Teacher Education:**

Math 3310 or Math 4000, Math 3372, Math 4331.

**Course Syllabus:** University policy requires that during the first week of class each instructor provide a syllabus, explaining how final course grades are to be determined and listing student outcomes and assessment procedures. The same regulation applies to the distance education courses. Sample syllabi with expected learning assessment and student learning outcomes are provided below for several courses.

## Course Number: Mathematics 1351 – Distance Education

### Descriptive Title: Calculus I

**Prerequisites:** C in MATH 1350 or 1550 or 7 on MPE or C in 1321 with 5 on MPE or B in 1321 or 660 on SATM or 29 on ACTM (or equivalent transfer credit, according to existing university regulations)

**About the Course:** This course begins with an introduction to the concept of limit and its relation to continuity of a function. Then the limit of a difference quotient and slope of the tangent line to a curve are used to acquire geometric intuition about the concept of differentiation. Tools for computing derivatives are introduced allowing for direct computation of derivatives of complicated functions including products, quotients and composite functions. Numerous applications of derivatives are covered allowing students to see the wide range of practical problems that can be solved using differential calculus. Examples of standard applications covered include related rates, rectilinear motion, graphing of functions, and maximum and minimum optimization problems. The concept of limit is then used to develop the definite integral motivated by the problem of finding the area under a curve. The Fundamental Theorem of Calculus, relating differential and integral calculus, is introduced and its utility in computing indefinite and definite integrals is examined. The theoretical material covered in the class only accounts for a large part of this course. Of equal importance is development of skills in problem solving. Students are encouraged to work as many problems as possible to fully appreciate the utility of calculus and to enhance the basic mathematical skills. While the use of technology, including graphing calculators, is encouraged for some homework problems, whenever possible, students are encouraged to work as many problems as possible by hand in order to improve problem solving skills.

**Text:** *CALCULUS*, 5<sup>th</sup> Custom Edition for Texas Tech University, by Strauss, Bradley, and Smith; published by Pearson Education, Inc.

### *Computer Software and Web-based Instruction*

For some students “just reading the book” will not be enough to prepare them to work homework problems and do well on exams. In such cases students are encouraged to take advantage of a number of helpful sources. We mention several such sources here.

- There are some web sites that contain useful information to supplement the discussion in the book. Students are strongly encouraged to check out the information on these web sites for each block of material covered in the book.

The first is The Calculus Page at Calculus.org

<http://www.calculus.org/>

The second is the MIT Open Courseware page

<http://ocw.mit.edu/courses/mathematics/>

The third is the SOS Mathematics Page for Calculus

<http://www.sosmath.com/calculus/calculus.html>

- There is an **Interactive CD-ROM** which comes free with every new copy of the text-book. This software, licensed by Pearson Education, is protected by copyright and is intended for the solely student use as a learning tool for the current text-book.
- Students may find the **Course Companion Website** provided by the text-book editors to be of some use:

<http://www.prenhall.com/strauss>

The essence of this website lies in Live Examples powered by Live Math. Each text section includes teaching hints for several HW problems, most of them using geometric animations.

## Learning Assessment

- Students will be regularly assigned online homework and tests using WeBWorK. The students are encouraged to carefully read the information on using WeBWork at the following links.

[Introduction to WeBWork for Students](#)

- It is expected that students will have to cover roughly a text-book chapter every two to three weeks. The minimum number of homework assignments is five, and the maximum number is fifteen. The minimum number of tests spanning the entire course material is three, and the maximum number is five.
- Students will be expected to take a final comprehensive examination on a specific date. This examination will be administrated traditionally or via web. The date and time of the final exam is expected to be scheduled and communicated to the students during the first two weeks of classes. Students will be required to take the final examination in a supervised environment. Depending on their geographic location, each student and instructor should make arrangements with a certified testing service. In case no agreeable solution can be found, the University Testing Services will be designated to administer the examination. Each individual instructor is responsible for writing the tests. A print-out of the final examination answers and scores must be kept for up to 12 months after the final grade is posted.

**Student Learning Outcomes:** M1351 satisfies the university core curriculum requirement in Mathematics: “*Students graduating from Texas Tech University should be able to demonstrate the ability to apply quantitative and logical skills to solve problems.*” It meets the TTU general education student learning outcomes for mathematics that students will:

- Apply arithmetic, algebraic, geometric, statistical and logical reasoning to solve problems.
- Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically.
- Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.

Upon completion of M1351, students will be able to:

- Understand the concept of a limit;
- Explain the concept of continuous function;
- Compute instantaneous rate of change;
- Calculate derivatives of polynomial, transcendental and composite functions;
- Apply differentiation techniques to graph functions, and solve related rate and optimization problems;
- Compute definite and indefinite integrals.

### Course Outline

*(All the sections in each chapter are to be learned, unless otherwise specified)*

	Expected study time
Chapter 1 .....	4-8 hours
Chapter 2 .....	4-8 hours
Chapter 3 .....	8-16 hours
Chapter 4 .....	8-16 hours
Chapter 5 .....	9-18 hours
Total: .....	33-66 hours

Note: The necessary time to cover the sections from the text-book and web resources depend on many factors, such as: concentration level, background, major, and individual academic skills. The necessary time for homework completion, practice tests and test-taking is not included in this estimate. For each semester-based course, students should expect to devote the amount of time necessary to understand the material and be able to work problems based on the material.

## Course Number: Mathematics 1352 – Distance Education

### Descriptive Title: Calculus II

**Prerequisites:** C in 1351 (or equivalent transfer credit, according to existing university regulations)

**About the Course:** The two main areas of calculus are differential and integral calculus. Differential calculus in one variable is the main topic of Calculus I (M1351). That course also contains a brief introduction to integral calculus. M1352 begins with a continuation of integral calculus. The course begins with examination of several applications of integrals including computation of area between curves, volumes, surfaces of revolution and length of a curve. Using the objective of computing indeterminate limits students are taught the difference between rates of growth of polynomials and exponential functions. Next students are introduced to a wide range of techniques of integration including a variety of standard techniques of substitution and integration by parts. The second main topic in M1352 is an investigation of convergence of infinite sequences and series. Topics include tests for convergence of series and a discussion of Taylor and Maclaurin series. The final topic is an introduction to vectors in the plane.

**Text:** *CALCULUS*, 5<sup>th</sup> Custom Edition for Texas Tech University, by Strauss, Bradley, and Smith; published by Pearson Education, Inc.

### *Computer Software and Web-based Instruction*

For some students “just reading the book” will not be enough to prepare them to work homework problems and do well on exams. In such cases students are encouraged to take advantage of a number of helpful sources. We mention several such sources here.

- There are some web sites that contain useful information to supplement the discussion in the book. Students are strongly encouraged to check out the information on these web sites for each block of material covered in the book.

The first is The Calculus Page at Calculus.org

<http://www.calculus.org/>

The second is the MIT Open Courseware page

<http://ocw.mit.edu/courses/mathematics/>

The third is the SOS Mathematics Page for Calculus

<http://www.sosmath.com/calculus/calculus.html>

- There is an **Interactive CD-ROM** which comes free with every new copy of the text-book. This software, licensed by Pearson Education, is protected by copyright and is intended for the solely student use as a learning tool for the current text-book.
- Students may find the **Course Companion Website** provided by the text-book editors to be of some use:

<http://www.prenhall.com/strauss>

The essence of this website lies in Live Examples powered by Live Math. Each text section includes teaching hints for several HW problems, most of them using geometric animations.

## Learning Assessment

- Students will be regularly assigned online homework and tests using WeBWorK. The students are encouraged to carefully read the information on using WeBWork at the following links.

### [Introduction to WeBWork for Students](#)

- It is expected that students will have to cover roughly a text-book chapter every two to three weeks. The minimum number of homework assignments is five, and the maximum number is fifteen. The minimum number of tests spanning the entire course material is three, and the maximum number is five.
- Students will be expected to take a final comprehensive examination on a specific date. This examination will be administrated traditionally or via web. The date and time of the final exam is expected to be scheduled and communicated to the students during the first two weeks of classes. Students will be required to take the final examination in a supervised environment. Depending on their geographic location, each student and instructor should make arrangements with a certified testing service. In case no agreeable solution can be found, the University Testing Services will be designated to administer the examination. Each individual instructor is responsible for writing the tests. A print-out of the final examination answers and scores must be kept for up to 12 months after the final grade is posted.

**Student Learning Outcomes:** M1352 satisfies the university core curriculum requirement in Mathematics: “*Students graduating from Texas Tech University should be able to demonstrate the ability to apply quantitative and logical skills to solve problems.*” It meets the TTU general education student learning outcomes for mathematics that students will:

- Apply arithmetic, algebraic, geometric, statistical and logical reasoning to solve problems.
- Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically.
- Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.

Upon completion of M1352, students will be able to:

- Use an integral to calculate area between two curves, volumes, surfaces of revolution, and length of a curve;
- Evaluate integrals using a variety of integration techniques including: substitutions, integration by parts, trigonometric methods, and partial fractions;



- Compute limits of infinite sequences and series;
- Apply tests to determine convergence of power series: integral test, p-test, comparison test, ratio and root tests, and alternating series test;
- Find Taylor and Maclaurin series and radius of convergence. Determine absolute and conditional convergence;
- Examine basic properties of vectors in the plane and in space.

### Course Outline

*(All the sections in each chapter are to be learned, unless otherwise specified)*

	Expected study time
Chapter 5, Review .....	2-4 hours
Chapter 6 .....	8-16 hours
Chapter 7 .....	9-18 hours
Chapter 8 .....	10-20 hours
Chapter 9 (sec. 9.1-9.4) .....	5-10 hours
Total: .....	34-68 hours

Note: The necessary time to cover the sections from the text-book and web resources depend on many factors, such as: concentration level, background, major, and individual academic skills. The necessary time for homework completion, practice tests and test-taking is not included in this estimate. For each semester-based course, students should expect to devote the amount of time necessary to understand the material and be able to work problems based on the material.

## Course Number Mathematics 2350 – Distance Education

### Descriptive Title: Calculus III

**Prerequisites:** C in 1352 (or equivalent transfer credit, according to existing university regulations)

**About the Course:** This is calculus of several variables. The concepts are extensions of the concepts from Calculus I. It is necessary to remind the students of those basic concepts, as the course progresses. Multivariable Calculus is an important tool in Science and Engineering. The instructor should emphasize the importance of all relevant concepts, including: curves and surfaces in Euclidean 3-space, length and curvature; surfaces, partial derivatives, total differential, tangent planes to surfaces; multiple integration; area and volume; gradient; vector-valued functions; path integral; Stokes' theorem, which should be stated, with an emphasis on its important particular cases, Green's Theorem and Divergence Theorem - followed by a few simple examples.

**Text:** *CALCULUS*, 5<sup>th</sup> Custom Edition for Texas Tech University, by Strauss, Bradley, and Smith; published by Pearson Education, Inc.

### *Computer Software and Web-based Instruction*

For some students “just reading the book” will not be enough to prepare them to work homework problems and do well on exams. In such cases students are encouraged to take advantage of a number of helpful sources. We mention several such sources here.

- There are some web sites that contain useful information to supplement the discussion in the book. Students are strongly encouraged to check out the information on these web sites for each block of material covered in the book.

The first is The Calculus Page at Calculus.org

<http://www.calculus.org/>

The second is the MIT Open Courseware page

<http://ocw.mit.edu/courses/mathematics/>

The third is the SOS Mathematics Page for Calculus

<http://www.sosmath.com/calculus/calculus.html>

- There is an **Interactive CD-ROM** which comes free with every new copy of the text-book. This software, licensed by Pearson Education, is protected by copyright and is intended for the sole student use as a learning tool for the current text-book.
- Students may find the **Course Companion Website** provided by the text-book editors to be of some use:

<http://www.prenhall.com/strauss>

The essence of this website lies in Live Examples powered by Live Math. Each text section includes teaching hints for several HW problems, most of them using geometric animations.

## Learning Assessment

- Students will be regularly assigned online homework and tests using WeBWorK. The students are encouraged to carefully read the information on using WeBWork at the following links.

### [Introduction to WeBWork for Students](#)

- It is expected that students will have to cover roughly a text-book chapter every two to three weeks. The minimum number of homework assignments is five, and the maximum number is fifteen. The minimum number of tests spanning the entire course material is three, and the maximum number is five.
- Students will be expected to take a final comprehensive examination on a specific date. This examination will be administrated traditionally or via web. The date and time of the final exam is expected to be scheduled and communicated to the students during the first two weeks of classes. Students will be required to take the final examination in a supervised environment. Depending on their geographic location, each student and instructor should make arrangements with a certified testing service. In case no agreeable solution can be found, the University Testing Services will be designated to administer the examination. Each individual instructor is responsible for writing the tests. A print-out of the final examination answers and scores must be kept for up to 12 months after the final grade is posted.

**Student Learning Outcomes:** M2350 satisfies the university core curriculum requirement in Mathematics: “*Students graduating from Texas Tech University should be able to demonstrate the ability to apply quantitative and logical skills to solve problems.*” It meets the TTU general education student learning outcomes for mathematics that students will:

- Apply arithmetic, algebraic, geometric, statistical and logical reasoning to solve problems.
- Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically.
- Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.

Students are expected to develop skills in differentiation and integration needed to solve problems in 2- and 3-dimensional space. In particular the students will learn about

- tangent and normal vectors, and their geometric and physical interpretations;
- partial derivatives, tangent planes, directional derivatives and gradients, and how to compute them;
- integration in two- and three-dimensional space, including learning how to change order of integration in multiple integrals;

- changing variables in double and triple integrals, e.g., rectangular, polar, cylindrical and spherical coordinates.
- calculation of surface area and evaluating line integrals,
- vector fields, divergence, and curl, and how to calculate them.

## Course Outline

*(All the sections in each chapter are to be learned, unless otherwise specified)*

	Expected study time
Chapter 9 (brief review of 9.1-9.4, followed by 9.5-9.7) .....	4-8 hours
Chapter 10 (section 10.5 is optional) .....	5-10 hours
Chapter 11 .....	9-18 hours
Chapter 12 (cover section 12.6 briefly) .....	9-18 hours
Chapter 13 .....	8-16 hours
Total: .....	35-70 hours

Note: The necessary time to cover the sections from the text-book and web resources depend on many factors, such as: concentration level, background, major, and individual academic skills. The necessary time for homework completion, practice tests and test-taking is not included in this estimate. For each semester-based course, students should expect to devote the amount of time necessary to understand the material and be able to work problems based on the material.

## Course Number: Mathematics 3350 – Distance Education

**Descriptive Title: Higher Mathematics for Engineers and Scientists I**

**Prerequisites: C in 2350 (or equivalent transfer credit, according to existing university regulations)**

***About the Course:*** This course covers topics in ordinary differential equations. Topics to be covered include: first-order differential equations; modeling with first-order differential equations; higher-order differential equations; modeling with higher-order differential equations; the Laplace transform and application to solving differential equations; power series solutions of differential equations.

***Text:*** *Advanced Engineering Mathematics* 3<sup>rd</sup> Edition by Dennis G. Zill and Michael R. Cullen, published by Jones & Bartlett

### ***Computer Software and Web-based Instruction***

For some students “just reading the book” will not be enough to prepare them to work homework problems and do well on exams. In such cases students are encouraged to take advantage of a number of helpful sources. We mention several such sources here.

- There are some web sites that contain useful information to supplement the discussion in the book. Students are strongly encouraged to check out the information on these web sites for each block of material covered in the book.

The first is Paul’s Online Math Notes

<http://tutorial.math.lamar.edu/Classes/DE/DE.aspx>

The second is the SOS Mathematics Page for Differential Equations

<http://www.sosmath.com/diffeq/diffeq.html>

### **Learning Assessment**

- Students will be regularly assigned online homework and tests using WeBWorK. The students are encouraged to carefully read the information on using WeBWork at the following links.

[Introduction to WeBWork for Students](#)

- It is expected that students will have to cover roughly a text-book chapter every two to three weeks. The minimum number of homework assignments is five, and the maximum number is fifteen. The minimum number of tests spanning the entire course material is three, and the maximum number is five.
- Students will be expected to take a final comprehensive examination on a specific date. This examination will be administrated traditionally or via web. The date and time of the final exam is expected to be scheduled and communicated to the students during the first two weeks of classes. Students will be required to take the final examination in a supervised environment. Depending on their geographic location, each student

and instructor should make arrangements with a certified testing service. In case no agreeable solution can be found, the University Testing Services will be designated to administer the examination. Each individual instructor is responsible for writing the tests. A print-out of the final examination answers and scores must be kept for up to 12 months after the final grade is posted.

**Student Learning Outcomes:** M3350 satisfies the university core curriculum requirement in Mathematics: “*Students graduating from Texas Tech University should be able to demonstrate the ability to apply quantitative and logical skills to solve problems.*” It meets the TTU general education student learning outcomes for mathematics that students will:

- Apply arithmetic, algebraic, geometric, statistical and logical reasoning to solve problems.
- Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically.
- Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.

Upon completion of M3350, students will be able to:

- Recognize an ordinary differential equation and determine whether it is linear or non-linear. Understand the definition of a general solution and the solution of the initial value problem (IVP). Apply the fundamental existence and uniqueness theorem for first order IVPs.
- Solve a variety of first order differential equations and IVPs including: separable, first order linear, exact, Bernoulli, and homogeneous equations;
- Compute the general solution and find the solution of the IVP for homogeneous linear differential equations including constant coefficient second and higher order equations and Euler-Cauchy equations. Learn the methods of undetermined coefficients and variation of parameters for solving non-homogenous problems;
- Use Laplace transforms to solve differential and integral equations. Use of the Heaviside function, convolutions and the Dirac delta function;
- The main topics in the class that are to be covered by all sections of Math 3350 are Chapters 1– 4. Once these topics are covered the amount of time left in the semester will vary from section to section due to a variety of factors. Instructors can choose from various additional content for the remainder of course. Roughly 15 to 20% of the class is open to the instructors discretion.
  - (suggested additional topics) More applications, e.g., a look at nonlinear models as in Section 2.9
  - (suggested additional topics) Introduction to Maple with application to solving ODEs;

- (suggested additional topics) Find power series solutions for non-constant coefficient linear IVPs; or
- (suggested additional topics) Introduction to Euler’s method for the numerical solution of IVPs.

**Course Outline**

Chapter 1: (1.1, 1.2) Introduction .....	2-4 hours
Chapter 2: (2.1-2.8) First-Order Differential Equations (In Sections 2.7 and 2.8 instructors 9-18 hours	
Chapter 3 : (3.1-3.6, 3.8) Higher-Order Differential Equation .....	10-20 hours
Chapter 4 : (4.1-4.5) Laplace Transforms .....	9-18 hours
Suggestions for topics to complete the semester include:	
Chapter 2 : (2.9) Nonlinear Models	
Chapter 5 : (5.1) Series Solutions of Linear (section 5.3 if time permits) Equation	4-8 hours
Chapter 6 : (6.1) Euler methods for numerical solution of IVPs (e.g., Sections 2.7, 6.1)	4-8 hours
Total number of hours for Math 3350 .....	34-68 hours

## Course Number: Mathematics 3351 – Distance Education

### Descriptive Title: Higher Mathematics for Engineers and Scientists II

**Prerequisites:** C in 3350 or 3354 (or equivalent transfer credit, according to existing university regulations)

**About the Course:** This course covers topics in linear algebra, systems of ordinary differential equations, Fourier series and solution of boundary value problems for partial differential equations. Topics to be covered include: Linear Algebra and Matrix Theory; Systems of linear first-order differential equations; Orthogonal Functions and Fourier Series; Boundary-Value Problems in Rectangular Coordinates; Boundary-Value Problems in Other Coordinate Systems.

**Text:** *Advanced Engineering Mathematics* 3<sup>rd</sup> Edition by Dennis G. Zill and Michael R. Cullen, published by Jones & Bartlett

### *Computer Software and Web-based Instruction*

For some students “just reading the book” will not be enough to prepare them to work homework problems and do well on exams. In such cases students are encouraged to take advantage of a number of helpful sources. We mention several such sources here.

- There are some web sites that contain useful information to supplement the discussion in the book. Students are strongly encouraged to check out the information on these web sites for each block of material covered in the book.

The first is Paul’s Online Math Notes

<http://tutorial.math.lamar.edu/Classes/DE/IntroPDE.aspx>

The second is the SOS Mathematics Page for Differential Equations

<http://www.sosmath.com/diffeq/diffeq.html>

### Learning Assessment

- Students will be regularly assigned online homework and tests using WeBWorK. The students are encouraged to carefully read the information on using WeBWork at the following links.

[Introduction to WeBWork for Students](#)

- It is expected that students will have to cover roughly a text-book chapter every two to three weeks. The minimum number of homework assignments is five, and the maximum number is fifteen. The minimum number of tests spanning the entire course material is three, and the maximum number is five.
- Students will be expected to take a final comprehensive examination on a specific date. This examination will be administrated traditionally or via web. The date and time of the final exam is expected to be scheduled and communicated to the students during the first two weeks of classes. Students will be required to take the final examination



in a supervised environment. Depending on their geographic location, each student and instructor should make arrangements with a certified testing service. In case no agreeable solution can be found, the University Testing Services will be designated to administer the examination. Each individual instructor is responsible for writing the tests. A print-out of the final examination answers and scores must be kept for up to 12 months after the final grade is posted.

**Student Learning Outcomes:** M3351 satisfies the university core curriculum requirement in Mathematics: “*Students graduating from Texas Tech University should be able to demonstrate the ability to apply quantitative and logical skills to solve problems.*” It meets the TTU general education student learning outcomes for mathematics that students will:

- Apply arithmetic, algebraic, geometric, statistical and logical reasoning to solve problems.
- Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically.
- Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.

Upon completion of M3351, students will learn:

- Introductory linear algebra and matrix theory including eigenvalues and eigenvectors;
- How to solve linear systems of ordinary differential equations;
- The theory of orthogonal functions and Fourier series expansions. Statement of results for Sturm-Liouville systems.
- How to solve partial differential equations by separation of variables. This includes homogeneous and non-homogeneous heat and wave equation in one spatial dimension for various boundary conditions. Laplace, heat and the wave equation in two dimensional rectangular regions. The Laplacian in polar coordinates and solution of the Dirichlet problem in a disk.
- The main topics in the class that are to be covered by all sections of Math 3351 are Chapters 10 – 14.1. Once these topics are covered the amount of time left in the semester will vary from section to section due to a variety of factors. Instructors can choose from various additional content for the remainder of course. Roughly 15 to 20% of the class is open to the instructors discretion.
  - (suggested additional topics) Transform methods to solve partial differential equations.;
  - (suggested additional topics) Heat and wave equation in polar and cylindrical coordinates. (This option will require a discussion of Bessel functions, see Section 5.3).
  - (suggested additional topics) Laplace equation in spherical coordinates. (This topic requires a discussion of Legendre polynomials, see see Section 5.3).

- to apply these techniques to the three classical equations: the heat, wave, and Laplace's equation

### Course Outline

Chapter 8: (8.1-8.6, 8.8)<sup>3</sup> Introduction to Linear Algebra and Matrices including Eigenvalues  
8-14 hours

Chapter 10: (10.1, 10.2) Solving Systems Linear Differential Equations ..... 4-8 hours

Chapter 12 – (12.1-12.4) Orthogonal Functions and Fourier Series ..... 6-10 hours

Chapter 13 – (13.1-13.6, 13.8) Use separation of variables to solve heat, wave and Laplace equation in one and two dimensional rectangular domains. Solve non-homogenous one dimensional heat and wave equations. .... 6-12 hours

Chapter 14 – (14.1) Laplace equation in polar coordinates. .... 5-8 hours

Suggestions for topics to complete the semester include:

Chapter 15 (15.1 –15.2) Use Laplace transforms to solve partial differential equations. . 4-8 hours

Chapter 14 Heat and Wave equation in Cylindrical Coordinates (14.2 which will also require Bessel functions from Section 5.3) ..... 4-8 hours

Chapter 14 Laplace equation in Spherical Coordinates (14.2 which will also require Bessel functions from Section 5.3) ..... 4-8 hours

Total number of hours for Math 3351 ..... 30-60

Note: The necessary time to cover the sections from the text-book and web resources depend on many factors, such as: concentration level, background, major, and individual academic skills. The necessary time for homework completion, practice tests and test-taking is not included in this estimate. For each semester-based course, students should expect to devote the amount of time necessary to understand the material and be able to work problems based on the material.

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<sup>3</sup>Note that the material in Chapter 7 is contained in the prerequisite course Math 2350. Instructors may need to ask the students to review this material in Chapter 7 or refer to a Calculus III text.

## Course Number: Mathematics 1321 – Distance Education

### Descriptive Title: Trigonometry

**Prerequisites:** 4 on MPE, 610 on SATM, or 26 on ACTM, or C in MATH 1320 or 1420

**About the Course:** The purpose of this course is to prepare students to take Precalculus or Calculus as well as to prepare students for future courses within their chosen major, such as, but not limited to, Pre-Physical Therapy, Pre-Occupational Therapy, Pre-Dental, Interior Design and Construction Technology. From this course, students should acquire the skills and concepts necessary for a broad understanding of the basic concepts from trigonometry.

**Text:** *Trigonometry* 9th Edition by Lial, Hornsby, and Schneider; published by Pearson Education, Inc.

### *Computer Software and Web-based Instruction*

For some students “just reading the book” will not be enough to prepare them to work homework problems and do well on exams. In such cases students are encouraged to take advantage of a number of helpful sources. We mention several such sources here.

- There are some web sites that contain useful information to supplement the discussion in the book. Students are strongly encouraged to check out the information on these web sites for each block of material covered in the book.

Paul’s Online Math Notes

<http://tutorial.math.lamar.edu/Extras/AlgebraTrigReview/AlgebraTrigIntro.aspx>

SOS Mathematics Page for Trigonometry

<http://www.sosmath.com/trig/trig.html>

### Learning Assessment

- Students will be regularly assigned online homework and tests using WeBWorK. The students are encouraged to carefully read the information on using WeBWork at the following links.

[Introduction to WeBWork for Students](#)

- It is expected that students will have to cover roughly a text-book chapter every two to three weeks. The minimum number of homework assignments is five, and the maximum number is fifteen. The minimum number of tests spanning the entire course material is three, and the maximum number is five.
- Students will be expected to take a final comprehensive examination on a specific date. This examination will be administrated traditionally or via web. The date and time of the final exam is expected to be scheduled and communicated to the students during

the first two weeks of classes. Students will be required to take the final examination in a supervised environment. Depending on their geographic location, each student and instructor should make arrangements with a certified testing service. In case no agreeable solution can be found, the University Testing Services will be designated to administer the examination. Each individual instructor is responsible for writing the tests. A print-out of the final examination answers and scores must be kept for up to 12 months after the final grade is posted.

**Student Learning Outcomes:** M1321 satisfies the university core curriculum requirement in Mathematics: “*Students graduating from Texas Tech University should be able to demonstrate the ability to apply quantitative and logical skills to solve problems.*” It meets the TTU general education student learning outcomes for mathematics that students will:

- Apply arithmetic, algebraic, geometric, statistical and logical reasoning to solve problems.
- Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically.
- Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.

Upon completion of M1321, students will:

- understand the measurement of angles measured in both degrees and radians;
- understand the definitions of trigonometric functions using triangles and the unit circle;
- understand and verify trigonometric identities;
- understand the relationship between trigonometric functions and vectors, operations, and the dot product;
- graph trigonometric functions with understanding of translations, polar equations;
- interpret information given by graphs including intercepts, domain, and range;
- solve trigonometric equations and parametric equations;
- model real world situations right angle trigonometry, law of sines and cosines;

### Course Outline

*(All the sections in each chapter are to be learned, unless otherwise specified)*

Chapter 1 .....	4 days
Chapter 2 .....	5 days
Chapter 3 .....	4 days
Chapter 4 .....	5 days

Chapter 5 .....	5 days
Chapter 6 .....	5 days
Chapter 7 .....	5 days
Chapter 8 (Omit 8.4) .....	5 days
Total: .....	38 days

Note: The necessary time to cover the sections from the text-book and web resources depend on many factors, such as: concentration level, background, major, and individual academic skills. The necessary time for homework completion, practice tests and test-taking is not included in this estimate. For each semester-based course, students should expect to devote the amount of time necessary to understand the material and be able to work problems based on the material.