

To: Mathematics and Statistics Teaching Faculty  
From: Magda Toda, Department Chair  
Re: Departmental Handbook for 2019-2020  
Date: August 2019

This handbook describes the undergraduate and graduate programs offered by our department. It also contains syllabi, textbook information and course descriptions of our undergraduate and graduate mathematics courses.

University and department policies requires that during the first week of class each instructor provide each organized class with a syllabus, explaining how final course grades are to be determined and listing student outcomes and assessment procedures. **Further, compliance with HB 2504 will require the submission of an electronic version of the syllabus (at Texas Tech that submission will be made through *Digital Measures*) for undergraduate classes by the 7<sup>th</sup> class day (3 Sep 2014).** A sample syllabus and examples of assessment practices and student learning outcomes are provided on pages 14-17 of this document. Student learning outcomes and assessment statements must be included in every syllabus. Please note the special statements that have been provided for the courses in the Mathematics Core Curriculum-M1300, M1320, M1321, M1330, M1331, M1350, M1451, M1452, M1420, M1430, M1550, M2300, M2345, M2370, and M2371. Suggestions for statements regarding ADA, student civility, illness and death notification, and absences due to religious observance are also provided. Please include the name of the Course Coordinator as indicated in the sample.

Please inform your students about the department supported *Tutoring and Study Center* that will operate out of Room 106. Early in the semester, you will receive a notice about the hours of operation.

Students need to be aware of class progress before the deadlines for dropping a class, declaring Pass/Fail or withdrawing from a class. It is important that you keep your students informed about their progress by administering, grading and returning examinations and/or quizzes prior to these deadlines.

Do not dismiss classes to extend holidays and do not give hour exams in the last week of the semester. Unless you are prepared to deal with the issue of students working collaboratively together on outside-of-class projects and exams (in spite of instructions to the contrary), do not give take-home exams.

Final examinations must be given at the university scheduled time. You should include information in your syllabus delineating the scheduled time for your Final Exam, especially if it is a common departmental final. If you teach a course which has a common departmental final, you will be assigned a Course Coordinator for that course. The Course Coordinator will be responsible for constructing the departmental examination and establishing the guidelines under which it is to be administered. Such guidelines usually include policies regarding calculators, formula sheets, or other aids. In such a course, you are expected to administer the common departmental final and to follow the guidelines established for it. It is highly recommended to follow the same guidelines for the mid-semester tests/exams.

When you leave Texas Tech University permanently, you must turn in your Texas Tech University keys, grade books (or a copy), and a copy of all recent Final Exams.

Thank you for your professional and conscientious efforts in helping the department meet its teaching mission.

## Contents

Degrees Offered.....	3
Entrance Credit.....	4
Mathematics Placement Examination.....	5
Prerequisite Courses for Undergraduate Mathematics.....	6
Scholarships, Awards, and Financial Support.....	7
Undergraduate Degree Programs.....	8
Mathematics Major Degree Requirements: Bachelor of Arts (B.A.) (120 hours).....	8
Mathematics Major Degree Requirements: Bachelor of Science (B.S.) (120 hours).....	9
Accelerated Bachelors-to-Masters.....	10
Minor in Mathematics.....	11
Minor in Actuarial Sciences.....	11
Selection of Elective Courses.....	12
Course Rotation of Upper Division Courses.....	13
Syllabus Guide.....	14
Undergraduate Course Outlines.....	18
Graduate Degree Programs.....	77
Master's Degree in Mathematics.....	77
Master's Degree in Statistics.....	78
Doctoral Program.....	80
Leveling Coursework for Graduate students.....	83
Graduate Course Outlines.....	84

## Degrees Offered

The department offers five degrees. Undergraduate degree requirements are listed on pages 7 - 13, and graduate degree requirements are listed on pages 42- 46.

**The Bachelor of Arts Degree:** This degree provides traditional liberal arts training with a specialization in mathematics of at least 21 hours of upper level courses in mathematics (i.e., courses numbered 3000 or above).

**The Bachelor of Science Degree:** Placing greater emphasis on scientific training and requiring 27 hours of upper level courses in mathematics (i.e., courses numbered 3000 or above). This degree is particularly recommended to students intent upon graduate study.

**Dual Degree Program (Departments of Mathematics and Statistics and Computer Science):** A five-year program leading to a B.S. in mathematics from the College of Arts and Sciences, and a B.S. in computer science from the College of Engineering.

Students electing any of the above degrees may also complete the requirements for certification as high school teachers.

**The Master of Arts Degree in Mathematics:** The program of study leading to the M.A. degree is designed for teachers of pre-university mathematics.

**The Master of Science Degree in Mathematics:** The M.S. program is designed to prepare students for one or more of the following areas: pre-college or junior college teaching, industrial employment, or further graduate study. A minimum of specific course requirements allows the student a great deal of freedom in his or her program of study and thereby fulfills the purpose of the program.

**Master of Science in Statistics:** This program is a concentrated study in statistics.

**Combined Bachelor's and Master's Degree Program in Mathematics:** Undergraduate mathematics majors may apply for admission to the master's degree program during their junior year so that they can begin taking graduate courses during their senior year. This program can result in a BA/MA, BA/MS or BS/MS, depending on the needs of the student. The combined bachelor's and master's degrees in Mathematics differ only in the final two years; the first three years are the same as the standard Bachelor of Science in Mathematics program. See either the Graduate or Undergraduate Advisor for details.

**The Ph.D. Degree:** The principal goal of the Ph.D. program is to train research oriented mathematicians for college or university teaching, and for governmental and industrial employment. The student has the option of concentrating in one of four specialty areas: Applied Mathematics, Pure Mathematics, Statistics, and Mathematics of Finance.

Minimum course requirements have been established in each of these areas in order to ensure that the student obtains a broad based background in mathematics and in addition, attains depth in his or her specialty area.

## Entrance Credit

The Department of Mathematics and Statistics does not award credit on the basis of SAT or ACT (Aptitude) scores. However, credit is available in certain courses through the CEEB Advanced Placement Program and the CEEB College Level Examination Program (CLEP). For example, credit in Math 1451 can be achieved by a score of 4 or better on an AP Calculus Exam. Entrance credit is awarded by the Admissions Office at the time of admission. Please refer to [www.depts.ttu.edu/testing/uce.php](http://www.depts.ttu.edu/testing/uce.php) for a complete list of scores accepted.

Students who do not present scores of the appropriate tests at the time of admission are not eligible for entrance credit but may elect credit by examination.

In the CLEP program, a list of the tests, passing scores, and course equivalents is as follows:

<b>CLEP Test</b>	<b>Passing Score</b>	<b>TTU Course Equivalent</b>
College Algebra	52 And Above	Math 1320
Precalculus	50 And Above	Math 1550
Calculus	50 And Above	Math 1451

In the CEEB Advanced Placement (AP) Program the following table is to be consulted:

### AP

<b>Score</b>	<b>TTU Course Equivalent</b>
0, 1, 2, or 3	None
4 on Calculus AB	Math 1451
4 on Calculus BC	Math 1451, 1452
4 on Statistics	Math 2300

In the International Baccalaureate (IB) the following table is to be consulted:

### IB

<b>Score</b>	<b>TTU Course Equivalent</b>
0, 1, 2, or 3	None
4, 5, 6, 7 on Math Studies SL	Math 1320
4, 5 on Math SL	Math 1550
6, 7 on Math SL	Math 1451
4 on Math HL	Math 1550
5, 6, or 7 on Math HL	Math 1451

## Mathematics Placement Examination

University policy states that to be admitted to an entry-level mathematics course (0301-1451, 1420-2345), a student must meet one of the following prerequisites:

1. Students who have a sufficient high SAT Mathematics score (610 [660 for M1451] or higher) or ACT Mathematics score (26 [29 for M1451] or higher) may enroll in any of the entry-level courses.
2. Students who have collegiate credit for the appropriate prerequisite course from an accredited community college, junior college or university may enroll in the sequenced entry-level mathematics course.
3. Students who satisfactorily pass the Mathematics Placement Examination may enroll in the appropriate entry-level mathematics course.

For many students, achieving a satisfactory score on the Mathematics Placement Examination is the most direct and effective way to satisfy one of these prerequisites. The placement examination has one goal: **to place the student in the course which best matches the student's university major and the student's skill level.** The examination directs the student (i) to the course he or she wishes to take or (ii) to a course which develops the necessary prerequisite skills for the desired courses.

### Initial Administration

Students matriculating to the university in a Fall semester are typically expected to take the on-line Mathematics Placement Examination prior to attending their summer new student orientation. The examination may be taken on-line twice.

Students matriculating to the university in a Spring semester (or a Summer term) are expected to take the placement examination during the week of open registration prior to the start of the semester (or during the day of open registration prior to the start of the term).

### Subsequent Administrations

Students whose placement score (from the on-line administration of the Mathematics Placement Exam) do not match their expectations may retake the mathematics placement examination during the period of open registration prior to the beginning of each semester or term. The retakes of the placement examinations will be administered by a proctor from the Department of Mathematics and Statistics. Students desiring to retake the placement examination should check the examination schedule

[http://www.math.ttu.edu/Undergraduate/Resources/Placement/exam\\_schedule.shtml](http://www.math.ttu.edu/Undergraduate/Resources/Placement/exam_schedule.shtml)

or contact the receptionist in Room 201 of the Mathematics Building.

## Prerequisite Courses for Undergraduate Mathematics Courses at Texas Tech University

0301	None	0302	Code 2 or higher on the math placement exam or a score of at least 610 on the SATM or a score of at least 26 on the ACTM or a grade of A or B in MATH 0301 or TSI 0202 or a grade of D or better in MATH or TSI 0302 or a grade of D or better in a college level mathematics course
1300	[MATH 1332] (3) Prerequisites: A score of at least 3500 on the STA2, 500 on the SATM and composite score of 1070 or a score of at least 19 on the ACTM and composite score of 23, or a C or better in either MATH 0302, REF 0302, or TSI 0302. Quantitative literacy and problem solving with applications to finance, population dynamics, politics, and business. Partially fulfills core Mathematics requirement.	1320	Code 3 or higher on math placement exam or a score of at least 610 on the SATM or a score of at least 26 on the ACTM or a grade of A or B in MATH or TSI 0302 or a grade of C or better in a college level mathematics course
1321	Code 4 or higher on math placement exam or a score of at least 610 on the SATM or a score of at least 26 on the ACTM or a grade of C or better in MATH 1320 or MATH 1420	1330	Code 3 or higher on math placement exam or a score of at least 610 on the SATM or a score of at least 26 on the ACTM or a grade of A or B in MATH or TSI 0302 or a grade of C or better in a college level mathematics course
1331	Code 4 or higher on math placement exam or a score of at least 610 on the SATM or a score of at least 26 on the ACTM or a grade of C or better in MATH 1330 or MATH 1430	1350	MATH 1321 or a Code 6 or higher on math placement exam or a score of at least 660 on the SATM or a score of at least 29 on the ACTM
1451	Code 7 on the math placement exam or a or a score of at least 660 on the SATM or a score of at least 29 on the ACTM or a grade of a C or better in [MATH 1321 and Code 5 on the math placement exam] or MATH 1550 or MATH 1350	1452	1451 or consent of department
1420	Code 2 or higher on the math placement exam or a score of at least 610 on the SATM or a score of at least 26 on the ACTM or a grade of A or B in MATH 0301 or TSI 0202 or a grade of D or better in MATH or TSI 0302 or a grade of D or better in a college level mathematics course	1430	Code 2 or higher on the math placement exam or a score of at least 610 on the SATM or a score of at least 26 on the ACTM or a grade of A or B in MATH 0301 or TSI 0202 or a grade of D or better in MATH or TSI 0302 or a grade of D or better in a college level mathematics course
1550	Code 3 or higher on math placement exam or a score of at least 610 on the SATM or a score of at least 26 on SATM or a grade of an A in MATH or TSI 0302 or a grade of a C or better in college level mathematics course		
2300	Code 4 or higher on the math placement exam or a score of at least 610 on the SATM or a score of at least 26 on the ACTM or a grade of a C or better in a college level math course	2345	Code 4 or higher on math placement exam or a score of at least 610 on the SATM or a score of at least 26 on the ACTM or a grade of a C or better in MATH 1330 or MATH 1430
2450	1452 or consent of department	2356	1451 or 1331
2360	1452 or consent of department		
2370	Major of (EC or MDS) and 1320 or consent of department	2371	Major of (EC or MDS) and 1320 or consent of department
3310	2450 or consent of department		
3322	1452 or consent of department	3342	2450 or consent of department
3350	2450 or consent of department	3351	3350 or 3354 or consent of department
3354	2450 and 2360 or consent of department	3360	2360 and 3310 or consent of department
3370	2370 or consent of department	3371	1331 or 1451 or 2370 or consent of department
3372	2371 or consent of department		
3430	2450 and 2360 or consent of department	4000	consent of instructor and department
4310	3350 or 3354 or consent of department	4312	2360 or consent of department
4330	consent of instructor and department	4331	2450 and 3310 or consent of department
4342	2450 or consent of department	4343	4342 or consent of department
4350	2450 and 2360 and 3310 or consent of department	4351	4350 or consent of department
4354	3350 or 3354 or consent of department	4356	4350 or concurrent or consent of department
4360	3360 or consent of department	4362	3310 or consent of department
4370	3370 or consent of department	4371	2371 or 3371 or consent of the department

**Updated: August 21, 2019**

## Scholarships, Awards, and Financial Support

The Mathematics and Statistics Department at Texas Tech University is fortunate to have several scholarship funds established in memory of past members of the department, in honor of current faculty and former faculty, and donors. The amount available varies, but has been averaging approximately \$70,000 per year for undergraduates and \$12,500 per year for graduates, with awards based on merit and/or financial need, as specified by the donor.

### SCHOLARSHIPS FOR MATHEMATICS MAJORS

<b>Scholarship Name</b>	<b>Eligible Students</b>
Ronald Anderson	Graduate
H. Earl and Countess Fore Archer	Undergraduate
George Baldwin	Undergraduate
Ben Duran	Graduate
Gordon Fuller	Graduate
Rick & Sherrie Hale	Undergraduate
Emmett Hazlewood	Undergraduate
E. Richard Heineman	Freshmen
Mildred and Lonnie Langston	Undergraduate
Robert A. Moreland	Undergraduate
Morrison-Broughton	Undergraduate
Patrick Odell	Graduate
Herman Reynolds	Graduate
“dub” Rushing Family	Undergraduate
SIAM	Graduate
Monty J. Strauss	Undergraduate
Tarwater Family	Undergraduate
Ralph Underwood	Undergraduate
John T. White	Graduate

Undergraduate scholarships are administered in the department by the Scholarship Committee under the direction of Professor Monty J. Strauss. The standard university applications should be used in applying for undergraduate awards and are due by February 1. Students who apply for scholarships will be considered for all scholarships for which they are eligible and do not need to specify for which ones they wish to be considered.

In addition to the above scholarships there are two scholarship funds for the training of mathematics teachers. One is a scholarship established by Professor Derald Walling and the other was established in memory of Professor Paul Thompson.

Graduates should contact the director of graduate programs, Dr. Alex Wang, for information about applying for graduate scholarships.

### SCHOLARSHIPS FOR MATHEMATICS TEACHERS

<b>Scholarship Name</b>	<b>Eligible Students</b>
Paul Thompson	Elementary Specialist
Derald Walling	Secondary

Professor Ali R. Amir-Moez has established a fund to award undergraduates for research projects.

### UNDERGRADUATE RESEARCH AWARDS

<b>Award Name</b>	<b>Eligible Students</b>
A. Amir-Moez	Undergraduate

## Undergraduate Degree Programs

The Director of Undergraduate Studies or Departmental Undergraduate Advisor will sign all undergraduate degree plans and certification plans. A student may opt to remain under the catalog rules which were in effect when the student initially registered. A student must have a grade of C or better for each mathematics course counted toward a major, a minor, or certification (elementary or secondary).

Students are expected to develop a degree plan upon completing 60 hours of coursework. Forms and information for developing a degree plan in mathematics are available from the Director of Undergraduate Studies or the Departmental Undergraduate Advisor in the Department of Mathematics and Statistics. The degree plan must be approved by the Director of Undergraduate Studies or the Departmental Undergraduate Advisor.

Detailed information, listed by catalog year, can be found at

<http://www.depts.ttu.edu/artsandsciences/students/undergraduate/>.

### ***Mathematics Major Degree Requirements: Bachelor of Arts (B.A.) (120 hours)***

The curriculum established for this degree is designed to provide the foundation for a liberal education through a well-rounded study of the humanities and fine arts, the physical, biological, and social sciences, and mathematics. It also provides the factual basis and the insights requisite for specialized study and professional work in these fields.

#### **General Degree Requirements (For a B.A. in Mathematics):**

(See the section on Undergraduate Credit by Examination for information on credit provided by test scores for these requirements.) Students must take the specified number of hours in these areas. Courses from the major and minor may be used to satisfy these requirements, but courses used to fulfill specific requirements may not be used to satisfy distribution requirement.

1. English	12 hours
2. Oral Communication	3 hours
3. Foreign Language	6-11 hours
4. Natural Science	8-11 hours
5. Individual or Group Behavior	6 hours
6. American History	6 hours
7. Political Science	6 hours
8. Humanities	6 hours
9. Visual and Performing Arts	6 hours
10. Personal Fitness and Wellness	2 hours
11. Multicultural Requirement	3 hours



**Major, Minor and Electives (for the B.A. in Mathematics):**

**Major:** Twenty-one semester hours of upper level courses in mathematics are required. These course requirements may be broadly divided into four components:

Calculus	1451, 1452, 2450
Foundation	2360, 3310, 3354, 3360, 4350
Depth (one of the four courses)	4343, 4351, 4354, 4360
Breadth (a minimum of six semester hours (not used above) must be taken from the following list)	3342, 3430, 4310, 4312, 4330, 4331, 4342, 4343, 4351, 4354, 4356, 4360, 4362, 4363, 4000

Total MATH hours must be at least 33, with at least half of the upper division (3\*\*\*/4\*\*\*) courses taken at Texas tech University.

**Minor:** A minimum of eighteen semester hours is required, six of which must be advanced. The minor is subject to the requirements of and must be approved by the minor department.

**Elective courses:** Additional courses, sufficient to bring the total to 120 semester hours, must be taken.

For the Bachelor of Arts degree, *a minimum of 40 semester hours of junior and senior work must be presented*; not more than 42 semester hours in one subject may be counted; not more than 8 hours may be counted in applied music and/or music ensemble except for students offering music as a major or minor; not more than 6 hours in P.E. activity courses may be counted as electives; not more than 24 hours in the technical or professional subjects or agriculture, business administration, engineering, and/or human sciences may be counted as electives.

***Mathematics Major Degree Requirements: Bachelor of Science (B.S.) (120 hours)***

The B.S. degree permits a greater degree of specialization than that afforded by the B.A. degree. The following are the requirements for this degree.

**General Degree Requirements (For a B.S. in Mathematics):**

- |   |            |
|---|------------|
| 1. English  | 12 hours   |
| 2. Oral Communication                                   | 3 hours    |
| 3. Foreign Language                                     | 6-16 hours |
| 4. Natural Science                                      | 8 hours    |
| 5. Individual or Group Behavior                         | 3 hours    |
| 6. American History                                     | 6 hours    |
| 7. Political Science                                    | 6 hours    |
| 8. Humanities   | 3 hours    |
| (May be satisfied with the 12-hour English requirement) |            |
| 9. Visual and Performing Arts                           | 3 hours    |
| 10. Personal Fitness and Wellness                       | 2 hours    |
| 11. Multicultural Requirement                           | 3 hours    |

### Major, Minor, Adjunct Requirements and Electives (for the B.S. in Mathematics):

**Major:** Twenty-seven semester hours of upper level courses in mathematics are required. The mathematics requirements are similar with those for the B.A. degree except that two additional advanced mathematics courses are required. These course requirements may be broadly divided into four components:

Calculus	1451, 1452, 2450
Foundation	2360, 3310, 3354, 3360, 4350
Depth (two of the four courses)	4343, 4351, 4354, 4360
Breadth (a minimum of nine semester hours (not used above) must be taken from the following list)	3342, 3430, 4310, 4312, 4330, 4331, 4342, 4343, 4351, 4354, 4356, 4360, 4362, 4363, 4000

Total MATH hours must be at least 39, with at least half of the upper division (3\*\*\*/4\*\*\*) courses taken at Texas tech University.

**Minor:** Candidates for the B.S. degree must choose their minor from the following: actuarial science, atmospheric science, biology, chemistry, chemical engineering, civil engineering, computer science, economics, electrical engineering, exercise and sport sciences, geology, geophysics, industrial engineering, mechanical engineering, microbiology, petroleum engineering, physics, or zoology. A minor must include 18 semester hours, 6 of which must be advanced. In particular, an engineering minor must consist of 18 semester hours in only one department. Courses counted for the minor must be approved by the minor department.

**Adjunct Requirements** (a special requirement by the Department of Mathematics and Statistics): Candidates for the B.S. degree must complete 8 hours of laboratory science (biology, botany, chemistry, geosciences, microbiology, physical geography, physics, or zoology) outside their minor area.

**Electives:** Additional courses must be taken which, together with the above, are sufficient to total to 120 semester hours.

The inventory of courses which can be used to fulfill various requirements changes every year, with some courses deleted and others added. Students should consult a recent Catalog, or the Director of Undergraduate Studies if they have any questions about a particular course and the general degree requirements.

#### *Accelerated Bachelors-to-Masters*

Undergraduate mathematics majors may apply for admission to the master's degree program during their junior year so they can begin taking graduate courses during their senior year. This program can result in a B.A./M.A., B.A./M.S., or B.S./M.S. depending on the needs of the student. The combined bachelor's and master's degree in mathematics differs only in the final two years; the first three years are the same as the standard B.S. in mathematics program. See either the graduate or undergraduate advisor for details.

#### *Dual Degree (159 hours)*

The Department of Mathematics and Statistics also participates with the Department of Computer Science to offer a dual-degree program in mathematics and computer science. This is a five-year program that culminates in a B.S. degree with a major in mathematics and a minor in computer science from the College of Arts and Sciences as well as a B.S. degree in computer science from the College of Engineering. Students should consult with an academic advisor in each college and may declare either as their primary college. See the Department of Computer Science catalog section for curriculum information.

### ***Minor in Mathematics***

A minor in mathematics for most students consists of the following:

1. MATH 1451 and 1452 and 2450
2. MATH 2360 or 3351
3. Six semester hours of mathematics at the junior-senior level, subject to approval by the Director of Undergraduate Programs, selected from the following list: 3430, 3350 or 3354 (credit may not be received for both 3350 and 3354), 4354, 3360, 4310, 4312, 4330, 4331, 4342, 4343, 4350, 4351, 4356, 4360, 4362, 4300. For Economics B.S. students, the recommended upper division courses are MATH 3354 and 4350.

For the minor and major in mathematics at least one half of the upper level mathematics courses must be taken in the Department of Mathematics and Statistics at Texas Tech University. This residency requirement will be waived by the department only in very exceptional circumstances.

### ***Minor in Actuarial Sciences***

This training for an actuary requires one to pass a series of established (society) exams, leading to the two major milestones of: *Associateship* (at least 5 exams), and *Fellowship* (several more exams). For life, health, and pension actuaries, exams are given by the Society of Actuaries (SOA). For property and casualty actuaries, the exams are administered by the Casualty Actuarial Society (CAS). Candidates will need to specialize their training early on in their career path, either SOA or CAS. In order to secure an entry-level position, a candidate is currently expected to have passed at least one of the *preliminary exams*, as well as have acquired validation through education experience (*VEE credits*) in 3 areas (required by SOA). The exams are offered at appropriate times (twice each year in the Spring and Fall) and locations (most major cities and college campuses). The VEE credits can be acquired by taking appropriate college courses.

Preliminary exams (CAS/SOA):

- 1/P (Probability)
- 2/FM (Mathematics of Finance)
- 3F-3L/MFE-MLC (Actuarial Modeling)
- 4/C (Construction and Evaluation of Actuarial Models)

VEE credits (required by SOA):

- Applied Statistical Methods
- Corporate Finance
- Economics

CAS exams 1,2, and 4 are the same as SOA exams P, FM, and C, respectively. But CAS exam 3F-3L does not correspond exactly to SOA exam MFE-MLC, so at this point the candidate may already have to choose a specialty, either SOA or CAS.

TTU offers a minor in *actuarial science*, administered by the Mathematics & Statistics Department and advised by Dr. Alex Trindade. The minor requirements can be satisfied by taking any 6 courses from the following list (boldface courses are required; ECO 2301 and AAEC 2305 cannot both be counted):

- MATH: **2356** (prereq=1351, 1451 or 1331); **4342** (prereq=2350 or 2450); 4343 (prereq=4342)
- ECO: 2301 (or AAEC 2305); 2302 (prereq=2301)
- FIN: 3320 (prereq=ACCT 2300-2301, ECO 2301-2302, MATH 2345); 3322 (prereq=3320); 4329 (prereq=3320, 3323)

Notes. ECO 2301 and AAEC 2305 cannot both be counted. The ACCT 2300-2301 prerequisite for FIN 3320 is waived for MATH majors. Keep in mind that any given course cannot simultaneously be counted toward the major and the minor (i.e. there must be no overlap between the major and minor lists of courses).

As an example, a typical MATH major, after picking up all the necessary prerequisites, might satisfy the minor by taking the following (not necessarily in this order): ECO 2301, ECO 2302, MATH 2356, FIN 3320, FIN 3322, MATH 4342.

In order to fit the minor into your graduation plan, note/check carefully the prerequisites for each course, and when these courses are offered. MATH 2356 (Quantitative Theory of Interest) is a new course that will be offered for the first time in Spring 2010. Students should plan to take all of these courses, since:

- MATH 4342 covers the syllabus for Exam 1/P
- MATH 2356 & FIN 4329 cover the syllabus for Exam 2/FM
- FIN 3320 & FIN 3322 satisfy the VEE credit in Corporate Finance
- ECO 3311 & ECO 3312 satisfy the VEE credit in Economics (AAEC 3315 can be substituted for ECO 3312)
- MATH 4343 prepares students for the graduate-level courses leading to the VEE in Applied Statistical Methods. This VEE basically consists of a *regression analysis* course and a *time series* course, and can be obtained in any of the following ways:
  - STAT 5371 (regression) & STAT 5379 (time series)
  - AAEC 5307 (regression) & AAEC 6311 (time series)
  - One can also pair a regression course like: STAT 5371, AAEC 4302, AAEC 5307, or ISQS 5349, with a time series course like: STAT 5379, or AAEC 6311.

To officially obtain VEE credit (in the eyes of SOA) for a given subject, the student may have to apply for it through SOA after taking the courses. (See SOA website for details.)

### *Selection of Elective Courses*

The department recommends that the student select a junior-senior curriculum depending on whether the student plans to go to graduate school, enter the job market, or teach in public schools. The suggested course selections are as follows.

#### **Graduate School**

The following MATH courses are recommended for those planning to enter graduate school: 3310, 3430 and/or 4330, 4360, 4351, 4356, 4310, 4312, 4342, 4343, 4362.

#### **Industrial or Applied Job Sector**

The following courses are recommended: 3430 and/or 4330, 4310, 4312, 4342, 4343, 4354. In addition, it is recommended that the student learn the computer language C++.

### Secondary Certification

The 24-hour mathematics requirements for certification to teach mathematics in secondary schools are as follows:

- a) 1451, 1452, 2450, 2360, 3310, and 4331
- b) One of 2300, 3342, or 4342
- c) One of 3430, 4330, or 4371

For the 36-hour certification, the student selects an additional 12 hours of upper level courses.

A secondary certification with mathematics as a teaching field may be obtained through the College of Arts and Sciences by completing supplementary work in education courses and in another teaching field. Advisors in the department offering the second teaching field and in secondary education should be consulted concerning specific course requirements in those areas.

### Middle School Certification

The courses offered in mathematics for students intending to prepare themselves to be middle school mathematics teachers are 1320, 2370, 2371, 3370, 3371, 3372, 4370, and 4371.

Generally all students seeking certification at the middle school level will enroll in the College of Education and as MDS majors. This program calls for a specialization in one subject area, referred to as the “academic specialization.”

#### *Course Rotation of Upper Division Courses*

We will try to offer upper division courses according to the following schedule:

##### **Fall Block:**

3310 3322 3430  
3342 3350 3354  
3360 3370 3371  
4342 4350 4354  
4371

##### **Spring Block:**

3310 3322 3342  
3350 3351 3354  
3360 3372 4330  
4331 4343 4351  
4360 4370

**Odd Fall:** Block + 4356

**Even Fall:** Block + 4362

**Even Spring:** Block + 4312

**Odd Spring:** Block + 4310

##### **Odd Summer:**

**session 1:** 3310 3342 3350 3371 4331

**session 2:** 3342 3350 3360 4350 4371

##### **Even Summer:**

**session 1:** 3310 3342 3350 3370

**session 2:** 3342 3350 3360 4350 4370

## Syllabus Guide

The following guidelines for creating a syllabus were taken, with some modifications from [www.tlhc.ttu.edu/teach/TLHC%20Teaching%20Resources/EffectiveSyllabus.asp](http://www.tlhc.ttu.edu/teach/TLHC%20Teaching%20Resources/EffectiveSyllabus.asp) where additional information can be found.

### Faculty Information:

- Name
- Building and office number
- Phone number
- Office hours
- E-mail address (indicate your preferred way to communicate with students)

### Course Information:

- Course name and number
- Meeting place and time
- Labs or Discussion sections
- Pre-requisites for the course
- Required and recommended textbooks

### Course Description and Purpose:

State the intent of the course and if applicable how it contributes to the major.

State any expectations regarding the students' prior knowledge of the subject.

### Course Outline:

The organization or schedule of the material to be covered. May be specific (day-by-day) or general (weekly or in units).

### Expected Student Learning Outcomes:

These statements express what the student should know and be able to do (knowledge, skills and abilities) as a result of completing the course. Student learning outcomes are provided with the course descriptions that follow in this handbook. The university Core Curriculum Committee has issued special requirements for courses in the general education core curriculum. In particular, the syllabus must indicate that the course meets the university core curriculum requirement for Mathematics. An additional statement must be provided that indicates how the expected learning outcomes for the specific course meet the Mathematics Core Curriculum student learning outcomes. If you are teaching M1300, M1320, M1420, M1321, M1330, M1430, M1331, M1451, M1452, M1550, M2300, M2345, M2450, M2360, M2370 or M2371 please use the statement of expected learning outcomes that are provided in this handbook.

### Methods of Assessment of Learning Outcomes (See pages 16-17 for examples)

#### Criteria for Grading:

Indicate how the above methods of assessment will be used to determine the final grade in the course.

- Percent, weight, points, etc., associated with each assignment
  - Note: If the course has a common departmental Final Exam, then the instructor is expected to administer the common departmental final and to use grade from that final as a substantial portion of the final course grade.
- Percent, weight, points, etc., associated with absences, participation, etc.
- Tell how grades are announced – Texas Tech University Operating Policy 34.12 states that instructors may not post grades for any examinations, including Final Examinations, unless permission is granted by the department chairperson and a substantiated random identification procedure is in place. Leaving papers with social security numbers or TechID numbers visible for students to pick up violates confidentiality as well.

- Clarify any curve applied and how it works
- Describe any grading consequences for missing deadlines
- Explain any opportunities for extra credit and specifically how it will count toward the final grade
- Emphasize if there is any portion of the course that is required to PASS the course
- If class participation is counted in the grade, state what that means:
  - ✓ Student asking instructor questions
  - ✓ Student answering instructor questions
  - ✓ Student responding to other students' questions
  - ✓ Student initiating discussion
  - ✓ Lab participation
  - ✓ External requirements such as field trips, lecture/concert attendance
  - ✓ Discussion group participation
  - ✓ Participation in group projects

Freshmen and sophomore level courses are expected to have several exams during the semester in addition to the Final Exam. At least one of those exams should be administered and returned with a grade before midsemester grades are due.

Describe your expectations for preparation for class. The Texas Tech University Catalog states that students are expected to spend approximately two hours in preparation for each hour of lecture.

**Class Attendance:**

- Absence and tardy policy - if excessive or unexcused absences or tardiness will lower the grade in the class be very specific about how points will be deducted.
- Policy regarding make up exams
- Absence due to religious observance - The Texas Tech University Catalog states that a student shall be excused from attending classes or other required activities, including examinations, for the observance of a religious holy day, including travel for that purpose. A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. A student who is absent from classes for the observance of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence. (p.57)
- Absence due to officially approved trips – The Texas Tech University Catalog states that the department chairpersons, directors, or others responsible for a student representing the university on officially approved trips should notify the student's instructors of the departure and return schedules in advance of the trip. The instructor so notified must not penalize the student, although the student is responsible for material missed. Students absent because of university business must be given the same privileges as other students (e.g., if other students are given the choice of dropping one of four tests, then students with excused absences must be given the same privilege). (p.57)
- Whether an absence is excused or unexcused is determined solely by the instructor with the exception of absences due to religious observance and officially approved trips described above. In case of an illness that will require absence from class for more than one week, the student should notify his/her academic dean. The dean's office will inform the student's instructors through departmental office. In case of absences because of a brief illness, the student should inform the instructor directly.

**Illness and Death Notification:**

The Center for Campus Life is responsible for notifying the campus community of student illnesses, immediate family deaths and/or student death. Generally, in cases of student illness or immediate family deaths, the notification to the appropriate campus community members occur when a student is absent from class for four (4) consecutive days with appropriate verification. It is always the student's responsibility for missed class assignments and/or course work during their absence. The student is encouraged to contact the faculty member immediately regarding the absences and to provide verification afterwards. The notification from the Center for Campus Life does not excuse a student from class, assignments, and/or any other course requirements. The notification is provided as a courtesy.

**Academic Integrity****Academic Misconduct:**

- You may wish to quote the university's statement on academic integrity found in the Texas Tech University Catalog (p.57) and (OP 34.12):

“It is the aim of the faculty of Texas Tech University to foster a spirit of complete honesty and a high standard of integrity. The attempt of students to present as their own any work that they have not honestly performed is regarded by the faculty and administration as a serious offense and renders the offenders liable to serious consequences, possibly suspension.”

- You also may wish to include the descriptions of Cheating and Plagiarism found in the Texas Tech University Catalog: (p.57)
- It is helpful to also include interpretations of plagiarism and academic misconduct especially relevant to your discipline.

**Civility in the Classroom:**

- Include a statement regarding your expectations for acceptable behavior in the classroom. More information about this topic is available on-line at <http://www.depts.ttu.edu/studentjudicialprograms/AcademicIntegrity.pdf>

**Students with Disabilities:**

- Include a statement in the syllabus and make a verbal announcement at the beginning of class that students should inform you of their special needs as soon as possible. The university approved statement found in OP 34.22 is:

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note: instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.



## **Examples of Assessment Statements and Procedures**

### **Example 1**

The expected learning outcomes for the course will be assessed through:

Exams, in-class activities, quizzes, research paper, class discussion, one-minute classroom assessment techniques, polling the class, active learning activities.

### **Example 2**

Assessment of the learning outcomes will be achieved through one or more activities such as class discussion, board work, short non-graded quizzes, selected non-graded homework, and other optional activities deemed appropriate by the instructor. It is important to note that these assessments are for your learning benefit only and will NOT affect your grade. Class grades will be assigned according to the following rubric. (*Evaluation procedure follows*).

### **Example 3**

The assessment of students' mastery of the skills and concepts as specified in the expected learning outcomes will occur, with appropriate course grades assigned, as follows. (*Describe the method by which you will determine the final course grades: points for quizzes, exams, homework, Final Exam, projects, etc; as well as your policies about class attendance and makeup work.*)

### **Example 4**

Continuous formative assessment of the progress of the course will occur via ongoing communication between the instructor and the students. To this end all students are encouraged to ask questions during class and to seek the instructor's help out of class when needed.

Other activities in support of student-instructor communication include the following:

- Use of Blackboard facilities to improve communication. (Several people do this and will be happy to share their experience with you, so ask around if you are interested in doing something with Blackboard.)
- Giving practice quizzes or exams.
- Reviewing homework.
- Observing students working in class. (group activities, students working problems on the board, etc)
- One-minute papers and/or midterm evaluations.
- Use of Learnstar (Consult B. Williams)
- Use of Webwork (Consult D. Gilliam or B. Byerly)
- Use of MyMathLab, MathXL, or Enhanced WebAssign, online homework systems associated with different publishers (Consult Course Coordinator)
- Requiring students who do poorly on first exam, or quiz, to schedule an appointment to discuss their performance with you in your office.
- Requiring one-on-one office interviews with all your students (probably suitable only for "smaller" classes)

## Undergraduate Course Outlines

The pages that follow contain information about certain courses in the undergraduate program. Current course outlines are included for multi-section courses. Additions and changes will be made as textbook changes or revisions of course outlines are made.

Note: All the following course outlines are based on 3 meeting times a week for 50 minutes each. Each outline allows plenty of time for testing and review. Most outlines cover about 35 meeting times, not counting tests and review periods, where we usually meet 42-44 times per semester. If you have a 4 hour class, a TT class or if you are teaching during a summer session, you will have to make appropriate adjustments.

### Core Curriculum Courses

<u>Math 1300</u> .....	19
<u>Math 1320</u> .....	22
<u>Math 1321</u> .....	25
<u>Math 1330</u> .....	<b>Error!</b>
<b>Bookmark not defined.</b>	
<u>Math 1331</u> .....	31
<u>Math 1350</u> .....	34
<u>Math 1420</u> .....	<b>Error!</b>
<b>Bookmark not defined.</b>	
<u>Math 1430</u> .....	<b>Error!</b>
<b>Bookmark not defined.</b>	
<u>Math 1451</u> .....	37
<u>Math 1452</u> .....	40
<u>Math 1550</u> .....	43
<u>Math 2300</u> .....	46
<u>Math 2345</u> .....	49
<u>Math 2370</u> .....	53
<u>Math 2371</u> .....	56

### Non-Core Curriculum Courses

<u>Math 0301</u> .....	59
<u>Math 0302</u> .....	60
<u>Math 2356</u> .....	61
<u>Math 2360</u> .....	61
<u>Math 2450</u> .....	62
<u>Math 3310</u> .....	63
<u>Math 3322</u> .....	64
<u>Math 3342</u> .....	65
<u>Math 3350, 3351</u> .....	66
<u>Math 3354, 4354</u> .....	67
<u>Math 3360, 4360</u> .....	68
<u>Math 3370</u> .....	69
<u>Math 3371</u> .....	69
<u>Math 3372</u> .....	70
<u>Math 3430</u> .....	71
<u>Math 4000</u> .....	71
<u>Math 4310</u> .....	71
<u>Math 4312</u> .....	72
<u>Math 4330</u> .....	72
<u>Math 4331</u> .....	72
<u>Math 4342, 4343</u> .....	72
<u>Math 4350, 4351</u> .....	74
<u>Math 4356</u> .....	75

<u>Math 4362</u> .....	75
<u>Math 4370</u> .....	75
<u>Math 4371</u> .....	76

## Undergraduate Course Outlines

The pages that follow contain information about certain courses in the undergraduate program. Current course outlines are included for multi-section courses. Additions and changes will be made as textbook changes or revisions of course outlines are made.

Note: All the following course outlines are based on 3 meeting times a week for 50 minutes each. Each outline allows plenty of time for testing and review. Most outlines cover about 35 meeting times, not counting tests and review periods, where we usually meet 42-44 times per semester. If you have a 4 hour class, a TT class or if you are teaching during a summer session, you will have to make appropriate adjustments.

## Core Curriculum Courses

**Course Number:**           **Mathematics 1300**  
**Descriptive Title:**       **Contemporary Mathematics**  
**Prerequisite:**           **At least 3500 on the STA2, 500 on the SATM and composite score of 1070 or a score of at least 19 on the ACTM and composite score of 23, or a C or better in either MATH 0302, REF 0302, or TSI 0302.**

### CATALOG DESCRIPTION

[MATH 1332] (3) Prerequisites: A score of at least 3500 on the STA2, 500 on the SATM and composite score of 1070 or a score of at least 19 on the ACTM and composite score of 23, or a C or better in either MATH 0302, REF 0302, or TSI 0302. Quantitative literacy and problem solving with applications to finance, population dynamics, politics, and business. Partially fulfills core Mathematics requirement.

### CURRENT TEXTBOOK:

Thomas L. Pirnot – Mathematics all around, 5<sup>th</sup> Edition, Pearson, 2013.

*Note: Use of MyMathLab, Enhanced WeBAssign, WeBWork, as well as any other textbook-specific interactive web-based homework is subject to approval by the Course Coordinator and/or the Departmental Administration every semester.*

### PURPOSE OF COURSE

The course is intended for Non STEM (Science, Technology, Engineering, and Mathematics) majors. Topics include introductory treatments of sets and logic, financial mathematics, probability and statistics with appropriate applications. Number sense, proportional reasoning, estimation, technology, and communication should be embedded throughout the course. Additional topics may be covered.

The course fulfills a set of learning objectives as established by the Texas Higher Education Coordinating Board. The are: (1) Apply the language and notation of sets. (2) Determine the validity of an argument or statement and provide mathematical evidence. (3) Solve problems in mathematics of finance. (4) Demonstrate fundamental probability/counting techniques and apply those techniques to solve problems. (5) Interpret and analyze various representations of data. (6) Demonstrate the ability to choose and analyze mathematical models to solve problems from real-world settings, including, but not limited to, personal finance, health literacy, and civic engagement.

### CORE CURRICULUM/GRADUATION REQUIREMENTS SATISFIED BY MATH 1300

MATH 1300 satisfies part of the university Core Curriculum requirement in Mathematics; it is designed for a large range of majors, as specified in the previous paragraph.

## COURSE-SPECIFIC LEARNING OBJECTIVES AND CORRESPONDING OUTCOMES

### 1. Apply arithmetic, algebraic, geometric, statistical and/or logical reasoning to solve problems.

In Math 1300 students will develop skills to: (1) construct simple logical expressions and arguments; (2) evaluate simple algebraic expressions; (3) use linear and exponential models; (4) create multiple graphical representations of data; (5) compute compound interest, annuities and tax payments; (6) apply techniques of problem solving.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

### 2. Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically

In Math 1300 students will learn how to adequately communicate mathematical information in writing, verbally and graphically, by using words, numerical answers, algebraic expressions, logical sentences, as well as graphs and diagrams.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

### 3. Use mathematical and logical reasoning to evaluate the validity of an argument.

In Math 1300 students will learn how to identify, understand and apply mathematical and logical reasoning to real-life situations. In particular, sufficient attention will be given to tables of truth and deductive reasoning.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

### 4. Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.

In Math 1300 students will learn to identify and interpret mathematical information contained in formulas, graphs and tables, in particular: (a) formulas containing linear, polynomial, rational, exponential and logarithmic functions; (b) applications that model real world problems via linear systems; (c) discrete arithmetic formulas. The development of student interpretative and inference skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

*College-Level Competency: Students graduating from Texas Tech University should be able to: demonstrate the ability to apply quantitative and logical skills to solve problems. In particular, students who have taken Math 1300 will be able to use the course-specific learning objectives in order to provide individual solutions to mathematical*

problems and interpret the results in a relevant manner. The assessment of these skills will be conducted via embedded assessments in final exams, senior surveys (GSS) and senior assessments (OSA).

### **LEARNING ASSESSMENT:**

Learning outcomes will be assessed through homework exercises, in-class quizzes, and examinations. The following assessments represent a general departmental requirement:

- 1). Homework assignments are expected to be given once or twice per week, either as on-line, web-based assignments, or as writing-intensive assignments
- 2). It is expected that two to four midterm exams be given
- 3). A common, unique departmental final exam will be given according to the academic schedule established by the university and department, for all the course sections whose primary delivery method is the traditional one (lecture, face-to-face).

*General requirement: The Common Final represents a course requirement. A student who did not complete the Final Examination, but otherwise completed all the other requirements successfully cannot be assigned a passing letter grade (D or higher) unless taking the Final Examination. Each designated instructor has to keep their copy of partial scores and grades for each student, for one calendar year from the date of recording the grade in the web database.*

#### Common Grading Scale Correspondence:

Letter grade A = a percentile grade of 90% or higher

Letter grade B = a percentile grade of 80% or higher, that is lower than 90%

Letter grade C = a percentile grade of 70% or higher, that is lower than 80%

Letter grade D = a percentile grade of 60% or higher, that is lower than 70%

Letter grade F = a percentile grade lower than 60%

### **CIVILITY IN THE CLASSROOM:**

Texas Tech University endeavor to foster a classroom climate of mutual respect among students and between students and teacher. Mutual respect means that we should be tolerant of different ideas and varying opinions about topics of discussion in class, that we address each other respectfully and without interrupting while others are speaking, and that we do not engage in disruptive behavior in class. Signs of disrespect include, but are not restricted to: ringing cell phones (students must turn them off or leave them home), reading a newspaper or other material that is not part of a class assignment while in class, talking with classmates during class, eating and drinking in class, and similar disruptive behaviors. Students who engage in disruptive behavior will be warned. Repeated disruptive behavior may result in the student being asked to leave the classroom.

### **ACADEMIC HONESTY STATEMENT:**

The TTU “Code of Student Conduct”, which you should have received when you enrolled in the university, contains a lengthy list of prohibited behaviors, among which is “Academic Dishonesty”. Please note that cheating and plagiarism (a form of cheating) are included among the actions that are subject to disciplinary action. Cheating will not be tolerated in this course. A student who is caught cheating will receive a grade of 0 on the exam, paper, or exercise. Awarding of a grade of F for the course is also a possible penalty. In addition, the incident of academic dishonesty will be reported to the Dean of the appropriate academic college for such disciplinary action as they see fit to administer.

#### **Plagiarism:**

“The appropriation or imitation of the language, ideas, and thoughts of another author, and representation of them as one’s original work.” *The Random House College Dictionary*, revised edition. New York: Random House, 1975, p. 1014.

“1. The use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement; 2. the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.” *Student Affairs Handbook*, Texas Tech University, Lubbock, Texas, 1998-99, p. 22. Plagiarism and cheating are not tolerated and will result in a grade of

0 on work that contains plagiarized material. In addition, a grade of F may be awarded for the course. Any cases of cheating will be reported to the Honors College and the responsible academic dean (i.e., Arts & Sciences, Business Administration, Engineering, etc.)

**ACCOMMODATION OF STUDENTS WITH DISABILITIES:**

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor’s office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

**STUDENT ABSENCE FOR OBSERVATION OF RELIGIOUS HOLY DAYS:**

A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day.

**COURSE OUTLINE**

Chapter 1: Problem solving	3 hours
Chapter 3: Logic	5 hours
Chapter 4: Graph Theory	4 hours
Chapter 8: Consumer Mathematics	6 hours
Chapter 10: Apportionment	3 hours
Chapter 11: Voting	4 hours
Chapter 12: Counting (optional)	(3 hours)
Chapter 13: Probability	4 hours
Chapter 14: Descriptive Statistics	5 hours
Review and testing	8 hours
	Total 45 hours

**Course Number:** Mathematics 1320  
**Descriptive Title:** College Algebra  
**Prerequisite:** B in MATH/TSI 0302, C in a college level math, 3 on MPE, 610 on SATM, or 26 on ACTM

**CATALOG DESCRIPTION**

[MATH 1314] (3 credit hours) Prerequisites: Code 3 or higher on MPE or a score of at least 610 on the SATM or a score of at least 26 on the ACTM or a grade of A or B in MATH 0302 or a grade of A or B in TSI 0302 or a grade of C or better in a college level mathematics course. Inequalities, determinants, theory of equations, binomial theorem, progressions, mathematical induction. Partially fulfills Core Mathematics requirement. Only one of MATH 1300, 1320, or 1420 can be used to fulfill Core Mathematics requirement.

**CURRENT TEXTBOOK:**

*Blitzer, College Algebra, 7<sup>th</sup> Edition, Pearson, 2018.*

*Note: Use of any textbook-specific interactive web-based Homework is subject to approval by the Course Coordinator and/or Departmental Administration every semester.*

**PURPOSE OF COURSE**

This course is designated for a wide student body population. The course fulfills a set of learning objectives as established by the Texas Higher Education Coordinating Board for students whose major foundation is *not* a mathematical one, including: arts, business, earth sciences, humanities, life sciences, medical sciences, social sciences. Topics include: Real numbers, inequalities, matrices and determinants, theory of equations, binomial theorem, progressions, mathematical induction, polynomial functions, exponential and logarithmic functions.

### **CORE CURRICULUM/GRADUATION REQUIREMENTS SATISFIED BY MATH 1320**

MATH 1320 satisfies part of the university Core Curriculum requirement in Mathematics; it is designed for a large range of majors, as specified in the previous paragraph.

### **COURSE-SPECIFIC LEARNING OBJECTIVES AND CORRESPONDING OUTCOMES**

#### **1. Apply arithmetic, algebraic, geometric, statistical and/or logical reasoning to solve problems.**

In Math 1320 students will develop skills to: (1) solve linear, quadratic, rational, logarithmic and exponential equations; (2) graph and interpret functions; (3) formulate and solve problems that involve real world applications; (4) perform simple counting and probability computations. Student mastery of problem solving skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **2. Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically**

In Math 1320 students will learn how to adequately communicate mathematical information in writing, verbally and graphically, by using words, numerical answers, algebraic expressions, logical sentences, as well as graphs and diagrams.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **3. Use mathematical and logical reasoning to evaluate the validity of an argument.**

In Math 1320 students will learn how to identify, understand and apply mathematical and logical reasoning to theoretical and applied problems. In particular, attention will be devoted to the principle for constructing proofs by mathematical induction.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **4. Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.**

In Math 1320 students will learn to identify and interpret mathematical information contained in formulas, graphs and tables, in particular: (a) formulas containing linear, polynomial, rational, exponential and logarithmic functions; (b) applications that model real world problems via linear systems; (c) discrete arithmetic formulas and equations. The development of student interpretative and inference skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

*College-Level Competency: Students graduating from Texas Tech University should be able to: demonstrate the ability*

*to apply quantitative and logical skills to solve problems. In particular, students who have taken Math 1320 will be able to use the course-specific learning objectives in order to provide individual solutions to mathematical problems and interpret the results in a relevant manner. The assessment of these skills will be conducted via embedded assessments in final exams, senior surveys (GSS) and senior assessments (OSA).*

### **LEARNING ASSESSMENT:**

Learning outcomes will be assessed through homework exercises, in-class quizzes, and examinations. The following assessments represent a general departmental requirement:

- 1). Homework assignments are expected to be given weekly, either as on-line, web-based assignments, or as writing-intensive assignments
- 2). It is expected that a test will be given at the end of each major chapter
- 3). A common, unique departmental final exam will be given according to the academic schedule established by the university and department, for all the course sections whose primary delivery method is the traditional one (lecture, face-to-face).

*General requirement: The Common Final represents a course requirement. A student who did not complete the Final Examination, but otherwise completed all the other requirements successfully cannot be assigned a passing letter grade (D or higher) unless taking the Final Examination. Each designated instructor has to keep their copy of partial scores and grades for each student, for one calendar year from the date of recording the grade in the web database.*

#### Common Grading Scale Correspondence:

Letter grade A = a percentile grade of 90% or higher

Letter grade B = a percentile grade of 80% or higher, that is lower than 90%

Letter grade C = a percentile grade of 70% or higher, that is lower than 80%

Letter grade D = a percentile grade of 60% or higher, that is lower than 70%

Letter grade F = a percentile grade lower than 60%

### **CIVILITY IN THE CLASSROOM:**

Texas Tech University endeavor to foster a classroom climate of mutual respect among students and between students and teacher. Mutual respect means that we should be tolerant of different ideas and varying opinions about topics of discussion in class, that we address each other respectfully and without interrupting while others are speaking, and that we do not engage in disruptive behavior in class. Signs of disrespect include, but are not restricted to: ringing cell phones (students must turn them off or leave them home), reading a newspaper or other material that is not part of a class assignment while in class, talking with classmates during class, eating and drinking in class, and similar disruptive behaviors. Students who engage in disruptive behavior will be warned. Repeated disruptive behavior may result in the student being asked to leave the classroom.

### **ACADEMIC HONESTY STATEMENT:**

The TTU “Code of Student Conduct”, which you should have received when you enrolled in the university, contains a lengthy list of prohibited behaviors, among which is “Academic Dishonesty”. Please note that cheating and plagiarism (a form of cheating) are included among the actions that are subject to disciplinary action. Cheating will not be tolerated in this course. A student who is caught cheating will receive a grade of 0 on the exam, paper, or exercise. Awarding of a grade of F for the course is also a possible penalty. In addition, the



incident of academic dishonesty will be reported to the Dean of the appropriate academic college for such disciplinary action as they see fit to administer.

**Plagiarism:**

“The appropriation or imitation of the language, ideas, and thoughts of another author, and representation of them as one’s original work.” *The Random House College Dictionary*, revised edition. New York: Random House, 1975, p. 1014.

“1. The use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement; 2. the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.” *Student Affairs Handbook*, Texas Tech University, Lubbock, Texas, 1998-99, p. 22. Plagiarism and cheating are not tolerated and will result in a grade of 0 on work that contains plagiarized material. In addition, a grade of F may be awarded for the course. Any cases of cheating will be reported to the Honors College and the responsible academic dean (i.e., Arts & Sciences, Business Administration, Engineering, etc.)

**ACCOMMODATION OF STUDENTS WITH DISABILITIES:**

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor’s office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

**STUDENT ABSENCE FOR OBSERVATION OF RELIGIOUS HOLY DAYS:**

A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day.

**COURSE OUTLINE (all sections)**

Chapter P	5 hours
Chapter 1	7 hours
Chapter 2	8 hours
Chapter 3	7 hours
Chapter 4	5 hours
Chapter 5.1, 5.2, 5.4, 5.5	4 hours
Chapter 8.4-8.7	4 hours
Review and testing	5 hours
Total	45 hours

**Course Number:** Mathematics 1321  
**Descriptive Title:** Trigonometry  
**Prerequisites:** 4 on MPE, 610 on SATM, or 26 on ACTM, or C in MATH 1320 or 1420

**CATALOG DESCRIPTION**

[MATH 1316] (3 credit hours) Prerequisite: a grade of C or better in MATH 1320 or MATH 1420 or a test score of at least 610 on the SATM or 26 on the ACTM or 4 on Math Placement code. Trigonometric functions, radians, logarithms, solutions of triangles, identities, trigonometric equations, complex numbers, De Moivre's Theorem. Partially fulfills Core Mathematics requirement.

**CURRENT TEXTBOOK:**

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

*Note: Use of any textbook-specific interactive web-based Homework is subject to approval by the Course Coordinator and/or Departmental Administration every semester.*

## **PURPOSE OF COURSE**

This course is designated for a wide student body population. It fulfills a set of learning objectives as established by the Texas Higher Education Coordinating Board for students whose major foundation is *not* a mathematical one, including but not limited to: architecture, arts, earth sciences, humanities, life sciences, pre-medical sciences, pre-engineering, construction technology. Topics include: trigonometric functions, trigonometric equalities, solving triangles, sine law, cosine law, triangle geometry. While use of technology for class demos and practice is encouraged, this is not a technology-based course, and the students should not be expected to use a calculator in class or during examinations

## **CORE CURRICULUM/GRADUATION REQUIREMENTS SATISFIED BY MATH 1321**

MATH 1321 satisfies part of the university Core Curriculum requirement in Mathematics; it is designed for a large range of majors, as specified in the previous paragraph.

## **COURSE-SPECIFIC LEARNING OBJECTIVES AND CORRESPONDING OUTCOMES**

### **1. Apply arithmetic, algebraic, geometric, statistical and/or logical reasoning to solve problems.**

In Math 1321 students will develop skills to: (1) understand and use the definitions of trigonometric functions; (2) understand and verify trigonometric identities; (3) understand vectors, operations, and the dot product; (4) graph trigonometric functions with understanding of translations, polar equations; (5) interpret information given by graphs including intercepts, domain, and range; (6) solve trigonometric equations and parametric equations; (7) use technology appropriately; (8) understand the unit circle; (9) understand when to use certain rules, properties, theorems, and formulas in the above learning outcomes; (10) model real world situations using right angle trigonometry, law of sines and cosines; (11) integrate appropriate terminology into their everyday language when discussing mathematics; (12) appraise their progress in thinking logically, increasing their mathematical confidence, and appropriate organizational skills for mathematics. Student mastery of problem solving skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

### **2. Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically**

In Math 1321 students will learn how to adequately communicate mathematical information in writing, verbally and graphically, by using words, numerical answers, algebraic expressions, logical sentences, as well as graphs and diagrams.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

### **3. Use mathematical and logical reasoning to evaluate the validity of an argument.**

In Math 1321 students will learn how to identify, understand and apply mathematical and logical reasoning to theoretical and applied problems. In particular, attention will be given to procedures for establishing the validity of functional identities.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **4. Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.**

In Math 1321 students will learn to identify and interpret mathematical information contained in formulas, graphs and tables, in particular: (a) applied triangle problems; (b) harmonic motion; (c) vectors and applications to physical problems; (d) navigational applications. The development of student interpretative and inference skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

*College-Level Competency: Students graduating from Texas Tech University should be able to: demonstrate the ability*

*to apply quantitative and logical skills to solve problems. In particular, students who have taken Math 1321 will be able to use the course-specific learning objectives in order to provide individual solutions to mathematical problems and interpret the results in a relevant manner. The assessment of these skills will be conducted via embedded assessments in final exams, senior surveys (GSS) and senior assessments (OSA).*

#### **LEARNING ASSESSMENT:**

Learning outcomes will be assessed through homework exercises, in-class quizzes, and examinations. The following assessments represent a general departmental requirement:

- 1). Homework assignments are expected to be given weekly, either as on-line, web-based assignments, or as writing-intensive assignments
- 2). It is expected that a test will be given at the end of each major chapter
- 3). A common, unique departmental final exam will be given according to the academic schedule established by the university and department, for all the course sections whose primary delivery method is the traditional one (lecture, face-to-face).

*General requirement: The Common Final represents a course requirement. A student who did not complete the Final Examination, but otherwise completed all the other requirements successfully cannot be assigned a passing letter grade (D or higher) unless taking the Final Examination. Each designated instructor has to keep their copy of partial scores and grades for each student, for one calendar year from the date of recording the grade in the web database.*

Common Grading Scale Correspondence:

Letter grade A = a percentile grade of 90% or higher

Letter grade B = a percentile grade of 80% or higher, that is lower than 90%

Letter grade C = a percentile grade of 70% or higher, that is lower than 80%

Letter grade D = a percentile grade of 60% or higher, that is lower than 70%

Letter grade F = a percentile grade lower than 60%

#### **CIVILITY IN THE CLASSROOM:**

Texas Tech University endeavor to foster a classroom climate of mutual respect among students and between students and teacher. Mutual respect means that we should be tolerant of different ideas and varying opinions about topics of discussion in class, that we address each other respectfully and without interrupting while others are speaking, and that we do not engage in disruptive behavior in class. Signs of disrespect include, but are not restricted to: ringing cell phones (students must turn them off or leave them home), reading a newspaper or other material that is not part of a class assignment while in class, talking with classmates during class, eating and

drinking in class, and similar disruptive behaviors. Students who engage in disruptive behavior will be warned. Repeated disruptive behavior may result in the student being asked to leave the classroom.

**ACADEMIC HONESTY STATEMENT:**

The TTU “Code of Student Conduct”, which you should have received when you enrolled in the university, contains a lengthy list of prohibited behaviors, among which is “Academic Dishonesty”. Please note that cheating and plagiarism (a form of cheating) are included among the actions that are subject to disciplinary action. Cheating will not be tolerated in this course. A student who is caught cheating will receive a grade of 0 on the exam, paper, or exercise. Awarding of a grade of F for the course is also a possible penalty. In addition, the incident of academic dishonesty will be reported to the Dean of the appropriate academic college for such disciplinary action as they see fit to administer.

**Plagiarism:**

“The appropriation or imitation of the language, ideas, and thoughts of another author, and representation of them as one’s original work.” *The Random House College Dictionary*, revised edition. New York: Random House, 1975, p. 1014.

“1. The use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement; 2. the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.” *Student Affairs Handbook*, Texas Tech University, Lubbock, Texas, 1998-99, p. 22. Plagiarism and cheating are not tolerated and will result in a grade of 0 on work that contains plagiarized material. In addition, a grade of F may be awarded for the course. Any cases of cheating will be reported to the Honors College and the responsible academic dean (i.e., Arts & Sciences, Business Administration, Engineering, etc.)

**ACCOMMODATION OF STUDENTS WITH DISABILITIES:**

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor’s office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

**STUDENT ABSENCE FOR OBSERVATION OF RELIGIOUS HOLY DAYS:**

A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day.

**COURSE OUTLINE (all sections)**

Chapter 1	4 hours
Chapter 2	5 hours
Chapter 3	4 hours
Chapter 4	5 hours
Chapter 5	5 hours
Chapter 6	5 hours
Chapter 7	5 hours
Chapter 8 (omit 8.4)	5 hours
Review and testing	7 hours
	45 hours

**Course Number: Mathematics 1330**

**Descriptive Title: Introductory Mathematical Analysis I**

**Prerequisites: B in MATH/TSI 0302, C in a college level math, 500 on SATM, or 19 on ACTM**

**CATALOG DESCRIPTION**

[MATH 1324] (3 credit hours) Prerequisites: A score of at least 500 on the SATM or a score of at least 19 on the ACTM and a composite score of 23, or a grade of C or better in MATH 0302 or a grade of C or better in TSI 0302 or a grade of C or better in a college level mathematics course. Pre-calculus topics of interest to students of business and the social sciences. These include mathematics of finance, logical reasoning, and Markov processes. Cannot receive credit for both MATH 1330 and 1430. Partially fulfills Core Mathematics requirement.

**CURRENT TEXTBOOK:**

Lial/Greenwell/Ritchey Finite Math & Calculus with Applications, 9/e + MyMathLab (Pearson)

**PURPOSE OF COURSE**

This course is primarily designated for students majoring in Business, Economics and Social Sciences. It contains precalculus-level topics, based on algebra and logic, with applications to business and finances. This is an application intensive course. The examinations will consist primarily of business applications. Use of a graphing calculator is a course requirement.

**CORE CURRICULUM/GRADUATION REQUIREMENTS SATISFIED BY MATH 1330**

MATH 1330 satisfies part of the university Core Curriculum requirement in Mathematics.

**COURSE-SPECIFIC LEARNING OBJECTIVES AND CORRESPONDING OUTCOMES**

**1. Apply arithmetic, algebraic, geometric, statistical and/or logical reasoning to solve problems.**

In Math 1330 students will develop skills to: (1) derive and analyze linear models of supply and demand; (2) derive and analyze quadratic models of profit; (3) solve problems that involve compound interest; (4) compute future and present values of annuities; (5) (6) solve problems involving amortization; (6) analyze logical arguments; **Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs.

**2. Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically**

In Math 1330 students will learn how to adequately communicate mathematical information in writing, verbally and graphically, by using words, numerical answers, algebraic expressions, logical sentences, as well as graphs and diagrams.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs.

**3. Use mathematical and logical reasoning to evaluate the validity of an argument.**

In Math 1330 students will learn how to identify, understand and apply mathematical and logical reasoning to theoretical and applied problems. In particular, attention will be given to procedures for determining the choice of counting principles.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs.

**4. Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.**

In Math 1330 students will learn to identify and interpret mathematical information contained in formulas, graphs and tables, in particular: (a) financial interest problems; (b) applications that model real world problems via linear systems. The development of student interpretative and inference skills will be assessed through online homework exercises, in-class quizzes, examinations, and a comprehensive department final examination.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs.

*College-Level Competency: Students graduating from Texas Tech University should be able to: demonstrate the ability to apply quantitative and logical skills to solve problems. In particular, students who have taken Math 1330 will be able to use the course-specific learning objectives in order to provide individual solutions to mathematical problems and interpret the results in a relevant manner. The assessment of these skills will be conducted via embedded assessments in final exams, senior surveys (GSS) and senior assessments (OSA).*

### **LEARNING ASSESSMENT:**

Learning outcomes will be assessed through homework exercises, in-class quizzes, and examinations. The following assessments represent a general departmental requirement:

- 1). Online homework assignments are expected to be given weekly
- 2). In-class homework quizzes will be given weekly
- 3). It is expected that a minimum of 3 in-class exams be given.
- 4). A common, unique departmental final exam will be given according to the academic schedule established by the university and department, for all the course sections whose primary delivery method is the traditional one (lecture, face-to-face).

*General requirement: The Common Final represents a course requirement. A student who did not complete the Final Examination, but otherwise completed all the other requirements successfully cannot be assigned a passing letter grade (D or higher) unless taking the Final Examination. Each designated instructor has to keep their copy of partial scores and grades for each student, for one calendar year from the date of recording the grade in the web database.*

Common Grading Scale Correspondence:

Letter grade A = a percentile grade of 90% or higher

Letter grade B = a percentile grade of 80% or higher, that is lower than 90%

Letter grade C = a percentile grade of 70% or higher, that is lower than 80%

Letter grade D = a percentile grade of 60% or higher, that is lower than 70%

Letter grade F = a percentile grade lower than 60%

### **CIVILITY IN THE CLASSROOM:**

Texas Tech University endeavor to foster a classroom climate of mutual respect among students and between students and teacher. Mutual respect means that we should be tolerant of different ideas and varying opinions about topics of discussion in class, that we address each other respectfully and without interrupting while others are speaking, and that we do not engage in disruptive behavior in class. Signs of disrespect include, but are not restricted to: ringing cell phones (students must turn them off or leave them home), reading a newspaper or other material that is not part of a class assignment while in class, talking with classmates during class, eating and drinking in class, and similar disruptive behaviors. Students who engage in disruptive behavior will be warned. Repeated disruptive behavior may result in the student being asked to leave the classroom.

### **ACADEMIC HONESTY STATEMENT:**

The TTU “Code of Student Conduct”, which you should have received when you enrolled in the university, contains a lengthy list of prohibited behaviors, among which is “Academic Dishonesty”. Please note that cheating and plagiarism (a form of cheating) are included among the actions that are subject to disciplinary action. Cheating will not be tolerated in this course. A student who is caught cheating will receive a grade of 0 on the exam, paper, or exercise. Awarding of a grade of F for the course is also a possible penalty. In addition, the

incident of academic dishonesty will be reported to the Dean of the appropriate academic college for such disciplinary action as they see fit to administer.

**Plagiarism:**

“The appropriation or imitation of the language, ideas, and thoughts of another author, and representation of them as one’s original work.” *The Random House College Dictionary*, revised edition. New York: Random House, 1975, p. 1014.

“1. The use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement; 2. the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.” *Student Affairs Handbook*, Texas Tech University, Lubbock, Texas, 1998-99, p. 22. Plagiarism and cheating are not tolerated and will result in a grade of 0 on work that contains plagiarized material. In addition, a grade of F may be awarded for the course. Any cases of cheating will be reported to the Honors College and the responsible academic dean (i.e., Arts & Sciences, Business Administration, Engineering, etc.)

**ACCOMMODATION OF STUDENTS WITH DISABILITIES:**

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor’s office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

**STUDENT ABSENCE FOR OBSERVATION OF RELIGIOUS HOLY DAYS:**

A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day.

**COURSE OUTLINE**

Chapter 1, omit 1.3	4 hours
Chapter 2	7 hours
Chapter 3	6 hours
Chapter 5	7 hours
Chapter 10, omit 10.1, 10.2, 10.3	3 hours
Chapter 6	7 hours
Review and testing	11 hours
	Total 45 hours

**Course Number:** Mathematics 1331  
**Descriptive Title:** Introductory Mathematical Analysis II  
**Prerequisites:** C in 1330, 26 on ACTM, or 610 on SATM

**CATALOG DESCRIPTION**

[MATH 1325, 1425] (3) Prerequisite: a grade of C or better in MATH 1330 or MATH 1430 or a test score of at least 610 on SATM or 26 on ACTM or 4 on Math Placement code. Contains an introduction to regression analysis and topics from differential and integral calculus that are of interest to students of business and the social sciences. Partially fulfills Core Mathematics requirement.

**CURRENT TEXTBOOK:**

Lial/Greenwell/Ritchey Finite Math & Calculus with Applications, 9/e + MyMathLab (Pearson)

**PURPOSE OF COURSE**

This course is primarily designated for students majoring in Business, Economics and Social Sciences. It is a Calculus course, with applications to business and finances. This is an application intensive course. The examinations will consist of Calculus problems with business applications. Use of a graphing calculator is a course requirement.

### **CORE CURRICULUM/GRADUATION REQUIREMENTS SATISFIED BY MATH 1331**

MATH 1331 satisfies part of the university Core Curriculum requirement in Mathematics.

### **COURSE-SPECIFIC LEARNING OBJECTIVES AND CORRESPONDING OUTCOMES**

#### **1. Apply arithmetic, algebraic, geometric, statistical and/or logical reasoning to solve problems.**

In Math 1331 students will develop skills to: (1) explain the concepts of differential and integral calculus, including limits; (2) calculate derivatives, indefinite and definite integrals; (3) solve problems that involve marginal cost, revenue and profit, elasticity of demand, diminishing returns, consumers' and producers' surplus, economic lot size, economic order quantity, average value, continuous money flow, and Lorenz curves. Student mastery of problem solving skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **2. Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically**

In Math 1331 students will learn how to adequately communicate mathematical information in writing, verbally and graphically, by using words, numerical answers, algebraic expressions, logical sentences, as well as graphs and diagrams.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **3. Use mathematical and logical reasoning to evaluate the validity of an argument.**

In Math 1331 students will learn how to identify, understand and apply mathematical and logical reasoning to theoretical and applied problems. In particular, attention will be given to procedures for interpreting applications to business and economics.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **4. Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.**

In Math 1331 students will learn to identify and interpret mathematical information contained in formulas, graphs and tables, in particular: (a) formulas for differentiation; (b) applications of derivatives to economics and optimization; (c) applications of integration to area. The development of student interpretative and inference skills will be assessed through homework exercises, in-class quizzes, and examinations.



**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

*College-Level Competency: Students graduating from Texas Tech University should be able to: demonstrate the ability to apply quantitative and logical skills to solve problems. In particular, students who have taken Math 1331 will be able to use the course-specific learning objectives in order to provide individual solutions to mathematical problems and interpret the results in a relevant manner. The assessment of these skills will be conducted via embedded assessments in final exams, senior surveys (GSS) and senior assessments (OSA).*

### **LEARNING ASSESSMENT:**

Learning outcomes will be assessed through homework exercises, in-class quizzes, and examinations. The following assessments represent a general departmental requirement:

- 1). Online homework assignments are expected to be given weekly
- 2). It is expected that a minimum of 3 in-class exams be given
- 3). A common, unique departmental final exam will be given according to the academic schedule established by the university and department, for all the course sections whose primary delivery method is the traditional one (lecture, face-to-face).

*General requirement: The Common Final represents a course requirement. A student who did not complete the Final Examination, but otherwise completed all the other requirements successfully cannot be assigned a passing letter grade (D or higher) unless taking the Final Examination. Each designated instructor has to keep their copy of partial scores and grades for each student, for one calendar year from the date of recording the grade in the web database.*

#### Common Grading Scale Correspondence:

Letter grade A = a percentile grade of 90% or higher

Letter grade B = a percentile grade of 80% or higher, that is lower than 90%

Letter grade C = a percentile grade of 70% or higher, that is lower than 80%

Letter grade D = a percentile grade of 60% or higher, that is lower than 70%

Letter grade F = a percentile grade lower than 60%

### **CIVILITY IN THE CLASSROOM:**

Texas Tech University endeavor to foster a classroom climate of mutual respect among students and between students and teacher. Mutual respect means that we should be tolerant of different ideas and varying opinions about topics of discussion in class, that we address each other respectfully and without interrupting while others are speaking, and that we do not engage in disruptive behavior in class. Signs of disrespect include, but are not restricted to: ringing cell phones (students must turn them off or leave them home), reading a newspaper or other material that is not part of a class assignment while in class, talking with classmates during class, eating and drinking in class, and similar disruptive behaviors. Students who engage in disruptive behavior will be warned. Repeated disruptive behavior may result in the student being asked to leave the classroom.

### **ACADEMIC HONESTY STATEMENT:**

The TTU “Code of Student Conduct”, which you should have received when you enrolled in the university, contains a lengthy list of prohibited behaviors, among which is “Academic Dishonesty”. Please note that cheating and plagiarism (a form of cheating) are included among the actions that are subject to disciplinary action. Cheating will not be tolerated in this course. A student who is caught cheating will receive a grade of 0 on the exam, paper, or exercise. Awarding of a grade of F for the course is also a possible penalty. In addition, the incident of academic dishonesty will be reported to the Dean of the appropriate academic college for such disciplinary action as they see fit to administer.

#### **Plagiarism:**

“The appropriation or imitation of the language, ideas, and thoughts of another author, and representation of them as one’s original work.” *The Random House College Dictionary*, revised edition. New York: Random House, 1975, p. 1014.

“1. The use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement; 2. the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.” *Student Affairs Handbook*, Texas Tech University, Lubbock, Texas, 1998-99, p. 22. Plagiarism and cheating are not tolerated and will result in a grade of 0 on work that contains plagiarized material. In addition, a grade of F may be awarded for the course. Any cases of cheating will be reported to the Honors College and the responsible academic dean (i.e., Arts & Sciences, Business Administration, Engineering, etc.)

#### **ACCOMMODATION OF STUDENTS WITH DISABILITIES:**

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor’s office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

#### **STUDENT ABSENCE FOR OBSERVATION OF RELIGIOUS HOLY DAYS:**

A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day.

#### **COURSE OUTLINE**

Chapter 11	7 hours
Chapter 12	9 hours
Chapter 13	7 hours
Chapter 14	8 hours
Chapter 15	8 hours
Review and testing	6 hours
	Total 45 hours

**Course Number: Mathematics 1350**

**Descriptive Title: Analytic Geometry**

**Prerequisites: Math 1321, or departmental permission**

#### **CATALOG DESCRIPTION**

(3 credit hours)

Prerequisite: MATH 1321 or Code 6 or higher on MPE or a score of at least 660 on the SATM or a score of at least 29 on the ACTM. Fundamental concepts of analytical geometry. Partially fulfills core Mathematics requirement.

#### **CURRENT TEXTBOOK:**

*Analytic Geometry, 6<sup>th</sup> edition* by Douglas Riddle (Brooks/Cole publishers)

#### **PURPOSE OF COURSE**

This course is primarily designed for architecture and pre-engineering majors. It provides a basic background in analytic elementary geometry.

#### **CORE CURRICULUM/GRADUATION REQUIREMENTS SATISFIED BY MATH 1350**

MATH 1350 satisfies part of the university Core Curriculum requirement in Mathematics.

## COURSE-SPECIFIC LEARNING OBJECTIVES AND CORRESPONDING OUTCOMES

### 1. Apply arithmetic, algebraic, geometric, statistical and/or logical reasoning to solve problems.

In Math 1350 students will develop skills to: (1) analyze geometry in the plane; (2) determine properties of conic sections; (3) apply transformation of coordinates; (4) sketch curves; (5) use parametric curve representations; (6) investigate geometry in space; (7) integrate appropriate terminology into your everyday language when discussing mathematics; (8) appraise their own progress in thinking logically, increasing their mathematical confidence, and appropriate organizational skills for mathematics. Student mastery of problem solving skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of homework and exam problems will be created by the course coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective. The homework assignments and mid-term exams will include selected problems from this comprehensive list, and all of the problems on the final exams will be selected from this comprehensive list. The final exams will be periodically sampled and analyzed in order to assess how this particular objective was attained. The assessment will measure the percentage of students who achieved mastery of the skills and knowledge involved by this objective.

### 2. Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically

In Math 1350 students will learn how to adequately communicate mathematical information in writing, verbally and graphically, by using words, numerical answers, algebraic expressions, logical sentences, as well as graphs and diagrams.

**Assessment Strategies:** A comprehensive list of homework and exam problems will be created by the course coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective. The homework assignments and mid-term exams will include selected problems from this comprehensive list, and all of the problems on the final exams will be selected from this comprehensive list. The final exams will be periodically sampled and analyzed in order to assess how this particular objective was attained. The assessment will measure the percentage of students who achieved mastery of the skills and knowledge involved by this objective.

### 3. Use mathematical and logical reasoning to evaluate the validity of an argument.

In Math 1350 students will learn how to identify, understand and apply mathematical and logical reasoning to theoretical and applied problems. In particular, attention will be given to procedures for establishing of the validity of functional identities and to the principle for constructing proofs by mathematical induction.

**Assessment Strategies:** A comprehensive list of homework and exam problems will be created by the course coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective. The homework assignments and mid-term exams will include selected problems from this comprehensive list, and all of the problems on the final exams will be selected from this comprehensive list. The final exams will be periodically sampled and analyzed in order to assess how this particular objective was attained. The assessment will measure the percentage of students who achieved mastery of the skills and knowledge involved by this objective.

### 4. Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.

In Math 1350 students will learn to identify and interpret mathematical information contained in formulas, graphs and tables, in particular: (a) interpreting graphs of functions; (b) applications to geometric models; (c) applied

problems. The development of student interpretative and inference skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of homework and exam problems will be created by the course coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective. The homework assignments and mid-term exams will include selected problems from this comprehensive list, and all of the problems on the final exams will be selected from this comprehensive list. The final exams will be periodically sampled and analyzed in order to assess how this particular objective was attained. The assessment will measure the percentage of students who achieved mastery of the skills and knowledge involved by this objective.

*College-Level Competency: Students graduating from Texas Tech University should be able to: demonstrate the ability to apply quantitative and logical skills to solve problems. In particular, students who have taken Math 1350 will be able to use the course-specific learning objectives in order to provide individual solutions to mathematical problems and interpret the results in a relevant manner.*

*The assessment of these skills will be conducted via embedded assessments in final exams, senior surveys (GSS) and senior assessments (OSA).*

## STUDENT LEARNING OUTCOMES

Students will ·

- Apply trigonometry to geometric problems.
- Study conic in planes.
- Study quadrics in space.
- Perform geometric constructions in plane.
- Perform geometric constructions in space.
- Write basic geometric proofs.
- Study Euclidean motions in plane and in space.

## LEARNING ASSESSMENT:

Learning outcomes will be assessed through homework exercises, in-class quizzes, and examinations. The following assessments represent a general departmental requirement:

- 1). Homework assignments are expected to be given weekly, either as on-line, web-based assignments, or as writing-intensive assignments
- 2). It is expected that a test will be given at the end of each major chapter
- 3). A common, unique departmental final exam will be given according to the academic schedule established by the university and department, for all the course sections whose primary delivery method is the traditional one (lecture, face-to-face).

*General requirement: The Common Final represents a course requirement. A student who did not complete the Final Examination, but otherwise completed all the other requirements successfully cannot be assigned a passing letter grade (D or higher) unless taking the Final Examination. Each designated instructor has to keep their copy of partial scores and grades for each student, for one calendar year from the date of recording the grade in the web database.*

Common Grading Scale Correspondence:

Letter grade A = a percentile grade of 90% or higher

Letter grade B = a percentile grade of 80% or higher, that is lower than 90%

Letter grade C = a percentile grade of 70% or higher, that is lower than 80%

Letter grade D = a percentile grade of 60% or higher, that is lower than 70%

Letter grade F = a percentile grade lower than 60%

**ACCOMODATION OF STUDENTS WITH DISABLILITIES:**

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

**STUDENT ABSENCE FOR OBSERVATION OF RELIGIOUS HOLY DAYS:**

A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day.

**COURSE OUTLINE**

Chapter 1, Sections 1-7	7 hours
Chapter 2, Sections 1-3	3 hours
Chapter 3, Sections 1-3	3 hours
Chapter 4, Sections 1-2	2 hours
Chapter 5, Sections 1-4	4 hours
Chapter 6, Sections 1,3-4	3 hours
Chapter 7, Sections 1-6	6 hours
Chapter 8, Sections 1-6	6 hours
Chapter 9, Sections 1-6, 9	7 hours
Review and testing	4 hours
	Total 45 hours

**Course Number:** Mathematics 1451

**Descriptive Title:** Calculus I with Applications (4:4:0)

**Prerequisites:** (at least a) C in MATH 1350 or 1550, or 7 on MPE, or B in MATH 1321, or C in 1321 with 5 on MPE, or 660 on SATM, or 29 on ACTM, or 3 on AP AB Calculus with 5 on MPE

**CATALOG DESCRIPTION**

[MATH 2413, 2417, 2513] (4 credit hours) Prerequisite: MATH 1350 or 1550 with a grade of C or better, or MATH 1321 with a grade of C and Code 5 on MPE, or MATH 1321 with a grade of B or better, or Code 7 on MPE, or a score of at least 660 on the SATM, or a score of at least 29 on the ACTM, or a score of at least 3 on AP AB Calculus and Code 5 on MPE. Differentiation of algebraic and transcendental functions, differentials, indefinite integrals, definite integrals. Applications and problem-solving are strongly emphasized. Partially fulfills Core Mathematics requirement. A student will receive credit for either (not both) MATH 1351 or 1451. (Honors section offered.)

**CURRENT TEXTBOOK:**

K. Smith, M. Strauss and M. Toda – Calculus, 6<sup>th</sup> National Edition, Kendall Hunt.

**PURPOSE OF COURSE**

One of the main goals of this course is developing the student's geometric insight into the concepts of differentiation and integration, and applying these concepts to problem solving and "real world application". Instructors should emphasize the concepts of limit, continuity, and differentiability to properties of graphs. Intuitive discussions and "picture arguments" are acceptable, as well as a few short proofs (e.g., prove the product

rule for differentiation). This course is organized as a four hour lecture for the regular academic year (Fall and Spring) and the corresponding amount of hours for each Summer Session. Every week, the first three hours will be devoted to covering the material from the text-book. The fourth hour will be exclusively dedicated to applications, examples and exercises that are relevant to the learning objectives, and improve the student success in the examinations. Depending on availability of academic facilities, the fourth hour of lecture can be held in a regular classroom, a lecture hall, or a computer lab, where the students will follow the instructor's presentation and become actively involved in problem-solving at the same time.

### **CORE CURRICULUM/GRADUATION REQUIREMENTS SATISFIED BY MATH 1451**

MATH 1451 satisfies part of the university Core Curriculum requirement in Mathematics.

### **COURSE-SPECIFIC LEARNING OBJECTIVES AND CORRESPONDING OUTCOMES**

#### **1. Apply arithmetic, algebraic, geometric, statistical and/or logical reasoning to solve problems.**

In Math 1451 students will develop skills to: (1) be able to explain the concept of continuous functions; (2) compute instantaneous rate of change; (3) compute derivatives of polynomial and transcendental functions; (4) use differentiation to solve related rate and optimization problems; (5) compute definite and indefinite integrals; (6) apply specific concepts to certain problems from the real world and other sciences. Student mastery of problem solving skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **2. Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically**

In Math 1451 students will learn how to adequately communicate mathematical information in writing, verbally and graphically, by using words, numerical answers, algebraic expressions, logical sentences, as well as graphs and diagrams.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **3. Use mathematical and logical reasoning to evaluate the validity of an argument.**

In Math 1451 students will learn how to identify, understand and apply mathematical and logical reasoning to theoretical and applied problems. In particular, attention will be given to elementary proofs in calculus and hypothesis-conclusion inferences for applications such as the Mean Value Theorem and l'Hopital's Rule.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **4. Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.**

In Math 1451 students will learn to identify and interpret mathematical information contained in formulas, graphs and tables, in particular: (a) modeling rates of change in rectilinear motion; (b) linear approximations; (c) optimization and applications to physical problems; (d) Riemann sums and integration. The development of student interpretative and inference skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

*College-Level Competency: Students graduating from Texas Tech University should be able to: demonstrate the ability to apply quantitative and logical skills to solve problems. In particular, students who have taken Math 1451 will be able to use the course-specific learning objectives in order to provide individual solutions to mathematical problems and interpret the results in a relevant manner. The assessment of these skills will be conducted via embedded assessments in final exams, senior surveys (GSS) and senior assessments (OSA).*

### **LEARNING ASSESSMENT:**

Learning outcomes will be assessed through homework exercises, in-class quizzes, and examinations. The following assessments represent a general departmental requirement:

- 1). Homework assignments are expected to be given weekly, either as on-line, web-based assignments, or as writing-intensive assignments
- 2). It is expected that a test will be given at the end of each major chapter
- 3). A common, unique departmental final exam will be given according to the academic schedule established by the university and department, for all the course sections whose primary delivery method is the traditional one (lecture, face-to-face).

*General requirement: The Common Final represents a course requirement. A student who did not complete the Final Examination, but otherwise completed all the other requirements successfully cannot be assigned a passing letter grade (D or higher) unless taking the Final Examination. Each designated instructor has to keep their copy of partial scores and grades for each student, for one calendar year from the date of recording the grade in the web database.*

Common Grading Scale Correspondence:

Letter grade A = a percentile grade of 90% or higher

Letter grade B = a percentile grade of 80% or higher, that is lower than 90%

Letter grade C = a percentile grade of 70% or higher, that is lower than 80%

Letter grade D = a percentile grade of 60% or higher, that is lower than 70%

Letter grade F = a percentile grade lower than 60%

### **CIVILITY IN THE CLASSROOM:**

Texas Tech University endeavor to foster a classroom climate of mutual respect among students and between students and teacher. Mutual respect means that we should be tolerant of different ideas and varying opinions about topics of discussion in class, that we address each other respectfully and without interrupting while others are speaking, and that we do not engage in disruptive behavior in class. Signs of disrespect include, but are not restricted to: ringing cell phones (students must turn them off or leave them home), reading a newspaper or other material that is not part of a class assignment while in class, talking with classmates during class, eating and drinking in class, and similar disruptive behaviors. Students who engage in disruptive behavior will be warned. Repeated disruptive behavior may result in the student being asked to leave the classroom.

### **ACADEMIC HONESTY STATEMENT:**

The TTU “Code of Student Conduct”, which you should have received when you enrolled in the university, contains a lengthy list of prohibited behaviors, among which is “Academic Dishonesty”. Please note that cheating and plagiarism (a form of cheating) are included among the actions that are subject to disciplinary action. Cheating will not be tolerated in this course. A student who is caught cheating will receive a grade of 0 on the exam, paper, or exercise. Awarding of a grade of F for the course is also a possible penalty. In addition, the incident of academic dishonesty will be reported to the Dean of the appropriate academic college for such disciplinary action as they see fit to administer.

### **Plagiarism:**

“The appropriation or imitation of the language, ideas, and thoughts of another author, and representation of them as one’s original work.” *The Random House College Dictionary*, revised edition. New York: Random House, 1975, p. 1014. “1. The use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement; 2. the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.” *Student Affairs Handbook*, Texas Tech University, Lubbock, Texas, 1998-99, p. 22. Plagiarism and cheating are not tolerated and will result in a grade of 0 on work that contains plagiarized material. In addition, a grade of F may be awarded for the course. Any cases of cheating will be reported to the Honors College and the responsible academic dean (i.e., Arts & Sciences, Business Administration, Engineering, etc.)

**ACCOMMODATION OF STUDENTS WITH DISABILITIES:**

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor’s office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

**STUDENT ABSENCE FOR OBSERVATION OF RELIGIOUS HOLY DAYS:**

A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day.

**COURSE OUTLINE**

Chapter 1	8 hours
Chapter 2	9 hours
Chapter 3	11 hours
Chapter 4	10 hours
Chapter 5	8 hours
Applications, Review and Testing	14 hours
	Total 60 hours

**Course Number:** Mathematics 1452

**Descriptive Title:** Calculus II with Applications (4:4:0)

**Prerequisites:** (at least a) C in MATH 1351 or MATH 1451, or departmental permission (based on transfer or examination)

**CATALOG DESCRIPTION**

[MATH 2414, 2419] (4 credit hours) Prerequisite: MATH 1351 or MATH 1451 or departmental consent. Methods of integration, parametric equations, polar coordinates, hyperbolic functions, infinite series. Applications and problem-solving are strongly emphasized. Partially fulfills Core Mathematics requirement. A student will receive credit for either (not both) MATH 1352 or 1452. (Honors section offered).

**CURRENT TEXTBOOK:**

J. Bradley, M. Strauss, K. Smith – Calculus, 5<sup>th</sup> Custom Edition, Pearson (out of print),  
Or alternatively,  
K. Smith, M. Strauss and M. Toda – Calculus, 6<sup>th</sup> National Edition, Kendall Hunt.

**PURPOSE OF COURSE**

Students should develop an understanding of the basic transcendental functions and of their importance. In particular students should have a good understanding of the meaning of the terms exponential growth and logarithmic growth, and how they relate to polynomial growth. Students should experience a variety of applications of the definite integral. Sufficient attention will be devoted to logical thinking, and simple proofs that



emphasize deductive reasoning. Logical reasoning should prevail with respect to mechanical memorization on integration techniques or integration formulas. Students are expected to become familiar with polar coordinates, areas and volumes as obtained by integration, and the most common integration techniques, including certain trigonometric substitutions and integration by parts. They should be familiar with some of the most common formulas for antiderivatives of elementary functions, in order to compute others. Infinite sums (series) and criteria for convergence should be given sufficient attention. It is important to emphasize on the other hand, that most antiderivatives cannot be written in terms of elementary functions. Covering fundamental notions of vector analysis in 2-d and 3-d Euclidean spaces is of crucial importance. This course is organized as a four hour lecture for the regular academic year (Fall and Spring) and the corresponding amount of hours for each Summer Session. Every week, the first three hours will be devoted to covering the material from the text-book. The fourth hour will be exclusively dedicated to applications, examples and exercises that are relevant to the learning objectives, and improve the student success in the examinations. Depending on availability of academic facilities, the fourth hour of lecture can be held in a regular classroom, a lecture hall, or a computer lab, where the students will follow the instructor's presentation and become actively involved in problem-solving at the same time.

### **CORE CURRICULUM/GRADUATION REQUIREMENTS SATISFIED BY MATH 1452**

MATH 1452 satisfies part of the university Core Curriculum requirement in Mathematics.

### **COURSE-SPECIFIC LEARNING OBJECTIVES AND CORRESPONDING OUTCOMES**

#### **1. Apply arithmetic, algebraic, geometric, statistical and/or logical reasoning to solve problems.**

In Math 1452 students will develop skills to: (1) compute areas and volumes; (2) solve real world problems involving selected concepts from the physical and life sciences, and economics; (3) integrate by using substitution, integration by parts, and partial fractions; (4) analyze the convergence of infinite series and sequences; (5) perform basic vector algebra; (6) apply specific concepts to certain problems from the real world and other sciences. Student mastery of problem solving skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **2. Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically**

In Math 1452 students will learn how to adequately communicate mathematical information in writing, verbally and graphically, by using words, numerical answers, algebraic expressions, logical sentences, as well as graphs and diagrams.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **3. Use mathematical and logical reasoning to evaluate the validity of an argument.**

In Math 1452 students will learn how to identify, understand and apply mathematical and logical reasoning to theoretical and applied problems. In particular, attention will be given to elementary proofs in calculus and convergence inferences for improper integrals and infinite series.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **4. Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.**

In Math 1452 students will learn to identify and interpret mathematical information contained in formulas, graphs and tables, in particular: (a) applications to physical problems; (b) formulas from integration tables; (c) geometric and infinite series. The development of student interpretative and inference skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

*College-Level Competency: Students graduating from Texas Tech University should be able to: demonstrate the ability to apply quantitative and logical skills to solve problems. In particular, students who have taken Math 1452 will be able to use the course-specific learning objectives in order to provide individual solutions to mathematical problems and interpret the results in a relevant manner. The assessment of these skills will be conducted via embedded assessments in final exams, senior surveys (GSS) and senior assessments (OSA).*

#### **LEARNING ASSESSMENT:**

Learning outcomes will be assessed through homework exercises, in-class quizzes, and examinations. The following assessments represent a general departmental requirement:

- 1). Homework assignments are expected to be given weekly, either as on-line, web-based assignments, or as writing-intensive assignments
- 2). It is expected that a test will be given at the end of each major chapter
- 3). A common, unique departmental final exam will be given according to the academic schedule established by the university and department, for all the course sections whose primary delivery method is the traditional one (lecture, face-to-face).

*General requirement: The Common Final represents a course requirement. A student who did not complete the Final Examination, but otherwise completed all the other requirements successfully cannot be assigned a passing letter grade (D or higher) unless taking the Final Examination. Each designated instructor has to keep their copy of partial scores and grades for each student, for one calendar year from the date of recording the grade in the web database.*

#### **Common Grading Scale Correspondence:**

Letter grade A = a percentile grade of 90% or higher

Letter grade B = a percentile grade of 80% or higher, that is lower than 90%

Letter grade C = a percentile grade of 70% or higher, that is lower than 80%

Letter grade D = a percentile grade of 60% or higher, that is lower than 70%

Letter grade F = a percentile grade lower than 60%

#### **CIVILITY IN THE CLASSROOM:**

Texas Tech University endeavor to foster a classroom climate of mutual respect among students and between students and teacher. Mutual respect means that we should be tolerant of different ideas and varying opinions about topics of discussion in class, that we address each other respectfully and without interrupting while others are speaking, and that we do not engage in disruptive behavior in class. Signs of disrespect include, but are not restricted to: ringing cell phones (students must turn them off or leave them home), reading a newspaper or other material that is not part of a class assignment while in class, talking with classmates during class, eating and drinking in class, and similar disruptive behaviors. Students who engage in disruptive behavior will be warned. Repeated disruptive behavior may result in the student being asked to leave the classroom.

#### **ACADEMIC HONESTY STATEMENT:**

The TTU “Code of Student Conduct”, which you should have received when you enrolled in the university, contains a lengthy list of prohibited behaviors, among which is “Academic Dishonesty”. Please note that cheating and plagiarism (a form of cheating) are included among the actions that are subject to disciplinary action. Cheating will not be tolerated in this course. A student who is caught cheating will receive a grade of 0 on the exam, paper, or exercise. Awarding of a grade of F for the course is also a possible penalty. In addition, the incident of academic dishonesty will be reported to the Dean of the appropriate academic college for such disciplinary action as they see fit to administer.

**Plagiarism:**

“The appropriation or imitation of the language, ideas, and thoughts of another author, and representation of them as one’s original work.” *The Random House College Dictionary*, revised edition. New York: Random House, 1975, p. 1014. “1. The use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement; 2. the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.” *Student Affairs Handbook*, Texas Tech University, Lubbock, Texas, 1998-99, p. 22. Plagiarism and cheating are not tolerated and will result in a grade of 0 on work that contains plagiarized material. In addition, a grade of F may be awarded for the course. Any cases of cheating will be reported to the Honors College and the responsible academic dean (i.e., Arts & Sciences, Business Administration, Engineering, etc.)

**ACCOMMODATION OF STUDENTS WITH DISABILITIES:**

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor’s office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

**STUDENT ABSENCE FOR OBSERVATION OF RELIGIOUS HOLY DAYS:**

A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day.

**COURSE OUTLINE** (all sections covered, unless otherwise specified by Course coordinator)

Chapter 5 (Review of Calculus I)	6 hours
Chapter 6	10 hours
Chapter 7	12 hours
Chapter 8	12 hours
Chapter 9 (only 9.1-9.5)	6 hours
Applications, Review and Testing	14 hours
	Total 60 hours

**Course Number:** Mathematics 1550  
**Descriptive Title:** Precalculus  
**Prerequisites:** A in MATH/TSI 0302, C in a college level math, 3 on MPE, 610 on SATM, or 26 on ACTM

**CATALOG DESCRIPTION**

(5 credit hours)

Prerequisite: Code 3 or higher on MPE or a score of at least 610 on the SATM or a score of at least 26 on the ACTM or a grade of A in MATH 0302 or a grade of A in TSI 0302 or a grade of C or better in a college level mathematics course. Topics from college algebra, trigonometry, and analytical geometry that are necessary prerequisites for Calculus I. Partially fulfills Core Mathematics requirement.

## **CURRENT TEXTBOOK:**

*Precalculus*, Tenth Edition (2018) by Ron Larson.

## **PURPOSE OF COURSE**

The purpose of this course is to prepare students to take the Calculus sequence as well as to prepare students for future courses within their chosen major, such as, but not limited to, Engineering and Chemistry. From this course, students should acquire the skills and concepts necessary for success. Although a graphing calculator is required, it will not be a central feature of this course; we will use them to aid understanding after you have mastered the concepts.

## **CORE CURRICULUM/GRADUATION REQUIREMENTS SATISFIED BY MATH 1550**

MATH 1550 satisfies part of the university Core Curriculum requirement in Mathematics.

## **COURSE-SPECIFIC LEARNING OBJECTIVES AND CORRESPONDING OUTCOMES**

### **1. Apply arithmetic, algebraic, geometric, statistical and/or logical reasoning to solve problems.**

In Math 1550 students will develop skills to: (1) use linear and quadratic functions; (2) use rational functions, graphs, and asymptotes; (3) compute exponential and logarithmic expressions; (4) solve linear, quadratic, exponential and logarithmic equations; (5) utilize the unit circle and basic trigonometric functions; (6) graph trigonometric functions; (7) solve simple trigonometric equations; (8) use technology appropriately; (9) integrate appropriate terminology into your everyday language when discussing mathematics; (10) appraise their own progress in thinking logically, increasing their mathematical confidence, and appropriate organizational skills for mathematics. Student mastery of problem solving skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

### **2. Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically**

In Math 1550 students will learn how to adequately communicate mathematical information in writing, verbally and graphically, by using words, numerical answers, algebraic expressions, logical sentences, as well as graphs and diagrams.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

### **3. Use mathematical and logical reasoning to evaluate the validity of an argument.**

In Math 1550 students will learn how to identify, understand and apply mathematical and logical reasoning to theoretical and applied problems. In particular, attention will be given to procedures for establishing of the validity of functional identities and to the principle for constructing proofs by mathematical induction.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

### **4. Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.**

In Math 1550 students will learn to identify and interpret mathematical information contained in formulas, graphs and tables, in particular: (a) interpreting graphs of functions; (b) applications to biological models; (c) applied triangle problems; (d) applications that model real world problems via linear systems; (e) discrete arithmetic formulas and equations. The development of student interpretative and inference skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

*College-Level Competency: Students graduating from Texas Tech University should be able to: demonstrate the ability to apply quantitative and logical skills to solve problems. In particular, students who have taken Math 1550 will be able to use the course-specific learning objectives in order to provide individual solutions to mathematical problems and interpret the results in a relevant manner. The assessment of these skills will be conducted via embedded assessments in final exams, senior surveys (GSS) and senior assessments (OSA).*

### **LEARNING ASSESSMENT:**

Learning outcomes will be assessed through homework exercises, in-class quizzes, and examinations. The following assessments represent a general departmental requirement:

- 1). Homework assignments are expected to be given weekly, either as on-line, web-based assignments, or as writing-intensive assignments
- 2). It is expected that a test will be given at the end of each major chapter
- 3). A common, unique departmental final exam will be given according to the academic schedule established by the university and department, for all the course sections whose primary delivery method is the traditional one (lecture, face-to-face).

*General requirement: The Common Final represents a course requirement. A student who did not complete the Final Examination, but otherwise completed all the other requirements successfully cannot be assigned a passing letter grade (D or higher) unless taking the Final Examination. Each designated instructor has to keep their copy of partial scores and grades for each student, for one calendar year from the date of recording the grade in the web database.*

#### Common Grading Scale Correspondence:

Letter grade A = a percentile grade of 90% or higher

Letter grade B = a percentile grade of 80% or higher, that is lower than 90%

Letter grade C = a percentile grade of 70% or higher, that is lower than 80%

Letter grade D = a percentile grade of 60% or higher, that is lower than 70%

Letter grade F = a percentile grade lower than 60%

### **CIVILITY IN THE CLASSROOM:**

Texas Tech University endeavor to foster a classroom climate of mutual respect among students and between students and teacher. Mutual respect means that we should be tolerant of different ideas and varying opinions about topics of discussion in class, that we address each other respectfully and without interrupting while others are speaking, and that we do not engage in disruptive behavior in class. Signs of disrespect include, but are not restricted to: ringing cell phones (students must turn them off or leave them home), reading a newspaper or other material that is not part of a class assignment while in class, talking with classmates during class, eating and drinking in class, and similar disruptive behaviors. Students who engage in disruptive behavior will be warned. Repeated disruptive behavior may result in the student being asked to leave the classroom.

### **ACADEMIC HONESTY STATEMENT:**

The TTU “Code of Student Conduct”, which you should have received when you enrolled in the university, contains a lengthy list of prohibited behaviors, among which is “Academic Dishonesty”. Please note that cheating and plagiarism (a form of cheating) are included among the actions that are subject to disciplinary action.

Cheating will not be tolerated in this course. A student who is caught cheating will receive a grade of 0 on the exam, paper, or exercise. Awarding of a grade of F for the course is also a possible penalty. In addition, the incident of academic dishonesty will be reported to the Dean of the appropriate academic college for such disciplinary action as they see fit to administer.

**Plagiarism:**

“The appropriation or imitation of the language, ideas, and thoughts of another author, and representation of them as one’s original work.” *The Random House College Dictionary*, revised edition. New York: Random House, 1975, p. 1014. “1. The use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement; 2. the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.” *Student Affairs Handbook*, Texas Tech University, Lubbock, Texas, 1998-99, p. 22. Plagiarism and cheating are not tolerated and will result in a grade of 0 on work that contains plagiarized material. In addition, a grade of F may be awarded for the course. Any cases of cheating will be reported to the Honors College and the responsible academic dean (i.e., Arts & Sciences, Business Administration, Engineering, etc.)

**ACCOMMODATION OF STUDENTS WITH DISABILITIES:**

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor’s office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

**STUDENT ABSENCE FOR OBSERVATION OF RELIGIOUS HOLY DAYS:**

A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day.

**COURSE OUTLINE**

Appendix (A.2, A.5 A.6)	3 hours
Chapter 1	12 hours
Chapter 2	7 hours
Chapter 3	6 hours
Chapter 4 (omit 4.8)	9 hours
Chapter 5	6 hours
Chapter 6 (6.4 is optional)	6 hours
Chapter 7 (7.5 is optional, omit 7.6)	5 hours
Chapter 8 (8.2 and 8.3 are optional; omit 8.4 and 8.5)	2 hours
Chapter 9 (omit 9.4-9.7)	3 hours
Chapter 10 (omit 10.1, 10.5, 10.6, 10.9)	5 hours
Review and testing	11 hours
	Total 75 hours

**Course Number:** Mathematics 2300  
**Descriptive Title:** Statistical Methods  
**Prerequisites:** 4 on MPE, 610 on SATM, 26 on ACTM, or C in a college level math

**CATALOG DESCRIPTION**

[MATH 1342, 1442, 2342, 2442] (3 credit hours) Prerequisite: Code 4 or higher on MPE or a score of at least 610 on the SATM or a score of at least 26 on the ACTM or a grade of C or better in a college level mathematics

course. Methods of analyzing data, statistical concepts and models, estimation, tests of significance, introduction to analysis of variance, linear regression, and correlation. Partially fulfills Core Mathematics requirement.

### **CURRENT TEXTBOOK:**

*Elementary STATISTICS*; 9th Edition by Neil A. Weiss, published by Pearson

*Note: Use of MyStatsLab, MyMathLab, WeBWork, as well as any other textbook-specific interactive web-based homework is subject to approval by the Course Coordinator and/or Departmental Administration every semester.*

### **PURPOSE OF COURSE**

This course is designated for a wide student body population. It gives the students an *introduction* to some of the *basic statistical methods* used in practice. Math 2300 fulfills a set of learning objectives as established by the Texas Higher Education Coordinating Board. While use of technology for class demos and practice is encouraged, this is not a technology-based course. Use of technology in the classroom and during examinations will be established by the Course Coordinator, together with individual instructors.

### **CORE CURRICULUM/GRADUATION REQUIREMENTS SATISFIED BY MATH 2300**

MATH 2300 satisfies part of the university Core Curriculum requirement in Mathematics. It is designed for a large range of majors, as Statistics plays a major role in Science, Education and everyday life.

### **COURSE-SPECIFIC LEARNING OBJECTIVES AND CORRESPONDING OUTCOMES**

#### **1. Apply arithmetic, algebraic, geometric, statistical and/or logical reasoning to solve problems.**

In Math 2300 students will develop skills to: (1) develop proficiency in solving real-world problems; (2) compute various statistical measures, including the mean, median, mode, standard deviation, variance, and quartiles; (3) utilize graphical representations of data; (4) solve problems involving the binomial and normal distributions; (5) apply the Central Limit Theorem; (6) compute and interpret confidence intervals; (7) conduct and interpret hypothesis tests; (8) use linear regression models. Student mastery of problem solving skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **2. Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically**

In Math 2300 students will learn how to adequately communicate mathematical information in writing, verbally and graphically, by using words, numerical answers, algebraic expressions, logical sentences, as well as graphs and diagrams.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **3. Use mathematical and logical reasoning to evaluate the validity of an argument.**

In Math 2300 students will learn how to identify, understand and apply mathematical and logical reasoning to theoretical and applied problems. In particular, attention will be given to procedures for the construction of inferences and establishing of the validity of hypothesis testing.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### **4. Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.**

In Math 2300 students will learn to identify and interpret mathematical information contained in formulas, graphs and tables, in particular: (a) measures of central tendency and variation; (b) constructing and interpreting histograms and charts; (c) probability distributions; (d) interpreting confidence intervals. The development of student interpretative and inference skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

*College-Level Competency: Students graduating from Texas Tech University should be able to: demonstrate the ability to apply quantitative and logical skills to solve problems. In particular, students who have taken Math 2300 will be able to use the course-specific learning objectives in order to provide individual solutions to mathematical problems and interpret the results in a relevant manner. The assessment of these skills will be conducted via embedded assessments in final exams, senior surveys (GSS) and senior assessments (OSA).*

#### **LEARNING ASSESSMENT:**

Learning outcomes will be assessed through homework exercises, in-class quizzes, and examinations. The following assessments represent a general departmental requirement:

- 1). Homework assignments are expected to be given weekly, either as on-line, web-based assignments, or as writing-intensive assignments
- 2). It is expected that a test will be given at the end of each major chapter
- 3). A common, unique departmental final exam will be given according to the academic schedule established by the university and department, for all the course sections whose primary delivery method is the traditional one (lecture, face-to-face).

*General requirement: The Common Final represents a course requirement. A student who did not complete the Final Examination, but otherwise completed all the other requirements successfully cannot be assigned a passing letter grade (D or higher) unless taking the Final Examination. Each designated instructor has to keep their copy of partial scores and grades for each student, for one calendar year from the date of recording the grade in the web database.*

Common Grading Scale Correspondence:

Letter grade A = a percentile grade of 90% or higher

Letter grade B = a percentile grade of 80% or higher, that is lower than 90%

Letter grade C = a percentile grade of 70% or higher, that is lower than 80%

Letter grade D = a percentile grade of 60% or higher, that is lower than 70%

Letter grade F = a percentile grade lower than 60%

#### **CIVILITY IN THE CLASSROOM:**

Texas Tech University endeavor to foster a classroom climate of mutual respect among students and between students and teacher. Mutual respect means that we should be tolerant of different ideas and varying opinions about topics of discussion in class, that we address each other respectfully and without interrupting while others are speaking, and that we do not engage in disruptive behavior in class. Signs of disrespect include, but are not restricted to: ringing cell phones (students must turn them off or leave them home), reading a newspaper or other material that is not part of a class assignment while in class, talking with classmates during class, eating and



drinking in class, and similar disruptive behaviors. Students who engage in disruptive behavior will be warned. Repeated disruptive behavior may result in the student being asked to leave the classroom.

**ACADEMIC HONESTY STATEMENT:**

The TTU “Code of Student Conduct”, which you should have received when you enrolled in the university, contains a lengthy list of prohibited behaviors, among which is “Academic Dishonesty”. Please note that cheating and plagiarism (a form of cheating) are included among the actions that are subject to disciplinary action. Cheating will not be tolerated in this course. A student who is caught cheating will receive a grade of 0 on the exam, paper, or exercise. Awarding of a grade of F for the course is also a possible penalty. In addition, the incident of academic dishonesty will be reported to the Dean of the appropriate academic college for such disciplinary action as they see fit to administer.

**Plagiarism:**

“The appropriation or imitation of the language, ideas, and thoughts of another author, and representation of them as one’s original work.” *The Random House College Dictionary*, revised edition. New York: Random House, 1975, p. 1014. “1. The use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement; 2. the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.” *Student Affairs Handbook*, Texas Tech University, Lubbock, Texas, 1998-99, p. 22. Plagiarism and cheating are not tolerated and will result in a grade of 0 on work that contains plagiarized material. In addition, a grade of F may be awarded for the course. Any cases of cheating will be reported to the Honors College and the responsible academic dean (i.e., Arts & Sciences, Business Administration, Engineering, etc.)

**ACCOMMODATION OF STUDENTS WITH DISABILITIES:**

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor’s office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

**STUDENT ABSENCE FOR OBSERVATION OF RELIGIOUS HOLY DAYS:**

A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day

**COURSE OUTLINE**

Chapter 1 - 1.1-1.2	1 hour
Chapter 2 - 2.1-2.4	3 hours
Chapter 3 - 3.1-3.5	4 hours
Chapter 5 - 5.1-5.6	6 hours
Chapter 6 - 6.1-6.3	3 hours
Chapter 7 - 7.1-7.3	3 hours
Chapter 8 - 8.1-8.3	3 hours
Chapter 9 - 9.1-9.5	4 hours
Chapter 10 - 10.1-10.4	4 hours
Chapter 11 - 11.1-11.3	2 hours
Review and testing	10 hours
	Total 43 hours

**Course Number: Mathematics 2345**

**Descriptive Title: Business Statistics**

**Prerequisites: C in MATH 1330 or 1430, 4 on MPE, 26 on ACTM, or 610 on SATM**

## CATALOG DESCRIPTION

(3 credit hours)

Prerequisite: Code 4 or higher on MPE or a score of at least 610 on the SATM or a score of at least 26 on the ACTM or MATH 1330 or 1430 with a grade of C or better. Statistics and probability for business. Data collection, description, interpretation, prediction, inference, and computer software. Partially fulfills Core Mathematics requirement.

## CURRENT TEXTBOOK:

“Essentials of Modern Business Statistics”, by Anderson, Sweeney, and Williams; from Cengage Learning.

*Note: Use of APLIA, EWA, MyStatsLab, MyMathLab, WeBWork, as well as any other textbook-specific interactive web-based homework is subject to approval by the Course Coordinator and/or Departmental Administration every semester.*

## PURPOSE OF COURSE

In Math 2345 students will learn the meanings of, and computational procedures related to, the elementary statistical concepts used for making decisions in business and economics. Math 2345 fulfills a set of learning objectives as established by the Texas Higher Education Coordinating Board. While use of technology for class demos and practice is encouraged, this is not a technology-based course. Use of technology in the classroom and during examinations will be established by the Course Coordinator, together with individual instructors.

## CORE CURRICULUM/GRADUATION REQUIREMENTS SATISFIED BY MATH 2345

MATH 2345 satisfies part of the university Core Curriculum requirement in Mathematics.

## COURSE-SPECIFIC LEARNING OBJECTIVES AND CORRESPONDING OUTCOMES

### 1. Apply arithmetic, algebraic, geometric, statistical and/or logical reasoning to solve problems.

In Math 2345 students will: (1) develop proficiency in solving real-world problems; (2) compute various statistical measures, including the mean, median, mode, standard deviation, variance, and quartiles; (3) utilize graphical representations of data; (4) solve problems involving the binomial and normal distributions; (5) apply the Central Limit Theorem; (6) compute and interpret confidence intervals; (7) conduct and interpret hypothesis tests; (8) use linear regression models; (9) construct and use control charts; (10) detect patterns in time series. Student mastery of problem solving skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

### 2. Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically

In Math 2345 students will learn how to adequately communicate mathematical information in writing, verbally and graphically, by using words, numerical answers, algebraic expressions, logical sentences, as well as graphs and diagrams.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

### 3. Use mathematical and logical reasoning to evaluate the validity of an argument.

In Math 2345 students will learn how to identify, understand and apply mathematical and logical reasoning to theoretical and applied problems. In particular, attention will be given to procedures for the construction of inferences and establishing of the validity of hypothesis testing.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

**4. Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.**

In Math 2345 students will learn to identify and interpret mathematical information contained in formulas, graphs and tables, in particular: (a) measures of central tendency and variation; (b) constructing and interpreting histograms and charts; (c) probability distributions; (d) interpreting confidence intervals. The development of student interpretative and inference skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

*College-Level Competency: Students graduating from Texas Tech University should be able to: demonstrate the ability to apply quantitative and logical skills to solve problems. In particular, students who have taken Math 2345 will be able to use the course-specific learning objectives in order to provide individual solutions to mathematical problems and interpret the results in a relevant manner. The assessment of these skills will be conducted via embedded assessments in final exams, senior surveys (GSS) and senior assessments (OSA).*

**LEARNING ASSESSMENT:**

Learning outcomes will be assessed through homework exercises, in-class quizzes, and examinations. The following assessments represent a general departmental requirement:

- 1). Homework assignments are expected to be given weekly, either as on-line, web-based assignments, or as writing-intensive assignments
- 2). It is expected that a test will be given at the end of each major chapter
- 3). A common, unique departmental final exam will be given according to the academic schedule established by the university and department, for all the course sections whose primary delivery method is the traditional one (lecture, face-to-face).

*General requirement: The Common Final represents a course requirement. A student who did not complete the Final Examination, but otherwise completed all the other requirements successfully cannot be assigned a passing letter grade (D or higher) unless taking the Final Examination. Each designated instructor has to keep their copy of partial scores and grades for each student, for one calendar year from the date of recording the grade in the web database.*

Common Grading Scale Correspondence:

Letter grade A = a percentile grade of 90% or higher

Letter grade B = a percentile grade of 80% or higher, that is lower than 90%

Letter grade C = a percentile grade of 70% or higher, that is lower than 80%

Letter grade D = a percentile grade of 60% or higher, that is lower than 70%

Letter grade F = a percentile grade lower than 60%

**CIVILITY IN THE CLASSROOM:**

Texas Tech University endeavor to foster a classroom climate of mutual respect among students and between students and teacher. Mutual respect means that we should be tolerant of different ideas and varying opinions about topics of discussion in class, that we address each other respectfully and without interrupting while others are speaking, and that we do not engage in disruptive behavior in class. Signs of disrespect include, but are not restricted to: ringing cell phones (students must turn them off or leave them home), reading a newspaper or other material that is not part of a class assignment while in class, talking with classmates during class, eating and drinking in class, and similar disruptive behaviors. Students who engage in disruptive behavior will be warned. Repeated disruptive behavior may result in the student being asked to leave the classroom.

**ACADEMIC HONESTY STATEMENT:**

The TTU “Code of Student Conduct”, which you should have received when you enrolled in the university, contains a lengthy list of prohibited behaviors, among which is “Academic Dishonesty”. Please note that cheating and plagiarism (a form of cheating) are included among the actions that are subject to disciplinary action. Cheating will not be tolerated in this course. A student who is caught cheating will receive a grade of 0 on the exam, paper, or exercise. Awarding of a grade of F for the course is also a possible penalty. In addition, the incident of academic dishonesty will be reported to the Dean of the appropriate academic college for such disciplinary action as they see fit to administer.

**Plagiarism:** “The appropriation or imitation of the language, ideas, and thoughts of another author, and representation of them as one’s original work.” *The Random House College Dictionary*, revised edition. New York: Random House, 1975, p. 1014. “1. The use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement; 2. the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.” *Student Affairs Handbook*, Texas Tech University, Lubbock, Texas, 1998-99, p. 22. Plagiarism and cheating are not tolerated and will result in a grade of 0 on work that contains plagiarized material. In addition, a grade of F may be awarded for the course. Any cases of cheating will be reported to the Honors College and the responsible academic dean (i.e., Arts & Sciences, Business Administration, Engineering, etc.)

**ACCOMMODATION OF STUDENTS WITH DISABILITIES:**

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor’s office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

**STUDENT ABSENCE FOR OBSERVATION OF RELIGIOUS HOLY DAYS:**

A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day.

**COURSE OUTLINE**

Chapter 1- 1.1-1.5	1 hour
Chapter 2- 2.1-2.4	3 hours
Chapter 3- 3.1-3.5	3 hours
Chapter 4- 4.1-4.4	2 hours
Chapter 5- 5.1-5.4	2 hours
Chapter 6- 6.1-6.2	2 hours
Chapter 7- 7.1-7.5	2 hours
Chapter 8- 8.1-8.4	2 hours
Chapter 9- 9.1-9.5	2 hours
Chapter 10- 10.1-10.3	3 hours
Chapter 11- 11.1-11.2	2 hours
Chapter 12- 12.1-12.5	3 hours
Chapter 13- 13.1-13.5	3 hours

Chapter 14- 14.1-14.2	3 hours
Additional Chapter	2 hours
Review and testing	9 hours
Total 45 hours	

**Course Number:** Mathematics 2370  
**Descriptive Title:** Elementary Analysis I  
**Prerequisites:** MATH 1320 and Major of EC or MDS

### CATALOG DESCRIPTION

(3 credit hours)

[MATH 1350] Prerequisite: MATH 1320 and major of EC or MDS or consent of department. Analytic geometry and the real number system with applications. Not for engineering, science, or mathematics majors. Partially fulfills Core Mathematics requirement.

### CURRENT TEXTBOOK:

The instructor has two options in terms of text-books to use:

1. *Bassarear, Mathematics for Elementary School Teachers, 5<sup>th</sup> Edition, published by Cengage*
2. *Billstein, Libesking and Lott: A problem solving approach to Mathematics of Elementary School Teachers, 10<sup>th</sup> Edition, by Pearson Education.*

*Note: Use of any textbook-specific interactive web-based homework is subject to approval by the Course Coordinator and/or Departmental Administration every semester. The textbook and specific chapters are chosen and revised every year by the instructors, in collaboration with the Departmental Committee on Teacher Education.*

### PURPOSE OF COURSE

This course is designed to provide the prospective elementary school teacher with some background in elementary analysis. Among other things, it covers number systems and coordinate geometry. It will be taught in a “cooperative learning environment” with supplemental group exercises and web-based materials.

### CORE CURRICULUM/GRADUATION REQUIREMENTS SATISFIED BY MATH 2370

MATH 2370 satisfies part of the university Core Curriculum requirement in Mathematics.

### COURSE-SPECIFIC LEARNING OBJECTIVES AND CORRESPONDING OUTCOMES

#### 1. Apply arithmetic, algebraic, geometric, statistical and/or logical reasoning to solve problems.

In Math 2370 students will understand number systems with different bases, the ring and field properties of the real number system, and the description of numbers and points using the coordinate axis. In particular, the students will: (1) explain and model the arithmetic operations for whole numbers, integers, and rational numbers; (2) explain and model computations with fractions, decimals, and percentages; (3) explain elementary number theory related to factors, multiples, and prime numbers and apply problem solving skills to numerical applications; (4) model with sequences and patterns. Student mastery of problem solving skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

#### 2. Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically

In Math 2370 students will learn how to adequately communicate mathematical information in writing, verbally and graphically, by using words, numerical answers, algebraic expressions, logical sentences, as well as graphs and diagrams.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

### **3. Use mathematical and logical reasoning to evaluate the validity of an argument.**

In Math 2370 students will learn how to identify, understand and apply mathematical and logical reasoning to theoretical and applied problems. In particular, they will be introduced to reasoning and logic, including deductive versus inductive arguments and truth tables.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

### **4. Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.**

In Math 2370 students will learn to identify and interpret mathematical information contained in formulas, graphs and tables, in particular: (a) numeration sets; (b) models for arithmetic operations; (c) estimation. The development of student interpretative and inference skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

*College-Level Competency: Students graduating from Texas Tech University should be able to: demonstrate the ability to apply quantitative and logical skills to solve problems. In particular, students who have taken Math 2370 will be able to use the course-specific learning objectives in order to provide individual solutions to mathematical problems and interpret the results in a relevant manner. The assessment of these skills will be conducted via embedded assessments in final exams, senior surveys (GSS) and senior assessments (OSA).*

#### **LEARNING ASSESSMENT:**

Learning outcomes will be assessed through homework exercises, in-class quizzes, and examinations. The following assessments represent a general departmental requirement:

- 1). Homework assignments are expected to be given weekly, either as on-line, web-based assignments, or as writing-intensive assignments
- 2). It is expected that a test will be given at the end of each major chapter
- 3). A common, unique departmental final exam will be given according to the academic schedule established by the university and department, for all the course sections whose primary delivery method is the traditional one (lecture, face-to-face).

*General requirement: The Common Final represents a course requirement. A student who did not complete the Final Examination, but otherwise completed all the other requirements successfully cannot be assigned a passing letter grade (D or higher) unless taking the Final Examination. Each designated instructor has to keep their copy of partial scores and grades for each student, for one calendar year from the date of recording the grade in the web database.*

Common Grading Scale Correspondence:

- Letter grade A = a percentile grade of 90% or higher
- Letter grade B = a percentile grade of 80% or higher, that is lower than 90%
- Letter grade C = a percentile grade of 70% or higher, that is lower than 80%
- Letter grade D = a percentile grade of 60% or higher, that is lower than 70%
- Letter grade F = a percentile grade lower than 60%

**CIVILITY IN THE CLASSROOM:**

Texas Tech University endeavor to foster a classroom climate of mutual respect among students and between students and teacher. Mutual respect means that we should be tolerant of different ideas and varying opinions about topics of discussion in class, that we address each other respectfully and without interrupting while others are speaking, and that we do not engage in disruptive behavior in class. Signs of disrespect include, but are not restricted to: ringing cell phones (students must turn them off or leave them home), reading a newspaper or other material that is not part of a class assignment while in class, talking with classmates during class, eating and drinking in class, and similar disruptive behaviors. Students who engage in disruptive behavior will be warned. Repeated disruptive behavior may result in the student being asked to leave the classroom.

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**Plagiarism:** “The appropriation or imitation of the language, ideas, and thoughts of another author, and representation of them as one’s original work.” *The Random House College Dictionary*, revised edition. New York: Random House, 1975, p. 1014. “1. The use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement; 2. the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.” *Student Affairs Handbook*, Texas Tech University, Lubbock, Texas, 1998-99, p. 22. Plagiarism and cheating are not tolerated and will result in a grade of 0 on work that contains plagiarized material. In addition, a grade of F may be awarded for the course. Any cases of cheating will be reported to the Honors College and the responsible academic dean (i.e., Arts & Sciences, Business Administration, Engineering, etc.)

**ACCOMMODATION OF STUDENTS WITH DISABILITIES:**

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**STUDENT ABSENCE FOR OBSERVATION OF RELIGIOUS HOLY DAYS:**

A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day.

**COURSE OUTLINE**

***Billstein and all:***

Chapter 1 (Problem Solving)	3 hours
Chapter 2 (Sets)	5 hours

Chapter 3 (Whole numbers)	5 hours
Chapter 4 (Algebraic Thinking)	5 hours
Chapter 5 (Integers)	6 hours
Chapter 6 (Rational Numbers)	6 hours
Chapter 7 (Decimals)	5 hours
Review and Testing	10 hours
	Total: 45 hours

***Bassarear:***

Chapter 1 (Foundations)	5 hours
Chapter 2 (Fundamental concepts)	5 hours
Chapter 3 (Four Fundamental Operations)	8 hours
Chapter 4 (Number Theory)	4 hours
Chapter 5 (Extending the Number System)	8 hours
Chapter 6 (Proportional Reasoning)	4 hours
Review and Testing	11 hours
	Total: 45 hours

**Course Number: Mathematics 2371**  
**Descriptive Title: Elementary Analysis II**  
**Prerequisites: MATH 1320 and Major of EC or MDS**

**CATALOG DESCRIPTION**

(3 credit hours)

Prerequisite: MATH 1320 and major of EC or MDS or consent of department. Elementary differential and integral calculus with application. Not for engineering, science, or mathematics majors. Partially fulfills Core Mathematics requirement.

**CURRENT TEXTBOOK:**

Waner, Costenoble: *Finite Mathematics + Applied Calculus 5e* by published by Cengage

*Materials:* EWA (Enhanced WebAssign), graphing calculator (TI-86)

*Note: Use of any textbook-specific interactive web-based homework is subject to approval by the Course Coordinator and/or Departmental Administration every semester.*

**PURPOSE OF COURSE**

This course is designed to provide the K-12 teacher with some background in Calculus. It covers Differential and Integral Calculus. It will be taught in a “cooperative learning environment” with supplemental group exercises and web-based materials. The course is concerned with the basic ideas of Calculus, as well as many applications and problems of the same type as those emphasized in the Teacher Certification Examinations (State of Texas) and in high-school AP Calculus.

**CORE CURRICULUM/GRADUATION REQUIREMENTS SATISFIED BY MATH 2371**

MATH 2371 satisfies part of the university Core Curriculum requirement in Mathematics.

**COURSE-SPECIFIC LEARNING OBJECTIVES AND CORRESPONDING OUTCOMES**

- 1. Apply arithmetic, algebraic, geometric, statistical and/or logical reasoning to solve problems.**

In Math 2371 students will: (1) compute derivatives of polynomials; (2) compute definite integrals with applications to area. Student mastery of problem solving skills will be assessed through homework exercises, in-class quizzes, and examinations.



**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

**2. Represent and evaluate basic mathematical and/or logical information numerically, graphically, and symbolically**

In Math 2371 students will learn how to adequately communicate mathematical information in writing, verbally and graphically, by using words, numerical answers, algebraic expressions, logical sentences, as well as graphs and diagrams.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

**3. Use mathematical and logical reasoning to evaluate the validity of an argument.**

In Math 2371 students will learn how to identify, understand and apply mathematical and logical reasoning to theoretical and applied problems. In particular, attention will be given to elementary proofs in calculus and their geometric interpretations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

**4. Interpret mathematical and/or logical models such as formulas, graphs, tables and schematics, and draw inference from them.**

In Math 2371 students will learn to identify and interpret mathematical information contained in formulas, graphs and tables, in particular: (a) mathematical modeling; (b) applications of the derivative to optimization problems; (c) applications of definite integrals to area. The development of student interpretative and inference skills will be assessed through homework exercises, in-class quizzes, and examinations.

**Assessment Strategies:** A comprehensive list of Homework and Exam problems will be created by the Course Coordinator in collaboration with the instructors/TAs. It is expected that at least 25% of the problems on this comprehensive list will address this specific objective.

*College-Level Competency: Students graduating from Texas Tech University should be able to: demonstrate the ability to apply quantitative and logical skills to solve problems. In particular, students who have taken Math 2371 will be able to use the course-specific learning objectives in order to provide individual solutions to mathematical problems and interpret the results in a relevant manner. The assessment of these skills will be conducted via embedded assessments in final exams, senior surveys (GSS) and senior assessments (OSA).*

**LEARNING ASSESSMENT:**

Learning outcomes will be assessed through homework exercises, in-class quizzes, and examinations. The following assessments represent a general departmental requirement:

- 1). Homework assignments are expected to be given weekly, either as on-line, web-based assignments, or as writing-intensive assignments
- 2). It is expected that a test will be given at the end of each major chapter
- 3). A common, unique departmental final exam will be given according to the academic schedule established by the university and department, for all the course sections whose primary delivery method is the traditional one (lecture, face-to-face).

*General requirement: The Common Final represents a course requirement. A student who did not complete the Final Examination, but otherwise completed all the other requirements successfully cannot be assigned a passing letter grade (D or higher) unless taking the Final Examination. Each designated instructor has to keep their copy of partial scores and grades for each student, for one calendar year from the date of recording the grade in the web database.*

**Common Grading Scale Correspondence:**

Letter grade A = a percentile grade of 90% or higher

Letter grade B = a percentile grade of 80% or higher, that is lower than 90%

Letter grade C = a percentile grade of 70% or higher, that is lower than 80%

Letter grade D = a percentile grade of 60% or higher, that is lower than 70%

Letter grade F = a percentile grade lower than 60%

**CIVILITY IN THE CLASSROOM:**

Texas Tech University endeavor to foster a classroom climate of mutual respect among students and between students and teacher. Mutual respect means that we should be tolerant of different ideas and varying opinions about topics of discussion in class, that we address each other respectfully and without interrupting while others are speaking, and that we do not engage in disruptive behavior in class. Signs of disrespect include, but are not restricted to: ringing cell phones (students must turn them off or leave them home), reading a newspaper or other material that is not part of a class assignment while in class, talking with classmates during class, eating and drinking in class, and similar disruptive behaviors. Students who engage in disruptive behavior will be warned. Repeated disruptive behavior may result in the student being asked to leave the classroom.

**ACADEMIC HONESTY STATEMENT:**

The TTU “Code of Student Conduct”, which you should have received when you enrolled in the university, contains a lengthy list of prohibited behaviors, among which is “Academic Dishonesty”. Please note that cheating and plagiarism (a form of cheating) are included among the actions that are subject to disciplinary action. Cheating will not be tolerated in this course. A student who is caught cheating will receive a grade of 0 on the exam, paper, or exercise. Awarding of a grade of F for the course is also a possible penalty. In addition, the incident of academic dishonesty will be reported to the Dean of the appropriate academic college for such disciplinary action as they see fit to administer.

**Plagiarism:** “The appropriation or imitation of the language, ideas, and thoughts of another author, and representation of them as one’s original work.” *The Random House College Dictionary*, revised edition. New York: Random House, 1975, p. 1014. “1. The use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgement; 2. the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.” *Student Affairs Handbook*, Texas Tech University, Lubbock, Texas, 1998-99, p. 22. Plagiarism and cheating are not tolerated and will result in a grade of 0 on work that contains plagiarized material. In addition, a grade of F may be awarded for the course. Any cases of cheating will be reported to the Honors College and the responsible academic dean (i.e., Arts & Sciences, Business Administration, Engineering, etc.)

**ACCOMMODATION OF STUDENTS WITH DISABILITIES:**

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor’s office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office in 335 West Hall or 806-742-2405.

**STUDENT ABSENCE FOR OBSERVATION OF RELIGIOUS HOLY DAYS:**

A student who is absent from classes for the observation of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence if, not

later than the fifteenth day after the first day of the semester, the student had notified the instructor of each scheduled class that the student would be absent for a religious holy day.

### **COURSE OUTLINE**

Chapter 1 (Functions and Linear Models)	2 hours
Chapter 9 (Nonlinear Functions and Models)	2 hours
Chapter 10 (Introduction to Derivative)	5 hours
Chapter 11 (Techniques of Differentiation with Applications)	6 hours
Chapter 12 (Further Applications Of Derivative)	8 hours
Chapter 13 (Integration)	7 hours
Chapter 14 (Further Integration Techniques)	3 hours
Review and Testing	12 hours
	Total: 45 hours

## **Non-Core Curriculum Courses**

**Course Number:** Mathematics 0301  
**Descriptive Title:** Essential Mathematics  
**Prerequisite:** None

*About the Course:* This course does not carry any credit toward any degree at Texas Tech and appears on the transcript as 0 hours attempted and 0 hours earned. A student who has not passed the TASP or received a score of 1 or less on the required math placement test is required to take this course. It is also recommended that the student with no background in algebra or who wishes to review basic arithmetic and geometric skills take this course. The purpose of the course is to prepare the student with a foundation of prerequisite skills and knowledge to successfully take MATH 0302 and review skills needed to pass the TASP.

*To the Instructor:* It is recommended that the instructor assign many exercises and give a test after each chapter. Emphasis on terminology, applications, and study skills for math (i.e. how to read a math textbook, how to study math, and how to prepare for math exams) in an encouraging and positive cooperative-learning environment is essential. Therefore, the instructor is advised to define all symbols and mathematical terms used. Requiring attendance through a percentage of their grade is advised at this level to prevent “gaps of knowledge” occurring in their prerequisite knowledge and skills foundation.

The Final Exam for non-evening sections of this course is scheduled as a common departmental final. Consequently, there is an expectation that the instructors of non-evening sections of this course will administer the common departmental final and that they will use the grade from that final as a substantial portion of the final course grade. Please refer to Common Final Exam times found at [www.depts.ttu.edu/officialpublications/ClassSchedule/FinalExams.php](http://www.depts.ttu.edu/officialpublications/ClassSchedule/FinalExams.php) to find the time of your scheduled final.

*Student Learning Outcomes:* The students will review those topics from pre-algebra that are required for success in typical pre-college algebra. In particular the students will be able to:

- Perform arithmetic operations
- Perform operations with equations and inequalities
- Graph linear functions in Cartesian coordinates and understand the concept of slope of a line
- Perform operations involving exponents
- Perform operations involving polynomials
- Understand functions and function notation
- Understand the basics of factoring

*Text:* *Elementary & Intermediate Algebra: Concepts & Applications* 6<sup>th</sup> Edition by Bittinger, Ellenbogen and Johnson; published by Pearson, with online access.

*Course Outline:*

Chapter 1 (Sections 1.1-1.8)	8 days
Chapter 2 (Sections 2.1-2.7)	7 days
Chapter 3 (Sections 3.1-3.7)	7 days
Chapter 4 (Sections 4.1-4.8)	8 days
Chapter 5 (Sections 5.1-5.2)	4 days
	34 days

**Course Number:** Mathematics 0302

**Descriptive Title:** Intermediate Algebra

**Prerequisite:** B in MATH 0301/TSI 0202 or 2 on MPE or D in college-level math, 610 on SATM, or 26 on ACTM

*About the Course:* This course does not carry any credit toward any degree at Texas Tech and appears on the transcript as 0 hours attempted, 0 hours earned. A student who has not passed the TASP or received a score of 2 on the required math placement test is required to take this course. This course is intended to be a thorough review of high school Algebra I, Algebra II and Geometry courses. Students must have a B or better in order to proceed to the next course. The purpose of this course is to prepare the student with a foundation of prerequisite skills and knowledge to successfully take MATH 1320 or MATH 1330 and to review skills needed to pass the TASP.

The purpose of the course is to prepare the student with a foundation of prerequisite skills and knowledge to successfully take MATH 1320 or MATH 1330 and to review skills needed to pass TASP.

*To the Instructor:* It is recommended that the instructor assign many exercises and give a test after each chapter. Emphasis on terminology, applications, and study skills for math (i.e. how to read a math textbook, how to study math, and how to prepare for math exams) in an encouraging and positive cooperative-learning environment is essential. Therefore, the instructor is advised to define all symbols and mathematical terms used.

The Final Exam for non-evening sections of this course is scheduled as a common departmental final. Consequently, there is an expectation that the instructors of non-evening sections of this course will administer the common departmental final and that they will use the grade from that final as a substantial portion of the final course grade. Please refer to Common Final Exam times found at [www.depts.ttu.edu/officialpublications/ClassSchedule/FinalExams.php](http://www.depts.ttu.edu/officialpublications/ClassSchedule/FinalExams.php) to find the time of your scheduled final.

*Text:* *Elementary & Intermediate Algebra: Concepts & Applications* 6<sup>th</sup> Edition by Bittinger, Ellenbogen and Johnson; published by Pearson, with online access.

*Student Learning Outcomes:* The students will review those topics from pre-college algebra that are required for success in college level mathematics. In particular the students will be able to:

- Understand relations and functions
- Factor standard polynomials
- Manipulate rational expressions and expressions involving radicals
- Solve systems of linear equations and inequalities
- Apply the quadratic formula

*Course Outline:*

Review of Sections 5.1-5.2	1 day
Chapter 5 (Sections 5.3-5.7)	5 days
Chapter 6 (Sections 6.1-6.6)	6 days
Chapter 7 (Sections 7.1-4.4)	4 days
Chapter 8 (Sections 8.1-8.4)	4 days
Chapter 9 (Sections 9.1-9.4)	4 days

Chapter 10 (Sections 10.1-10.8)	8 days
Chapter 5 (Sections 11.1-11.4)	4 days
	36 days

**Course Number:** Mathematics 2356  
**Descriptive Title:** Quantitative Theory of Interest  
**Prerequisites:** MATH 1351, 1451, or 1331

*About the Course:* This course covers the mathematical theory of interest. It is recommended for students who plan to take the professional examinations given by the Society of Actuaries (SOA) and the Casualty Actuarial Society (CAS). This course is required for Actuarial Science minor. Students are required to have a calculator with business capacities, for example, the Texas Instruments BA II Plus. The instructor is expected to be familiar with the calculator and to incorporate its use into the course as soon as possible.

*Student Learning Outcomes:* Students obtain the knowledge of key terms of financial mathematics and are proficient in the key procedures of financial mathematics. In particular the students will be able to demonstrate their ability to:

- Calculate the effective rate (or force) of interest (or discount)
- Calculate the present and future values of an annuity
- Calculate annuity payment
- Form amortization schedule or sinking fund schedule
- Determine the prices, values, and yield rates for bonds and other securities

*Text:* *The Theory of Interest* 3rd Edition by S. G. Kellison, published by McGraw-Hill/Irwin

*Course Outline*

Chapter 1 – The Measurement of Interest	7 days
Chapter 2 – Solution of Problems in Interest	4 days
Chapter 3 – Basic Annuities	6 days
Chapter 4 – More General Annuities	7 days
Chapter 5 – Amortization Schedules and Sinking Funds	6 days
Chapter 6 – Bonds and Other Securities	7 days
	37 days

**Course Number:** Mathematics 2360  
**Descriptive Title:** Linear Algebra  
**Prerequisites:** MATH 1352 or 1452

*About the Course:* It is essential that the presentation be very elementary with a great deal of attention directed to solving specific problems in order to meet with any great degree of success. This is *not* intended to be a course in *abstract mathematics*. Rigor, with proofs, is expected but all examples and applications should be concrete.

*Student Learning Outcomes:* M2360 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 following 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 develop skill in manipulating with matrices and understand their relationship to linear systems. They understand the concept of bases and vector spaces, as well as, eigenvectors and eigenspaces.

In particular, students

- perform basic vector algebra, and compute their bases
- express a linear transformation as a matrix
- perform basic matrix manipulations, and compute the determinant of a matrix
- compute eigenvalues and eigenvectors
- use the Gram-Schmidt process

General Sections:

*Text:* *Elementary Linear Algebra* 7<sup>th</sup> edition by R. Larson, published by Cengage

COURSE OUTLINE (all sections are required; the exact pace will be decided by Course Coordinators and individual Instructors)

Chapter 1	4 hours
Chapter 2	5 hours
Chapter 3	4 hours
Chapter 4	8 hours
Chapter 5	6 hours
Chapter 6	7 hours
Chapter 7	5 hours
Test and Review	6 hours
	45 hours

**Course Number**            **Mathematics 2450**

**Descriptive Title:**        **Calculus III with Applications (4:4:0)**

**Prerequisites:** (at least a) C in Math 1352 or Math 1452, or departmental permission (based on transfer or examination)

*About the course:* Partial differentiation, functions of several variables, multiple integrals, line integrals, surface integrals, Stokes Theorem. Applications and problem-solving are strongly emphasized. Partially fulfills Core Mathematics requirement. (Honors section offered).

*Mission Statement:* This course covers 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, area and volume; surfaces, partial derivatives, total differential, tangent planes to surfaces; 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 *basic* examples. This course is organized as a four hour lecture for the regular academic year (Fall and Spring) and the corresponding amount of hours for each Summer Session. Every week, the first three hours will be devoted to covering the material from the text-book. The fourth hour will be exclusively dedicated to applications, examples and exercises that are relevant to the learning objectives, and improve the student success in the examinations. Depending on availability of academic facilities, the fourth hour of lecture can be held in a regular classroom, a lecture hall, or a computer lab, where the students will follow the instructor's presentation and become actively involved in problem-solving at the same time.

*Student Learning Outcomes:* MATH2450 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.

*Course Specific Learning Outcomes:* Students develop skills in differentiation and integration needed to solve problems in 3-dimensional space. In particular the students will master the concepts of

- tangent and normal vectors, and their geometric and physical interpretations
- partial derivatives, tangent planes, directional derivatives, and gradients, and how to compute them
- three-dimensional integration, and how to compute such integrals
- vector fields, divergence, and curl, and certain applications to the real world and other sciences

*Learning Assessments:* Student learning will be assessed weekly, through homework assignments, of which a significant part will be administered on line using student-interactive software (e.g., WeBWorK) via individual accounts. Students are expected to take at least two in-class exams during the semester. The Final Examination is a *common examination* for all the sections of this course and it is administered by the department at a prescribed time as stated in the university list of Common Finals. *The Final Examination is expected to contribute to the overall score as a 20-50% (min-max, depending on the course format).*

The Final Examination represents a common departmental final. All sections will take the Final Examination at the same time, as scheduled by the university administration. Use of calculators in the Final exam is not permitted. Electronic devices which can store formulas, including cell phones, should be turned off and stored during the Final Exam.

Use of technology in the classroom is encouraged, and in particular use of mathematical software and demos. Mathematical software which can be used includes Matlab, Maple and Mathematica. Instructors will routinely assess the learning process through individual discussions in the classroom, as well as a comparative study on how students respond to specific questions, lab applications and problem-solving assignments.

*Text:*

J. Bradley, M. Strauss, K. Smith – Calculus, 5<sup>th</sup> Custom Edition, Pearson (out of print),

Or alternatively,

K. Smith, M. Strauss and M. Toda – Calculus, 6<sup>th</sup> National Edition, Kendall Hunt.

*Course Outline*

Chapter 9 (review 9.1-4, cover 9.5-9.7)	6 hours
Chapter 10 (10.3, 10.5 are optional)	5 hours
Chapter 11	11 hours
Chapter 12 (12.6 is optional)	12 hours
Chapter 13	11 hours
<i>Total 45 hrs</i>	

It is important that instructors cover all of the material specified, unless otherwise instructed by the Course Coordinator. If instructors discover that this will not be possible, they have the obligation to inform the Director of Undergraduate Studies and Course Coordinator immediately.

**Course Number:** Mathematics 3310  
**Descriptive Title:** An Introduction to Proof  
**Prerequisites:** MATH 2350 or 2450

*About the Course:* This course will teach students how to construct and organize their mathematical reasoning and develop skill for writing mathematical proofs. This is a writing intensive course.

*Learning Outcomes:*

- Students are expected to understand the following concepts and *use* them in various problems:

Sets, cardinality, subsets, elements, union, intersection, functions (including the meaning of injectivity, surjectivity and bijectivity), equivalence relations/classes, as well as an introduction to modular arithmetic.

- Students are expected to become proficient in *reading and writing proofs*.

The following represent the basic mandatory sections to be covered:

- *Truth tables and general logic (implications, quantifiers, negation)*
- *Direct proofs*
- *Contrapositive Proofs*
- *Proof by Contradiction*
- *Proof by Induction*
- *Proofs involving sets*
- *Proof that a function is 1:1 and/or onto*
- *Proofs involving composite and inverse functions*
- *Proofs involving images and pre-images of functions*
- *The Division Algorithm, greatest common divisors and relatively prime integers*

The following represent some optional topics to be covered if time permits:

- *Countable sets*
- *Proofs involving suprema and infima*
- *Proofs involving convergence (of sequences and series)*
- *Completeness of the real number line*
- *Graphs*
- *The Euclidean Algorithm*
- *The fundamental Theorem of Arithmetic*

*Text:* At the latitude of the instructor; selected text needs advanced departmental approval every semester

**Course Number:** Mathematics 3322  
**Descriptive Title:** Higher Mathematics for Engineering Technology  
**Prerequisites:** MATH 1352 or 1452

*About the Course:* This course is for students in Engineering Technology and touches on several topics of higher mathematics with emphasis on differential equations and includes Laplace Transforms, Fourier Series and vector algebra among others. Again, these subjects are presented from the standpoint of engineering application rather than a theoretical development. Students are required to have and learn to use a TI-85 calculator for this sequence. The instructor should use the TI-85 to aid in understanding the concepts. MATH 3322 introduces some topics of higher mathematics for the engineering technology students, with emphasis of differential equations and includes Laplace transforms, Fourier series, vector algebra, complex numbers, and matrix algebra. The POLY and SIMULT packages on the TI-86 should both be used.

*Student Learning Outcomes:* The students will develop the necessary skills from pre-calculus, calculus, and differential equations required to be successful in their engineering technology programs.

Students will understand infinite series and differential equations. In particular, students will:

- Understand the concept of multiple integration and learn to solve real-world problems involving multiple integrals.
- Understand sequences gain proficiency in determining convergence.
- Understand series gain proficiency in determining convergence.



- Solve first order and higher order differential equations.
- Understand and become proficient using Laplace transforms.

*Text:* TECHNICAL CALCULUS WITH ANALYTIC GEOMETRY 4<sup>th</sup> Edition by Kuhfittig, published by Cengage

*Reference:* Schaum's Outline - ADVANCED MATH FOR ENGINEERING & SCIENTISTS

*Course Outline*

Chapter 9-3D Space, partial Derivatives, Multiple Integrals	3 days
Chapter 10-Infinite Series	9 days
Chapter 11-1st Order Differential Equations	9 days
Chapter 12-Highest Order Differential Equations	6 days
Chapter 13-Laplace Transforms	9 days
	36 days

**Course Number:** Mathematics 3342  
**Descriptive Title:** Mathematical Statistics for Engineers and Scientists  
**Prerequisites:** MATH 2350 or 2450

*About the Course:* This course is designed to cover topics from mathematical statistics that are of interest to students from engineering and/or the sciences. Topics should include descriptive statistics, elementary probability, random variables and distributions, mean variance, parameter estimation, hypothesis testing, regression, and analysis of variance.

*Student Learning Outcomes:* Students will apply their calculus knowledge to learn the meanings of, and computational procedures relating to, basic statistical concepts used for making decisions in the sciences and engineering. In particular, students will

- Understand the need to be wary of statistical claims, common pitfalls in sampling, and misrepresentation of conclusions
- Understand the meanings of various statistical measures, including the mean, median, mode, standard deviation, variance, and quartiles
- Become familiar with various graphical representations of data and learn to recognize misleading graphs.
- Develop proficiency in real-world probability problems
- Understand the concept of a probability distribution and real-world problems involving various distributions, including binomial, normal, hypergeometric, and Poisson distributions
- Understand and apply the Central Limit Theorem
- Compute and interpret confidence intervals
- Conduct and interpret hypothesis tests
- Understand linear regression models

*Text:* Probability and Statistics for Engineering and Science by Devore, 8<sup>th</sup> Edition (published by Cengage Learning), 8<sup>th</sup> edition with Enhanced WebAssign, regular edition ISBN 1111655499

*Course Outline*

Chapter 1 – 1.1-1.4	5 days
Chapter 2 – 2.1-2.2, 2.4-2.5 (2.3 optional)	5 days
Chapter 3 – 3.1-3.4, 3.6 (3.5 optional)	4 days
Chapter 4 – 4.1-4.5	5 days
Chapter 6 – 6.1 (6.2 optional)	1 day
Chapter 7 – 7.1-7.4	4 days
Chapter 8 – 8.1-8.5	6 days
Chapter 9 – 9.1-9.5	6 days

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Chapter 5 is optional

**Course Number:** Mathematics 3350, 3351  
**Descriptive Title:** Higher Mathematics for Engineers and Scientists I, II  
**Prerequisites:** For 3350, MATH 2350 or 2450  
 For 3351, MATH 3350 or 3354

*About the course - Math 3350:* 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; Laplace transform; Series Solutions of Linear Equations.

*Student Learning Outcomes: (3350)* Math 3350 students will study topics of differential equations, their solutions, and applications to physical sciences and engineering. In particular the students *will learn to:*

- recognize a differential equation and its solution
- compute solutions of first order differential equations
- compute solutions of higher order differential equations
- use Laplace transforms
- the fundamental properties of power series, and how to use them to solve linear differential equations

*About the course - Math 3351:* 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.

*Student Learning Outcomes: (3351)* The students will extend their knowledge of differential equations and their solutions acquired in MATH 3350 by developing new methods to solve differential equations and by studying the concept of partial differential equations and their solutions and applications. In particular, the students learn:

- about the fundamental properties of linear systems, and their solutions
- how to solve partial differential equations by separation of variables or Fourier series
- to apply these techniques to the three classical equations: the heat, wave, and Laplace's equation
- about Frobenius' Theorem and its applications
- many examples of Boundary Value Problems that appear in physical sciences and engineering

*Text:* *Advanced Engineering Mathematics* 5<sup>th</sup> Revised Edition with online access by Dennis G. Zill and Warren S. Wright, published by Jones & Bartlett (2013)

*Course Outline (3350)*

Chapter 1 – (1.1, 1.2) Introduction	2 days
Chapter 2 – (2.1-2.8) First-Order Differential Equations	9 days
Chapter 3 – (3.1-3.6 & 3.8) Higher-Order Differential Equations	8 days
Chapter 4 – (4.1-4.5) Laplace Transforms	7 days
Chapter 5 – (5.1 & 5.3) Series Solutions of Linear Equations	2 days
Optional Topics (Instructor's Expertise Prevails)/Review of Ch. 1-5	8 days
	36 days

*Note I: Chapters 3 and 4 can be studied simultaneously, combined, or covered in reverse order*

*Note II: The Optional Topics can be chosen depending on the instructor's preference or expertise, as well as the students' majors and interests. Such topics may include: Numerical Methods, Special Functions (e.g., Bessel Functions), Hypergeometric Series, etc.*

*Course Outline (3351)*

Chapter 8 – (8.1-8.5, 8.8) Matrices	8 days
Chapter 10 – (10.1, 10.2) Systems of Linear Differential Equations	4 days
Chapter 12 – (12.1-12.4) Orthogonal Functions and Fourier Series (Review table of solutions for linear DEs p. 674)	6 days
Chapter 13 – (13.1-13.6, 13.8) Boundary-Value Problems Rectangular Coordinates	10 days
Chapter 14 – (14.1-14.3) BVP in Other Coordinate Systems	5 days
Chapter 15 – (Selected Topics) Integral Transforms	2 days
	35 days

**Course Number:** Mathematics 3354, 4354  
**Descriptive Title:** Differential Equations I, II  
**Prerequisites:** For 3354, MATH 2350 or 2450 and MATH 2360  
For 4354, MATH 3354 or MATH 3350

*About 3354:* 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; Laplace transform; Series solutions of Linear Equations.

*Student Learning Outcomes: (3354)* Students will obtain a thorough knowledge of solution techniques for first-order and for second- and higher-order constant coefficient linear homogenous and nonhomogeneous initial value problems using standard methods of undetermined coefficients and variation of parameters. In addition, the students will acquire a general understanding of how to apply the Laplace transform in solving initial value problems and convolution integral equations. Students will gain an appreciation for some of the applications of ordinary differential equations in biology and engineering.

*About 4354:* This course covers topics in ordinary and partial differential equations. Topics to be covered include: 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; Integral Transforms.

*Student Learning Outcomes: (4354)* Students will learn solution techniques for systems of ordinary differential equations. Students will also learn elements of Fourier series and how to apply these series in the solution of boundary value problems for partial differential equations, specifically, the heat equation, wave equation, and Laplace's equation in rectangular and other coordinate systems. In addition, students will obtain a general understanding of transform methods in the solution of initial and boundary value problems for partial differential equations.

*Text:* *Differential Equations with Boundary-Value Problems*, 8<sup>th</sup> Edition by D.G. Zill and W.R. Wright, published by Cengage

*Course Outline (3354)*

Chapter 1 – (1.1, 1.2) Introduction	2 hours
Chapter 2 – (2.1-2.6) First-Order Differential Equations	8 hours
Chapter 3 – (3.1-3.2) Modeling with First-Order Differential Equations	1 hour
Chapter 4 – (4.1-4.4, 4.6, 4.7) Higher-Order Differential Equations	9 hours
Chapter 5 – (5.1) Modeling with Higher-Order Differential Equations	1 hour
Chapter 6 – (6.1, 6.3) Series Solutions of Linear Equations	4 hours
Chapter 7 – (7.1-7.5) Laplace Transforms	9 hours
	34 hours

Course Outline (4354)

Chapter 8 – (8.1, 8.2) Systems of Linear Differential Equations	4 hours
Chapter 10 – (10.1-10.4) Plane Autonomous Systems	6 hours
Chapter 11 – (11.1-11.3) Orthogonal Functions and Fourier Series (Review table of solutions for linear DEs p. 416)	5 hours
Chapter 12 – (12.1-12.6, 12.8) Boundary-Value Problems Rectangular Coordinates	10 hours
Chapter 13 – (13.1-13.3) BVP in Other Coordinate Systems	5 hours
Chapter 14 – (14.1-14.4) Integral Transforms	5 hours
	35 hours

**Course Number:** Mathematics 3360, 4360  
**Descriptive Title:** Foundations of Algebra I, II  
**Prerequisites:** For 3360, MATH 2360 and 3310  
For 4360, MATH 3360

*About 3360:* This course is intended to be *the* introduction to *abstract mathematics*, with proofs. It is also a writing intensive course.

*Student Learning Outcomes: (3360)* Students learn how to think and reason abstractly in the context of algebraic structures and learn how to write correct and clear mathematical arguments in this context. Concepts to be mastered by the students include but are not limited to the following:

- Groups and group homomorphisms
- Group actions

*About 4360:* This is a continuation of MATH 3360.

*Student Learning Outcomes: (4360)* Students learn how to think and reason abstractly in the context of algebraic structures and learn how to write correct and clear mathematical arguments in this context. Concepts and skills to be mastered by the students include but are not limited to the following:

- Ideals and quotient rings
- Euclidean domains
- Field theory
- Galois theory; insolvability of a general quintic
- Applications (instructor's choice)

*Text:* *Algebra, Pure & Applied* by A. Papantonopoulou, published by Pearson

Course Outline (3360):

Chapter 1	7 days
Chapter 2	8 days
Chapter 3	6 days
Chapter 4.1	1 day
Chapter 4.2	2 days
Chapter 4.3	1 day
Chapter 6	4 days
Chapter 7.1	1 day
Chapter 7.2	1 day
Chapter 7.3	1 day
Chapter 8.1	1 day
Chapter 8.2	1 day
Chapter 8.3	1 day

Chapter 8.4	2 days
Chapter 8.5	1 day
	38 days

There will be 6-10 writing assignments. Students will be given the opportunity to rewrite at least four of the assignments, based on appropriate feedback from the instructor. In these cases, should the first submission be unsatisfactory, the second submission will count for the grade.

*Course Outline (4360)*

Chapter 7.3, 8.6, 8.7 (8.8 optional)	6 days
Chapter 9	5 days
Chapter 10 (10.1 optional)	7 days
Chapter 12.1, 12.2, 12.3, 12.5	11 days
Chapter 4.4 (optional), 4.5, 5.3	4 days
Total	33 days
Time permitting 4.6, 4.7 (optional)	4 days
Time permitting 5.1 (optional)	2 days
Time permitting Chapter 11, and 12.4 (optional)	6 days
Max. Total Hours	45 days

**Course Number:** Mathematics 3370  
**Descriptive Title:** Elementary Geometry  
**Prerequisites:** MATH 2370

*About the Course:* This course is designed to provide the prospective elementary and/or middle school teacher with a basic background in elementary geometry, probability and statistics. It will be taught in a “cooperative learning environment” with supplementary group exercises.

*Student Learning Outcomes:* Students will

- Construct and interpret statistical graphs.
- Solve problems involving measurement, elementary probability and statistics.
- Perform geometric constructions.
- Write basic geometric proofs.
- Construct and analyze tessellations.

**CURRENT TEXTBOOK:**

*The textbook and specific chapters are chosen and revised every year by the instructors, in collaboration with the Departmental Committee on Teacher Education.*

*Supplies:* A compass, a 4-function calculator, a straight edge, and a protractor.

The web-based HW is associated with the text (My Math Lab or EWA) and it is subject to departmental approval

**Course Number:** Mathematics 3371  
**Descriptive Title:** Elements of Finite Mathematics  
**Prerequisites:** MATH 1331, 1351, 1451, or 2370

*Text:* FINITE MATHEMATICS 9<sup>th</sup> edition by Lial, Greenwell, & Ritchey; published by Pearson

*About the Course.* This course is intended to introduce the prospective 5-8 teacher with topics from finite mathematics that are useful in everyday life.

*Student Learning Outcomes:* The student should learn how concepts from logic, mathematics of finance, probability and statistics, and combinatorics are used to solve real world problems of importance to the general population. Topics may include:

- Statements, truth tables, negations, analysis of arguments, quantifiers
- Simple and compound interest, present and future values of annuities, loan amortization
- Sets and Venn diagrams,
- Probability, conditional probability, probability distributions, expected value
- Understand Bayes' theorem and its significance
- Counting, permutation and combinations, binomial probability
- The normal distribution, normal approximation to the binomial distribution

In chapter 5, finance applications in simple and compound interest are discussed, as well as annuities and amortization. Chapter 6 is an introduction to logic. It introduces methods to analyze statements, find negations, and recognize arguments as valid or invalid. Some students respond well to the Lewis Carroll-style logic puzzles in 6.5. Chapter 7 lays the foundation for the study of probability and statistics. It reviews the fundamental aspects of set theory, including Venn Diagrams and tree diagrams. Basic probability, conditional probability and Bayes' Theorem is covered. Chapter 8 contains counting techniques, permutations, combinations, binomial probability, and probability distributions. Chapter 9 presents the rudiments of statistics, including graphical methods, measures of central tendency, measures of variation, the normal distribution, and the normal approximation to the binomial distribution. 9.1 and 9.2 may be reviewed fairly quickly, as most students will remember this material from Math 3370 and other courses.

*Course Outline*

Chapter 5	5 days
Chapter 6	8 days
Chapter 7	8 days
Chapter 8	7 days
Chapter 9	6 days
	34 days

**Course Number:** Mathematics 3372  
**Descriptive Title:** Math Modeling for Teachers  
**Prerequisites:** MATH 2371

*Student Learning Outcomes:* This course will introduce mathematical models of simple systems in science and engineering. Examples may include growth rates in biology, biomechanical motion, financial models, and engineering fluid flow simulations. Necessary mathematical background includes exponential and logarithmic equations, matrix formulae, and differential equations. Both calculus-based models and non-calculus based models will be used. Appropriate technology will be introduced and used as a simulation tool. Typical tools may include Maple, Mathematica, Logo, and Geometer's Sketchpad.

*Learning Outcomes:* The students will

- acquire skills needed to analyze mathematical models
- develop elementary mathematical models
- reinforce their knowledge of functions, including trigonometric functions
- develop elementary programming skills

*Text:* Instructor's notes, online readings, programming manuals

*Course Outline:*

Trigonometry review	6 days
Exponential and logarithmic equations	6 days
Differential equations	6 days
Maple programming	5 days
Technology for Geometry (Logo and Geometer's Sketchpad)	3 days
Growth models in biology and finance	6 days
Simulation models in engineering and medicine	6 days
Model wrap-up	1 day
	39 days

**Course Number:** Mathematics 3430  
**Descriptive Title:** Computational Techniques for Science and Mathematics  
**Prerequisites:** MATH 2350 or 2450 and MATH 2360

*About the Course:* Emphasis on scientific computing and problem-solving techniques using state-of-the-art mathematics software packages. Restricted to mathematics majors or students enrolled in a secondary mathematics teacher program.

*Student Learning Outcomes:* Students reinforce their knowledge of concepts from arithmetic, algebra, number theory, calculus, and linear algebra, and learn how to use the program MAPLE to study and demonstrate these concepts. Students will become familiar with the general capabilities of a CAS, and obtain experience employing these capabilities to solve mathematical problems in the context of MAPLE. In order to communicate with the program students obviously will have to use the appropriate syntax. However, learning MAPLE syntax is never to be considered the main objective.

*Text:* Instructor's notes

**Course Number:** Mathematics 4000  
**Descriptive Title:** Selected Topics  
**Prerequisites:** Approved by the Director of Undergraduate Programs

*About the Course:* This course can be anything from an individual study/research course to a formal lecture course on a particular selected topic. Credit can be rewarded on a 1, 2, or 3 hour basis and it can be repeated for credit.

*Student Learning Outcomes:* Students will learn to apply mathematics research methodology in an attempt to solve a problem of mutual interest with an instructor.

**Course Number:** Mathematics 4310  
**Descriptive Title:** Introduction to Numerical Analysis I  
**Prerequisites:** MATH 3350 or 3354

*About the Course:* This course covers the standard topics from Numerical Analysis used to solve differential equations. Numerical integration should also be addressed, as well as interpolation.

*Student Learning Outcomes:* The students will learn the basic numerical procedures for solving differential equations and computing definite integrals, and apply these procedures to real world problems. Concepts and skills to be mastered by the students include but are not limited to the following: (Here the instructor should include a list of the particular concepts he or she obtain from his or her offering of this particular course.)

*Text:* At the discretion of the instructor, subject to approval by Director of Undergraduate Programs.

**Course Number:** Mathematics 4312  
**Descriptive Title:** Introduction to Numerical Analysis II  
**Prerequisites:** MATH 2360

*About the Course:* This is a course in numerical linear algebra.

*Student Learning Outcomes:* The students will learn the basic numerical procedures for solving systems of linear equations, and apply these procedures to real world problems. Concepts and skills to be mastered by the students include but are not limited to the following: (Here the instructor should include a list of the particular concepts he or she obtain from his or her offering of this particular course.)

*Text:* At the discretion of the instructor, subject to approval by Director of Undergraduate Programs.

**Course Number:** Mathematics 4330  
**Descriptive Title:** Mathematics Computing  
**Prerequisites:** Consent of Department

*About the Course:* This course is intended to *introduce* mathematics majors to special topics in mathematics and programming. While the students may be assumed to be advanced mathematics students, the instructor must assume they are *beginning* programming students. Students with advanced programming experience should *not* be allowed to take this course.

*Student Learning Outcomes:* The students will learn how computers can be used to study concepts, or solve problems related to the special topic chosen by the department for the particular semester. Concepts and skills to be mastered by the students include but are not limited to the following: (Here the instructor should include a list of the particular concepts he or she obtain from his or her offering of this particular course.)

*Text:* At the discretion of the instructor, subject to approval by Director of Undergraduate Programs.

**Course Number:** Mathematics 4331  
**Descriptive Title:** Advanced Geometry  
**Prerequisites:** MATH 2350 or 2450 and MATH 3310

*About the Course:* This course covers Euclidean, non-Euclidean, and projective geometries and is required for secondary teacher certification.

*Student Learning Outcomes:* Students master the concepts from Euclidean and non-Euclidean geometry that are taught in the typical high school geometry class. Concepts and skills to be mastered by the students include but are not limited to the following: (Here the instructor should include a list of the particular concepts he or she obtain from his or her offering of this particular course.)

*Text:* At the discretion of the instructor, subject to approval by Director of Undergraduate Programs

**Course Number:** Mathematics 4342, 4343  
**Descriptive Title:** Mathematical Statistics  
**Prerequisites:** For 4342, MATH 2350 or 2450  
For 4343, MATH 4342

*About the Course:* This mathematical statistics sequence constitutes the backbone of the Actuarial Science minor. It is therefore important to cover enough material that the student gets an appropriate exposure to the subject, since this knowledge will be assumed in what they will do next toward that goal. The range of topics is similar to the graduate level offering (STAT 5328-5329), **and should include primarily the following:**



**Probability, discrete and continuous families of distribution functions, expectations, conditional distributions, distribution of functions of random variables, sampling distributions, central limit theorem, point and interval estimation, hypothesis testing.**

The suggested text is:

*Mathematical Statistics with Applications, 7th ed.*, by Wackerly, Mendenhall, and Scheaffer, Duxbury Press, 2008.

The suggested coverage is:

- MATH 4342: Chapters 1-6. (And Chapter 7 if possible).
- MATH 4342: Chapters 7-10.

In particular, it is important that 4342 cover at least Chapters 1-6 (and ideally also Chap. 7), since the students expect this course to cover the syllabus for the first Actuarial Science Exam (1/P). The syllabus for this exam is actually Chapters 1-7. You should strive to get to Chapters 5-6 as soon as possible, since this is where students really struggle with their calculus, etc. (Omit Chapter 1, assign it as reading.) Holding weekly help sessions outside of class will greatly assist them. At a minimum you should hold a review session before each test (outside of class). A strategy that has worked well for me is to not collect homework, but give a 50 minute test after every chapter. (But keep in mind that with this strategy many students will only do the problems a few days before the test.)

4343 should cover at least through Chapter 10 (hypothesis testing), so that they see important topics like The Rao-Blackwell Theorem and minimum variance unbiased estimation (MVUE), maximum likelihood estimation (MLE), The Neyman-Pearson Lemma and uniformly most-powerful (UMP) tests, and the likelihood ratio test. Emphasize in the beginning that the material for 4342 should be well-known and fresh in their minds if their taking of 4343 is to be successful. Students that get below a B in 4342 typically struggle to “survive” in 4343.

Exposure to this sequence will then allow them to study/take more advanced courses that assume this, e.g. linear models and time series analysis.

**Expected Learning Outcomes (4342)**

- Calculate probabilities of events using counting rules; calculate conditional probabilities; determine independence of events; apply the Law of Total Probability and Bayes' Rule.
- Calculate probabilities, moments, and moment-generating functions for discrete random variables; recognize the following standard discrete distributions: binomial, geometric, hypergeometric, poisson.
- Calculate probabilities, moments, and moment-generating functions for continuous random variables; recognize the following standard continuous distributions: uniform, normal, gamma, beta.
- Calculate probabilities and moments for multivariate distributions; obtain marginal and conditional distributions; calculate covariance and correlation and determine independence of random variables; obtain expectations and variances for linear combinations of random variables.
- Find the distribution of a function of random variables using the methods of: distribution functions, transformations, and moment-generating functions; perform bivariate transformations using jacobians; calculate joint distributions and moments of order statistics.

**Expected Learning Outcomes (4343)**

- Calculate probabilities and quantiles for sampling distributions related to the normal distribution (t, chi-square, F); apply the central limit theorem to calculate probabilities and quantiles for the sample mean.
- Construct point and interval estimators; evaluate their goodness (bias, variance, mean squared error).
- Determine properties of point estimators (efficiency, consistency, sufficiency); find minimum variance unbiased estimators; find method of moments and maximum likelihood estimators.

- Perform hypothesis tests for the mean; compute p-values, type I, and type II errors; determine the power of a test and apply the Neyman-Pearson Lemma; construct likelihood ratio tests.

<http://www.math.ttu.edu/~atrindad/math4342/index.html>

<http://www.math.ttu.edu/~atrindad/math4343/index.html>

(Alex Trindade, 2010)

**Course Number: Mathematics 4350, 4351**

**Descriptive Title: Advanced Calculus 1 & 2**

**Prerequisites: For 4350, MATH 2350 or 2450 and MATH 2360 and 3310**

**For 4351, MATH 4350**

*About the Courses:* This course covers sets, functions, vector fields, partial derivatives, power series, and theory of integration. Students are expected to present proofs. Math 4350 and 4351 are writing intensive courses.

*Student Learning Outcomes: (4350)* Students learn how to think and reason abstractly in the context of analysis of the real line, and learn how to write correct and clear mathematical arguments in this context. There will be a heavy emphasis on proofs, especially epsilon-delta proofs. Concepts and skills to be mastered by the students include but are not limited to: suprema, infima, limits of sequences, limits of functions, continuous functions, derivatives of functions on the line.

*Student Learning Outcomes: (4351)* Students learn how to think and reason abstractly in the context of analysis of the real line, and learn how to write correct and clear mathematical arguments in this context. There will be a heavy emphasis on proofs, especially epsilon-delta proofs. Concepts and skills to be mastered by the students include but are not limited to: L'Hospital's Rules, Taylor's Theorem, the Riemann integral, sequences of functions, infinite series, introduction to the topology of the line, introduction to Lebesgue measure and integration.

*Text:* *Introduction to Real Analysis* 3<sup>rd</sup> edition by Bartle and Sherbert, published by Wiley

4351 also needs Chapter 11 of *Methods of Real Analysis* by Goldberg, 2<sup>nd</sup> ed., available from CopyTech

*Course Outline (4350):*

Chapters 1 and Appendix B (1.1 and 1.2 should be only briefly reviewed)	3 days
Chapter 2	7 days
Chapter 3	10 days
Chapter 4	5 days
Chapter 5	8 days
Chapter 6 (§1-2)	4 days
	37 days

*Course Outline (4351):*

Chapter 6 (§3-4)	4 days
Chapter 7	7 days
Chapter 8	5 days
Chapter 9	4 days
Chapter 11	5 days
Chapter 11 from Goldberg	12 days
	37 days

**Course Number:** Mathematics 4356  
**Descriptive Title:** Elementary Functions of a Complex Variable  
**Prerequisites:** MATH 4350 or concurrent

*About the Course:* This is an undergraduate course in complex numbers and functions.

*Student Learning Outcomes:* The student will learn, and be able to derive, basic concepts related to complex numbers and functions. Concepts and skills to be mastered by the students include but are not limited to the following: (Here the instructor should include a list of the particular concepts he or she obtain from his or her offering of this particular course.)

*Text:* *Fundamentals of Complex Analysis for Mathematics, Science and Engineers* 3<sup>rd</sup> Edition by Saff & Snider, published by Pearson

**Course Number:** Mathematics 4362  
**Descriptive Title:** Theory of Numbers  
**Prerequisites:** MATH 3310

*About the Course:* This course covers prime numbers; modular arithmetic; theorems of Fermat, Euler, and Wilson; residues, quadratic reciprocity; and Diophantine Equations. Students should write proofs.

*Student Learning Outcomes:* Students learn how to think and reason abstractly in the context of number theory, derive basic concepts, and learn how to write correct and clear mathematical arguments in this context. Concepts and skills to be mastered by the students include but are not limited to the following: (Here the instructor should include a list of the particular concepts he or she obtain from his or her offering of this particular course.)

*Text:* *Fundamentals of Number Theory* by LeVeque, published by Dover

**Course Number:** Mathematics 4370  
**Descriptive Title:** Elementary Problem Solving  
**Prerequisites:** MATH 3370

*About the Course:* It is assumed that the students have a working knowledge of counting numbers, integers, rational numbers and, to a lesser extent, the reals, linear equations, and quadratic equations.

This course might as well be described as a "baby" modern algebra course with a highly number theoretic orientation. To this extent divisibility, primeness, division algorithm, and modular arithmetic should be covered. Examples of groups, rings, and fields should be taken primarily from the integers, rationals, reals, and the complex number system as well as modular arithmetic.  $(0, 2, 4) \text{ Mod } 6$ , under multiplication is an excellent example of a field and will focus attention on the concept of the multiplicative identity.

*Student Learning Outcomes:* Students will understand concepts of elementary number theory that underlie the arithmetic taught in the 5-8 classroom, including divisibility, primality, and the Fundamental Theorem of Arithmetic. Students should learn to solve more sophisticated counting problems using techniques such as the Euclidean Algorithm or Chinese Remainder Theorem. Students should learn concepts of modern algebra through comparing modular arithmetic with more familiar algebraic structures such as the integers, the rationals, and the real numbers. Students should be aware of modern applications of number theory to areas such as cryptography.

*Text:* Instructor's notes

**Course Number:** Mathematics 4371  
**Descriptive Title:** Basic Computer Literacy and Programming  
**Prerequisites:** MATH 2371 or 3371

*About the Course:* This is a computer based, capstone course covering topics from all the previous 70-series courses in the context of the modern graphing calculator and the computer algebra system MAPLE.

*Student Learning Outcomes:* The students will

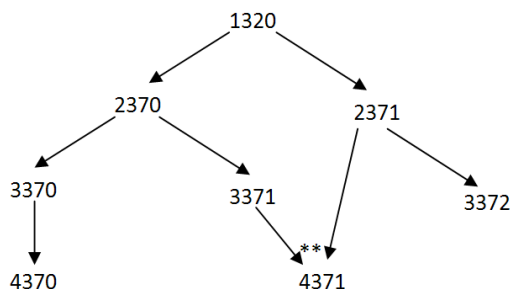
- develop the students' computer literacy
- get hands-on experience with computers and calculators
- develop elementary programming skills
- receive personal experience in computer-assisted instruction
- sharpen their basic mathematical skills
- learn the basics of programming with LOGO

*Text:* COMPARATIVE TECHNOLOGY by G.A. Harris

### THE 70 SERIES DESIGNED FOR ELEMENTARY SCHOOL TEACHERS

This is a sequence of seven courses (2370, 2371, 3370, 3371, 3372, 4370, 4371) for students in elementary education.

#### Prerequisite Flow Chart for “Elementary Math” Sequence



These prerequisites may be waived by the Department of Mathematics and Statistics, based on the student’s background and demonstrated mathematical abilities.

\*\*A student may take either 3371 or 2371 to enter 4371.

#### Future Scheduling of Upper Division “Elementary Math” Courses

**Every Fall:** 3370 and 3371 and 4371  
**Every Spring:** 3372 and 4370  
**Even Summers:** 3370 Summer 1 and 4370 Summer 2  
**Odd Summers:** 3371 Summer 1 and 4371 Summer 2

## Graduate Degree Programs

### *Master's Degree in Mathematics*

The Department of Mathematics and Statistics offers the Master's Degree in Mathematics in each of the three options discussed below. The requirements listed below are in addition to the University and Graduate School requirements found in the Catalog of the Graduate School. Each student's program of study and committee must be approved by the Director of Graduate Studies in the Department of Mathematics and Statistics. A student in a Master's program must fill out a degree plan after the end of the first long semester and before the start of their second long semester in the program.

The requirements listed here are to be regarded as *minimal* and the student should give very careful consideration to the selection of the particular option which is best suited to his or her needs. Work completed with a grade less than 'B' will not be accepted on a degree plan for any graduate degree in mathematics or statistics. Note that all Math536x courses except Math 5362 will not count toward a Master of Science degree unless specially approved by the Graduate Advisor. Any such approval must be sought before the start of the semester in which the course is taught.

- A. **MS (THESIS)** - This option is a 30 hour plan leading to the degree of Master of Science. This plan calls for 24 hours of course work and at least 6 hours of the *thesis* course (MATH 6000). Of the 24 hours of course work, 18 must be in mathematics and must include *one* sequence in a core area. The core areas are: 1) Algebra, 2) Ordinary Differential Equations / Partial Differential Equations 3) Complex Analysis, 4) Probability and Statistics, 5) Real Analysis, 6) Topology, 7) Numerical Analysis, 8) Applied Statistics. In the case of Real Analysis, 5318,-5319 is not considered to be a core sequence for purposes of Option A; likewise with 5310-5311 in the area of Applied Mathematics. A minor in an approved area outside of mathematics is permitted. A thesis defense is required.
- B. **MS (NON THESIS - REPORT)** - This option is a 36 hour plan leading to the degree of Master of Science. This program calls for 33 hours of course work and 3 hours of work on a departmental report (MATH 6310). Of the 33 hours of course work, 24 must be in mathematics and must include two sequences from the core areas listed in part A. A third core area is strongly recommended. A minor in an approved area outside mathematics is permitted. A final comprehensive examination for the report is required.
- C. **MS (NON THESIS - EXAM)** - This option is a 36 hour plan leading to the degree of Master of Science. This program calls for 36 hours of course work and passing 2 departmental Prelim Exams. Of the 36 hours of course work, 24 must be in mathematics and must include two sequences from the core areas listed in part A. A third core area is strongly recommended. A minor in an approved area outside mathematics is permitted. (See the Doctoral Program section for information on the Preliminary Examinations.)
- D. **MA (THESIS)** - This option is a 30 hour plan leading to the degree of Master of Arts and is designed for persons who are teaching (or plan to teach) mathematics at the pre-university level. This plan calls for 24 hours of course work and at least 6 hours of the *thesis* course (MATH 6000). Of the 24 hours of course work, 18 must be in mathematics. Of the 6 sequences listed below, the student must complete at least two or the equivalent: 1) Analysis (MATH 5366/5367), 2) Algebra (MATH 5368/5369), 3) Topology (MATH 5371/5372), 4) Geometry (MATH 5375/5376), 5) Applied Mathematics (MATH 5377/5378), and 6) Computer Literacy and Programming (MATH 5364/5365). A minor in an approved area outside of mathematics is permitted. A thesis defense is required.
- E. **MA (NON THESIS)** - This option is a 36 hour plan leading to the Master of Arts degree and is designed for persons who are teaching (or plan to teach) mathematics at the pre-university level. This plan calls for 33 hours of course work and 3 hours of work on a departmental report (MATH 6310). Of the 33 hours of course work at least 24 hours must be in mathematics. Of the 6 sequences listed below, the student must

complete at least three or the equivalent: 1) Analysis (MATH 5366/5367), 2) Algebra (MATH 5368/5369), 3) Topology (MATH 5371/5372), 4) Geometry (MATH 5375/5376), 5) Applied Mathematics (MATH 5377/5378), and 6) Computer Literacy and Programming (MATH 5364/5365). A minor of 9 hours in an approved area outside mathematics is permitted. Normally, work in the student's second field of certification or work towards the Professional Teacher's Certificate will be an acceptable minor area. A final comprehensive examination for the report is required.

- F. **MA (NON THESIS-PORTFOLIO)** - This option is a 36 hour plan leading to the Master of Arts degree and is designed for persons who are teaching (or plan to teach) mathematics at the pre-university level. This plan calls for 36 hours of course work and a completion of a portfolio. Of the 36 hours of course work at least 24 hours must be in mathematics. Of the 6 sequences listed below, the student must complete at least three or the equivalent: 1) Analysis (MATH 5366/5367), 2) Algebra (MATH 5368/5369), 3) Topology (MATH 5371/5372), 4) Geometry (MATH 5375/5376), 5) Applied Mathematics (MATH 5377/5378), and 6) Computer Literacy and Programming (MATH 5364/5365). A minor of 9 hours in an approved area outside mathematics is permitted. Normally, work in the student's second field of certification or work towards the Professional Teacher's Certificate will be an acceptable minor area. A portfolio is required.

With regard to programs A, B, D, and E above, it is expected that the student's final oral defense of his/her thesis or report will be open to all who wish to attend, with scheduling to reflect this.

### *Master's Degree in Statistics*

#### **Master of Science in Statistics**

- 1) Required courses:  
 STAT 5328 Intermediate Mathematical Statistics I  
 STAT 5329 Intermediate Mathematical Statistics II  
 STAT 5371 Regression Analysis  
 STAT 5373 Design of Experiments  
 STAT 5374 Theory of Linear Statistical Models  
  
Two courses from the following:  
 STAT 5326 Biostatistics  
 STAT 5372 Nonparametric Statistical Inference  
 STAT 5375 Statistical Multivariate Analysis  
 STAT 5378 Stochastic Processes  
 STAT 5379 Time Series Analysis  
 STAT 5386 Statistical Computing and Simulation
- 2) Six hours of mathematics to be selected with the approval of the Director of Graduate Studies and the Statistics Coordinator.
- 3) One of the following two options (to be selected with the approval of the Director of Graduate Studies)
  - a) Three hours in an area other Statistics, e.g. Mathematics, Animal Science, Computer Science, Biology, Economics, Engineering, Psychology, or Sociology. This option requires approval of the Graduate Advisor from the selected area.
  - b) Three additional hours in Statistics (to be selected from the Department of Mathematics and Statistics offerings).
- 4) Either a six-hour Master's Thesis, a three-hour Master's Report with an additional three hour course to be selected from requirements 1 or 3 above, or six additional hours to be selected from requirements 1 or 3 above and the completion of the Math Stat and Applied Stat Prelims. A thesis defense, final comprehensive examination for the report, or the passing of the two statistics prelims are required.

**NOTE:**

- a) All Statistics courses for the M.S. degree must be taken from the Statistics offerings in the Department of Mathematics and Statistics.
- b) Students who have the potential to be accepted in our PhD program and who have the agreement of an advisor may choose the thesis option.

## *Doctoral Program*

The following represents an outline of the Department of Mathematics and Statistics policies concerning the doctoral program. These policies are supplemental to the general Texas Tech University policies as outlined in the official catalogs of the university. Specific questions concerning interpretation of these policies should be directed to the Graduate Advisor. A student in the doctoral program must fill out a degree plan after the end of their second long semester and before the start of their third long semester in the program.

### **AREAS OF SPECIALIZATION**

Each doctorate in mathematics at Texas Tech University will be based on the doctoral candidate's choice of an area of specialization from the following four broad specialty areas:

1. Applied Mathematics
2. Pure Mathematics
3. Statistics
4. Mathematics Education

Overall policy guidelines have been established by the Department of Mathematics and Statistics with respect to work within these specialty areas.

### **PRELIMINARY EXAMINATIONS**

The Doctoral Preliminary Examinations will be administered twice each year (in May and in August) and are offered in the eight areas corresponding to the following graduate core courses:

1. Algebra (MATH 5326-5327)
2. Complex Analysis (MATH 5320-5321)
3. Ordinary Differential Equations (MATH 5330) and Partial Differential Equations (MATH 5332)
4. Numerical Analysis (MATH 5334-5335)
5. Real Analysis (MATH 5322-5323)
6. Topology (MATH 5324-5325)
7. Probability and Statistics (STAT 5328-5329)
8. Applied Statistics (STAT 5373-5374)

Each examination is four hours long with content based on important fundamental concepts in the area. Students should NOT infer that the Preliminary Examination is equivalent to a Final Examination over the respective core area. Rather, each examination is developed by a committee of faculty in the respective core area in consultation with the Graduate Committee. The topics over which a student can be tested are listed in the Preliminary Examination Topics List which is available from the Graduate Advisor.

At least three weeks prior to taking a Preliminary Examination the student must inform the Graduate Advisor which examinations he/she wishes to take. Up to three different examinations can be taken in each administration of the Preliminary examinations. A grade of *P* (pass) or *F* (fail) will be given in each examination. The policy is below:

#### **Definitions**

- I. Category A: Graduate students with a Master's degree in Math or Stat.
- II. Category B: Graduate students who are not in Category A.
- III. An attempt: A student is said to have attempted an exam when they have seen the contents of an exam while it is being administered.
- IV. Prelim requirements: Students have to pass 3 exams in different subject areas. One subject area must be from the "pure mathematics" group: Algebra, Complex analysis, Real analysis, or Topology. Students in statistics concentration must pass the Probability and Statistics exam.

Remark: Signing up for an exam and not showing up does not constitute an attempt.



**Policy:** Students in Category A are required to finish the prelim requirements for their concentration by the beginning of their third academic year. Category B students are required to finish the prelim requirements for their concentration by the beginning of their fourth academic year. All students are allowed a maximum of 12 attempts with a maximum of three attempts per area. Note that an academic year starts with the Fall semester.

Any student who does not successfully complete the Doctoral Preliminary Examinations according to the policy stated above may not continue in the Doctoral Program in the Department of Mathematics and Statistics at Texas Tech University.

### **QUALIFYING EXAMINATION**

Each doctoral student will be required to pass a Qualifying Examination on advanced topics beyond those covered in the Preliminary Examinations. In general, the Qualifying Examination will follow the format established by the Texas Tech University Graduate Catalog. Any exceptions to this format must be agreed upon by both the student's Doctoral Advisory Committee and the Graduate Advisor.

### **FOREIGN LANGUAGE REQUIREMENT**

Any foreign language requirement will be at the discretion of the student's dissertation advisor

### **AREA PROGRAMS**

The following list of area programs is meant to be an outline of minimal requirements. The individual student is encouraged to supplement specified requirements with as much advanced work as possible.

Specific course requirement may be waived at the request of the student's Doctoral Advisory Committee with the consent of the Graduate Advisor.

Advanced topics seminars which contribute to the student's overall mathematical background will be offered each semester. It is expected that each student will participate in seminar work in his/her area of specialty.

Note that Math 531x except Math 5312 and Math 5313, all Math536x courses except Math 5362, and all Math 537x will not count toward a doctoral degree. The student should check with the graduate advisor to see whether or not a specific course will count toward their degree.

### **APPLIED MATHEMATICS**

- 1) Foundational coursework (24 hours):
  - a) Three sequences from the following, with at least one sequence from Group A and at least one sequence from Group B:  
Group A:  
MATH 5320-5321 Functions of a Complex Variable I and II  
MATH 5322-5323 Functions of a Real Variable I and II  
MATH 5324-5325 Topology I and II  
MATH 5326-5327 Modern Algebra I and II  
MATH 5340-5341 Functional Analysis I and II  
  
Group B:  
MATH 5330 and MATH 5332 Ordinary Differential Equations I and Partial Differential Equations I  
MATH 5334-5335 Numerical Analysis I and II  
STAT 5328-5329 Intermediate Mathematical Statistics I and II  
STAT 5373-5374 Design of Experiments and Theory of Linear Statistical Models
  - b) At least two other courses (not necessarily in a sequence) chosen from Group A and Group B.
- 2) Additional coursework (36 hours): 36 additional hours selected with the approval of the student's dissertation advisor and the director of graduate studies. These may include courses offered by the Department of

Mathematics and Statistics relevant to the student's area of research or courses offered outside the department relevant to the student's area of research.

- 3) Twelve hours of MATH 8000

### **PURE MATHEMATICS**

- 1) All of the following four sequences:  
MATH 5320-5321 Functions of a Complex Variable I and II  
MATH 5322-5323 Functions of a Real Variable I and II  
MATH 5324-5325 Topology I and II  
MATH 5326-5327 Modern Algebra I and II
- 2) 36 additional hours selected with the approval of the student's major advisor and the Director of Graduate Studies. These may be courses offered by the Department of Mathematics and Statistics relevant to the student's area of research or courses offered outside the Department of Mathematics and Statistics relevant to the student's area of research.
- 3) Twelve hours of MATH 8000

### **STATISTICS**

- 1) All of the following courses:  
STAT 5328 Intermediate Mathematical Statistics I  
STAT 5329 Intermediate Mathematical Statistics II  
STAT 5371 Regression Analysis  
STAT 5373 Design of Experiments  
STAT 5374 Theory of Linear Statistical Models  
STAT 5380 Advanced Mathematical Statistics I  
MATH 5382 Advanced Probability
- 2) Four courses from the following statistics courses  
STAT 5326 Biostatistics  
STAT 5370 Decision Theory (Bayesian Statistics)  
STAT 5372 Nonparametric Statistical Inference  
STAT 5375 Statistical Multivariate Analysis  
STAT 5378 Stochastic Processes  
STAT 5379 Time series analysis  
STAT 5386 Statistical Computation and Simulation
- 3) 27 additional hours of statistics courses (excluding STAT 5302-5303 and STAT 5384-5385), mathematics courses relevant to the student's area of research, or courses offered outside the department relevant to the student's area of research. These courses must be approved approval of the student's dissertation advisor and the Director of Graduate Studies. Note that a Preliminary Exam in pure mathematics must be passed.
- 4) 12 hours of MATH 8000.

Note to all PhD Students:

- a) **Preliminary Examination:** Only those students who have passed the preliminary examination requirement are eligible to take MATH 8000. The students should check with the instructor of record in the year the preliminary exams are administered to find out the exact list of topics for the prelim exam.
- b) **Dissertation:** A dissertation is required of every candidate for the doctoral degree. This requirement is separate and apart from other requirements in the doctoral program. Consequently, successful

performance in other areas does not necessarily guarantee the acceptance of a dissertation. The dissertation should embody a significant contribution to new information to the subject.

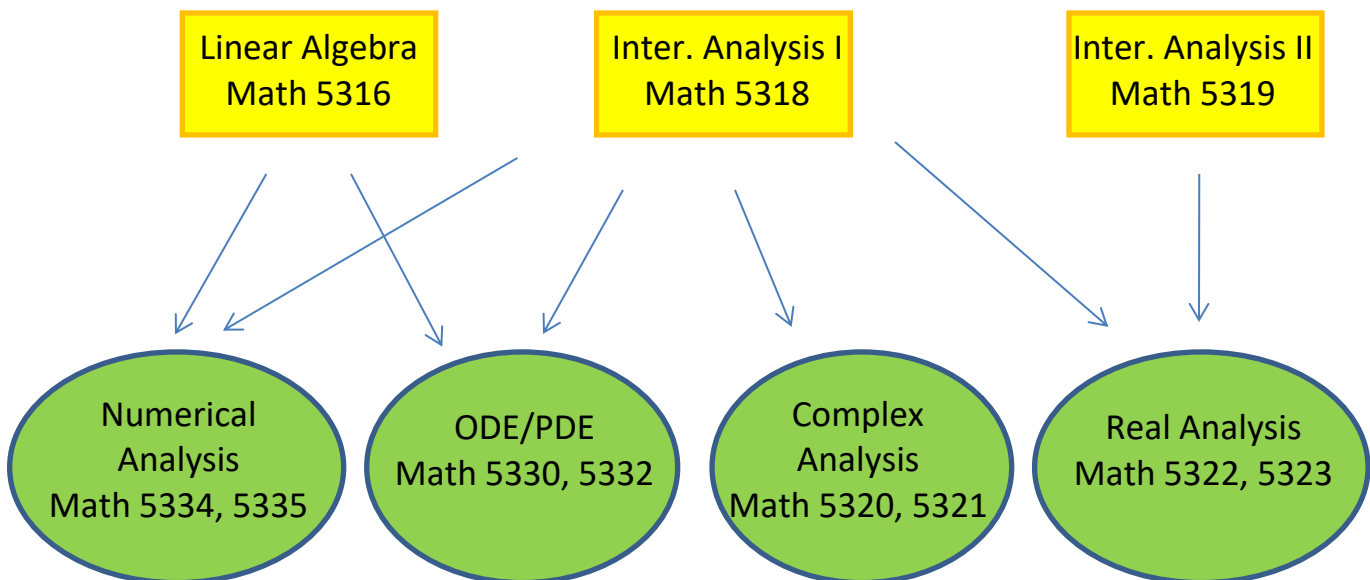
- c) Each doctoral student should become familiar with the university and departmental requirements and deadlines for the doctoral degree.
- d) **Final Examination:** A final public oral examination over the student's dissertation topics is required of every candidate for the doctorate.
- e) If a student passes a prelim without having taken the corresponding course sequence in our department, he or she is exempt from that specific sequence requirement. However, unless the student has appropriate transfer credit accepted by the department and the Graduate School, he or she must still complete the required number of foundational sequences and courses for his or her concentration. See Rules 2b and 3a below for information on transfer credit.

### Transfer of Courses

With the permission of the graduate advisor:

1. One course (3 credit hours) may transfer towards a grad certificate provided there is an equivalent TTU course.
2. Two courses (6 credit hours) may transfer towards a Master's degree, provided there is an equivalent TTU course.
  - a. A core course/sequence from a Master's degree granting institution will not transfer.
  - b. Students can be exempted from a core course/sequence by passing the corresponding Ph.D. prelim exam at TTU.
3. Up to 10 courses (30 credit hours) from a doctoral degree granting institution may transfer towards a Ph. D. degree.
  - a. A course course/sequence from a Ph.D. degree granting institution may transfer if the student has passed the corresponding prelim exam at TTU.
  - b. No courses from a Master's degree granting institution will be granted transfer credit.
4. No course or credit from an undergraduate program will be allowed to transfer toward a graduate degree or certificate.

### Leveling Coursework for Graduate students



## Graduate Course Outlines

The pages that follow contain information about certain courses in the main body of the graduate program. Recent textbooks and course content are included for some of the courses. The textbooks depend on the instructor. Students are advised to check with the instructor of record before buying any textbooks.

**The students should check with the instructor of record in the year the preliminary exams are administered to find out the exact list of topics for the prelim exam.**

**Course Number:** Mathematics 5310, 5311  
**Descriptive Title:** Principles of Classical Applied Analysis  
**Text:** *Applied Linear Algebra & notes from Applied Mathematics*, both by P. Oliver, published by Person

Partial differential equations, separation of variables, Fourier series, Sturm-Liouville theory, Green's functions, Laplace and Fourier transforms, calculus of variations

**Course Number:** Mathematics 5315  
**Descriptive Title:** Introduction to Set Theory  
**Text:** *Introduction to Set Theory*, Karel Hrbacek and Thomas Jech, 3<sup>rd</sup> edition, Taylor & Francis

Zermelo-Fraenkel axioms of set theory; relations, functions, and orderings; natural numbers; finite, countable and uncountable sets; cardinal numbers; ordinal numbers; alephs; the axiom of choice and its equivalents

*Learning outcomes:* First students will develop the basic Zermelo-Fraenkel Axioms of Set Theory. Why we need them, and what consequences they have. Once we have settled what a set is we can define relations, functions, ordered pairs, and natural numbers. Then we study the properties of natural numbers. Next students will realize that there are different flavors of infinity, e.g., there are (in what sense?) significantly more real numbers than natural numbers. This leads to the concept of cardinal numbers and their arithmetic. Ordinal numbers are a special type of sets, e.g., the set of all natural numbers is an ordinal number. Students will learn how to do arithmetic with ordinals. Finally we will discuss the (in)famous Axiom of Choice which says roughly: For any set of sets, let us call them  $X(i)$ , we can find elements  $\xi(i)$  in  $X(i)$  for all sets  $X(i)$  *simultaneously*.

**Course Number:** Mathematics 5316  
**Descriptive Title:** Applied Linear Algebra  
**Text:** *Matrix Theory: A Second Course*, by Ortega, Plenum Press.

Solution of linear systems, matrix inversion, vector spaces, projections, determinants, eigenvalues and eigenvectors, Jordan forms, computational methods, and applications.

*Learning outcomes:* Students will learn methods for solution of linear systems of equations (both exact and approximate), learn vector spaces and understand matrices as linear operators between vector spaces, study topics in matrix theory such as invertibility and their relation to solutions of linear systems of equations, understand eigenvalues, eigenvectors and the Jordan decomposition, study applications to optimization and solution of least squares problems, understand the singular value decomposition and its role in least squares problems, understand the relation between eigenvalues and stability of linear, time-invariant differential equations, learn the tools available in MatLab for the solution and visualization of linear algebra problems.

**Course Number:** Mathematics 5317  
**Descriptive Title:** Introduction to Modern Algebra  
**Text:** *Abstract Algebra*, Third Edition by Dummit and Foote, John Wiley & Sons Inc.

This is a graduate level introduction to the theory of groups and rings; it prepares the student for the graduate algebra sequence Modern Algebra I & II (Math 5326-5327), and the textbook is the same as the one used for that sequence. Students with a solid background in abstract algebra can go directly to Math 5326-5327.

*Learning outcomes:* The students will develop the skills in basic group theory and ring theory that are required to succeed in the Math 5326-5327 sequence. After completion of the class, students will have an operational understanding of the basic concepts in group theory and ring theory; including following: Important examples of groups, such as dihedral groups and matrix groups. Sub groups and quotient groups; the group isomorphism theorems. Group actions, centralizers, normalizers, and stabilizers. Important examples of rings, such as polynomial rings, matrix rings, and group rings. Ideals and quotient rings; the ring isomorphism theorems. Rings of fractions. The Chinese Remainder Theorem.

**Course Number:** Mathematics 5318-5319  
**Descriptive Title:** Intermediate Analysis  
**Text:** *Principles of mathematical analysis*, by W. Rudin, 3<sup>rd</sup> Ed.

This sequence covers the topics of single and multivariable advanced calculus in greater depth and with more rigor than in an ordinary advanced calculus course. It forms a bridge between senior-level analysis and the more advanced graduate studies in real analysis and functional analysis. Students with a good background in basic analysis can go to 5322-5323 directly.

*Learning Outcomes:* Upon completion of this two-semester series, students should master concepts and theories of single and multi variable calculus, including: sets, real number system, formal definition of limits of sequences, Cauchy sequences, epsilon-delta definition of limits of functions, continuous functions, differentiation, mean value theorems, Taylor's theorem, Riemann integrals, fundamental theorems of calculus, infinite series, sequences and series of functions, introduction to the topology of the line, introduction to Lebesgue measure and integration.

**Course Number:** Mathematics 5320-5321  
**Descriptive Title:** Functions of a Complex Variable  
**Text:** *Functions of One Complex Variable*, by Conway, Springer-Verlag, 2nd Edition.

Geometry and analysis of the complex plane. Topology of the plane. Analytic functions and conformal mapping. Complex integration. Residue theory. Maximum Modulus Theorem and its applications. Normal families and meromorphic functions. Analytic continuations and Riemann surfaces. Harmonic function theory.

*Learning Outcomes:* Upon completion of this two-semester series, students should master concepts and theories of geometry and analysis of complex plane, topology of the plane, analytic functions, conformal mapping, complex integration, residue theory, maximum modulus theorem and its applications, normal families, meromorphic functions, analytic continuations, and harmonic function theory.

**Course Number:** Mathematics 5322-5323  
**Descriptive Title:** Real Analysis  
**Text:** *Real Analysis and Modern Techniques*, by G. Folland, 2nd Edition

Topics covered primarily during the first semester of this course include a general development of measure, integration, convergence theorems, decomposition of measures and  $L^p$  theory. Chapters 2, 3, 5 and 6 represent the core of material covered in 5322. In 5323 basic elements of functional analysis, as well as topics in Fourier

analysis and probability theory, are covered. Other topics that might be covered are selected at the instructor's discretion. The necessary auxiliary topological facts are taught as they are needed for the main developments.

*Learning Outcomes:* Upon completion of this two-semester series, students should master concepts and theories of outer measures, the Caratheodory extension theorem, general measures, Lebesgue integrals with respect to a measure, Lebesgue measures, Lebesgue-Stieltjes measures, product measures, convergence theorems, Fubini-Tonelli theorem, signed measures, functions of bounded variation, absolutely continuous functions, differentiation theory, differentiation of a measure, metric spaces, compactness, Banach spaces,  $L_p$  spaces, Hilbert spaces, basic Fourier analysis, bounded linear functionals, dual spaces, and bounded linear operators.

**Course Number:** Mathematics 5324-5325  
**Descriptive Title:** Topology  
**Text:** *General Topology*, by S. Willard.

Mathematics 5324 will deal with the basics of metric and general topology: topologies, closure, bases and refinements, continuity, topological equivalence, compactness, paracompactness, connectedness, subspaces and embeddings, and separation properties. Core theory to be covered will include the metrization theorems of Urysohn and Bing-Nagata-Smirnov, the Tietze Extension Theorem, the Tychonoff Product Theorem, and the Stone-Cech Compactification, this fundamental cluster of material to be supplemented at the instructor's discretion.

Mathematics 5325 will deal with basic topics in algebraic topology: homotopy, fundamental groups, covering spaces, homology and exact sequence analysis, and special topics at the discretion of the instructor.

*Learning Outcomes:* In the two-semester sequence students should develop an understanding of basic concepts and relations of general topology. The first semester covers bases, subbases, subspaces, continuity and homeomorphisms, connectedness in its various forms, compactness, separation axioms, countability properties, products, quotients and metrization theorems. The second semester further covers metric and complete metric spaces, function spaces, as well as basics of homotopy theory, including covering spaces, fundamental group, surfaces and applications.

**Course Number:** Mathematics 5326-5327  
**Descriptive Title:** Modern Algebra  
**Text:** *Abstract Algebra*, by Dummit and Foote.

This two-semester sequence assumes the student has had undergraduate courses in abstract algebra and linear algebra. Topics covered are groups (solubility, nilpotency, Sylow theorems, groups acting on sets), rings (ideals, factorization in commutative rings), modules (standard functions and constructions, modules over principal ideal domains with applications to linear algebra), fields (extensions, Galois theory, structure of finite fields) and commutative algebra (localization, primary decomposition, polynomial and power series rings). Time permitting, topics in noncommutative ring theory will also be studied.

*Learning Outcomes:* Upon completion of this two-semester series, students should master concepts and theories of groups (solubility, nilpotency, Sylow theorems, groups acting on sets), rings (ideals, factorization in commutative rings), modules (standard functions and constructions, modules over principal ideal domains with applications to linear algebra), fields (extensions, Galois theory, structure of finite fields), and commutative algebra (localization, primary decomposition, polynomial and power series rings).

**Course Number:** Statistics 5328-5329  
**Descriptive Title:** Intermediate Mathematical Statistics  
**Text:** *Statistical Inference*, by George Casella, Roger Berger, 2nd Edition.

Statistics 5328: Random variables, mathematical expectation, probability density functions, cumulative distribution functions, conditional distributions, special distributions, transformation of random variables, order statistics, moment generating functions, limiting distributions, central limit theorem, stochastic convergence.

Statistics 5329: Point estimation, interval estimation, confidence intervals for means, confidence intervals for difference of means, efficiency of estimators, statistical hypotheses, uniformly most powerful tests, likelihood ratio tests, chi-square tests, noncentral chi-square, noncentral F, sufficient statistics.

*Learning Outcomes:* Upon completion of this two-semester series, students should master concepts and theories of random variables, mathematical expectation, probability density functions, cumulative distribution functions, conditional distributions, special distributions, transformation of random variables, order statistics, moment generating functions, limiting distributions, central limit theorem, stochastic convergence, point estimators, statistical hypotheses, uniformly most powerful tests, likelihood ratio tests,  $\chi^2$  tests, noncentral  $\chi^2$ , noncentral F, and sufficient statistics.

**Course Number:**        **Mathematics 5330-5331**  
**Descriptive Title:**    **Ordinary Differential Equations**  
**Text:**                    *Nonlinear Systems, by H. Khalil, 3<sup>rd</sup> Ed.*

M5330 is regarded as the first semester of a two-semester sequence that includes M5332. M5330 is a first course in the theory of ordinary differential equations. Prerequisites are undergraduate differential equations. Mathematical maturity at the level of 5318 and 5319 is desired. The topics to be covered in the first semester include: Existence and uniqueness results for initial value problems, dependence on data, continuation of solutions and maximal intervals of existence, linear equations and systems, oscillation theory, stability, Sturm-Liouville theory and boundary value problems, Green's functions.

M5331 is an advanced topics course in ordinary differential equations. The content is selected at the discretion of the instructor.

*Learning Outcomes:* Upon completion of this course, students should master concepts and theories of existence and uniqueness of initial value problems, dependence on data, continuation of solutions and maximal intervals of existence, linear equations and systems, oscillation theory, stability. Students will acquire an introductory level knowledge on basic concepts of the theory of dynamical systems, such as invariant sets, manifolds and their stability, and chaos.

**Course Number:**        **Mathematics 5332-5333**  
**Descriptive Title:**    Partial Differential Equations  
**Text:**                    *Partial Differential Equations, Lawrence Evans*

M5332 is the second semester of the two-semester sequence that includes M5330 and is designed as a first course in partial differential equations. The content includes quasi-linear and linear first order equations, classification of PDE's, hyperbolic equations, elliptic equations, and parabolic equations.

M5333 is an advanced topics course in partial differential equations. The content is selected at the discretion of the instructor.

*Learning Outcomes:* Upon completion of this course, students should master concepts and theories of quasi-linear and linear first order partial differential equations, classification of partial differential equations, hyperbolic equations, elliptic equations, and parabolic equations.

**Course Number:** Mathematics 5334-5335  
**Descriptive Title:** Numerical Analysis  
**Text:** Recommended: Concise Numerical Mathematics, by Robert Plato.

Mathematics 5334 covers computer arithmetic and error analysis; interpolation techniques; numerical differentiation and numerical quadrature; direct and iterative methods for solution of systems of linear equations.

Mathematics 5335 covers numerical solution of ordinary differential equations; solution of nonlinear systems of equations; calculation of eigenvalues and eigenvectors; special topics.

*Learning Outcomes:* Upon completion of this two-semester series, students should become proficient in the theoretical, analytical, and computational study of numerical analysis. Students should master concepts in computer arithmetic, rounding error analysis, numerical solution of nonlinear equations in one variable, interpolation theory, numerical differentiation, numerical quadrature, numerical linear algebra, approximation theory, direct and iterative methods for solution of linear systems, computational solution of eigenvalues-eigenvectors problems, numerical solution of initial-value differential equation systems, computational solution of systems of nonlinear equations, numerical optimization, and computational solution of boundary-value problems.