ATENEO DE MANILA UNIVERSITY
Loyola Schools
Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 11
Course Title	Modern Mathematics I
No. of Units	3 units

Course Description:

Math 11 is the first of a series of Math courses taken by non-science majors. It discusses the different types of real-valued functions including linear functions, quadratic functions, polynomial and rational functions, radical functions, exponential and logarithmic functions. It is a pre-calculus course needed for Math 19 or Math 20 as it tackles the essential algebraic concepts and skills needed for further study in mathematics.

Course Objectives:

At the end of the course, the student should be able to

1. apply the midpoint, slope and distance formulas to various problems in coordinate geometry;
2. solve systems of linear equations;
3. write the equation of a circle in standard form and determine its center and radius;
4. solve systems involving second-degree equations;
5. define the domain and range of various functions;
6. complete the square and apply the quadratic formula to solve quadratic equations;
7. find the maximum/minimum of a quadratic function;
8. apply synthetic division, the remainder theorem, the factor theorem and the rational root theorem to find the zeroes of polynomial functions;
9. solve equations and inequalities involving polynomial and rational expressions;
10. graph polynomial and rational functions;
11. find the inverse of a 1 – 1 function;

12. convert exponential equations to logarithmic form and vice versa;

13. apply laws of exponents and properties of logarithms to solve exponential and logarithmic equations;

14. solve problems involving exponential growth and decay.

Course Outline:

Sections 2012 edition	Sections 2007 edition	Topics
1.1 – 1.4	Appendix A	Exponents and Radicals
	Appendix B	Linear and Quadratic Equations/Inequalities
		Equations and Inequalities involving absolute value
2.1 – 2.5	1.1 – 1.5	The Rectangular Coordinate System and the Analytic Geometry of the Line
3.1	2.1, (2.2)	The Circle and the Parabola
3.2	2.3	Systems Involving Second-degree Equations
4.1 – 4.2	3.1 – 3.2	An Introduction to Functions
5.1 – 5.5	4.1 – 4.5	Polynomial and Rational Functions
6.1 – 6.6	5.1 – 5.6	Inverse Functions: Logarithmic and Exponential Functions

ATENEO DE MANILA UNIVERSITY
Loyola Schools
Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 12
Course Title	Modern Mathematics II
No. of Units	3 units

Course Description:

Ma 12 is a course that exposes the students to various aspects of human life in which mathematics is used as tool for analysis, decision-making and design creation. Applications in management, social science and the arts are discussed using at least five topics coming from such areas as: personal financial management; clock arithmetic and applications; analysis of data; election theory; geometry of shapes, patterns and designs; optimal use of resources; networks; logical reasoning; assessing chances; etc.

Course Objectives:

1) Cognitive Aims:

At the end of the course, the student should be able to

a) Perform computations involving compound interest, future value, installment buying, and credit.
b) Solve simple problems involving the Fundamental Principle of Counting, and problems involving permutations and combinations.
c) Apply basic probability concepts and formulas.
d) Describe statistical data in terms of measures of central tendency and variability.

2) Value aims:

The course is to be taught with a view to

a) Helping the student realize that in different life situations, problems encountered have a mathematical structure and mathematics is a handy tool in presenting the problem to others and in formulating solutions.
b) Providing an opportunity for the student to develop his analytic powers, creativity and open-mindedness in confronting modern day problems and the use of new techniques in their solutions.
c) Appreciating more practical uses of mathematics through its applications in the areas of modular arithmetic, geometry, networks, logic and election theory.

Course Outline:

Chapter 1. Personal Financial Mangement
* Compound Interest, Future Value, Installment Buying, Truth in Lending

Chapter 2. Counting Techniques and Probability
*Fundamental Counting Principle, Permutations, Combinations, Sample Space, Probability of Events, Addition of Probabilities, Conditional Probability (note that Binomial Theorem and Bayes' Theorem are not included)

Chapter 3. Statistics
(Frequency Distribution and Histogram, Box Plots and Measures of Center, the Best-fit Line, Linearization)

Chapter 4. Choice of the Teacher from below

Topic Choices for Chapter 4:

- Graph Theory (Or "Networks")
- Clock Arithmetic and Some Applications (new chapter)
- Election Theory (new chapter)
- Geometry: Shapes, Patterns, and Designs (new chapter)
- Logic
- Linear Programming

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Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 1.2
Course Title	Preparatory Course to College Algebra II
No. of Units	3 units

Course Description:

Ma 1.2 is the second in a series of two 3-unit credit, basic, bridging Math courses for students who took up Ma 1.1 in the previous semester. The course is a continuation of the intensive review of the high school mathematics necessary for Ma 11. Topics include: integral and rational exponents, operations on radicals, absolute value and order, linear and quadratic equations and inequalities.

Course Objectives:

At the end of the course, the student should be able to:

1. Apply the laws of exponents to simplify expressions with zero, negative and/or rational exponents.
2. Simplify and rationalize radical expressions.
3. Solve linear and quadratic equations in one variable.
4. Solve word problems using linear equations in one variable.
5. Solve linear and quadratic inequalities.
6. Solve equations and inequalities involving absolute values.

Course Outline:

Sections	Topics
	Review Laws of Exponents
3.9	The Zero Exponent, Negative Integers as Exponents
3.10	Rational Exponents
3.11	Simplification of Radicals
3.12	Addition and Subtraction of Radical
3.13	Multiplication and Division of Radicals
Appendix B / Supplementary	Five Axioms of Equality, Cancellation Laws
	Linear Equations in One Variable
	Solving Word Problems using Linear Equations in OneVariable

Appendix B / Supplementary	Inequalities, Order Axioms, The Interval Notation
	Solving Linear Inequalities and Compound Inequalities, Absolute Value
	Linear Equations and Inequalities involving Absolute Values
Appendix B / Supplementary	Solving Quadratic Equations in One Variable
	The Quadratic Formula, Solving Quadratic Inequalities by the Table of Signs Method

ATENEO DE MANILA UNIVERSITY
Loyola Schools
Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 18b
Course Title	Principles of Modern Mathematics II
No. of Units	3 units

Course Description:

This is the second part of a 6-unit pre-calculus course taken by science and engineering majors. The course is a preparation for the calculus series which includes Ma 21, Ma 22, and Ma 101. It covers topics in college algebra not covered in Ma 18a. The breakdown of the topics includes trigonometric functions and their applications, mathematical induction, sequences and series, and polar coordinates.

Course Objectives:

At the end of the course, the student should be able to:

1. Define the trigonometric functions, prove trigonometric identities and find solutions to trigonometric equations;
2. Relate the polar coordinate system with the Cartesian coordinate system and sketch graphs of polar equations.
3. Recognize arithmetic and geometric sequences and solve problems that involve them;
4. Use the principle of math induction as a method of proof.
5. Apply the Binomial Theorem

Course Outline:

6. Trigonometry I

6.1 Angles and Their Measurement
6.2 Trigonometric Functions of General Angles
6.3 Trigonometric Functions of Special Angles
6.4 Trigonometric Functions of Real Numbers
6.5 Graphs of the Sine and Cosine Functions
6.6 Graphs of the Tangent, Cotangent, Secant and Cosecant Functions
6.7 Applications of Trigonometric Functions in Periodic Phenomena

6. Trigonometry I

6.8 Identities
6.9 Sum and Difference Identities
6.10 Double Measure and Half-Measure Identities

7. Trigonometry II

7.1 Inverse Trigonometric Functions
7.2 Trigonometric Equations

7. Trigonometry II

7.3 Solutions of Right Triangles
7.4 The Law of Sine
7.5 The Law of Cosine
7.6 Polar Coordinates
7.7 Graphs of Polar Coordinates
7.8 Intersections of Polar Graphs

8. Sequences and Mathematical Induction

8.1 Sequences, Series and Sigma Notation
8.2 Mathematical Induction
8.3 Arithmetic Sequences and Series
8.4 Geometric Sequences and Series
8.5 The Binomial Theorem

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Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 19
Course Title	Applied Calculus for Business
No. of Units	6 units

Course Description:

Math 19 is a 6-unit course taken primarily by BS Management majors, both for the standard and honors programs. It covers differential and integral calculus in preparation for various topics in higher management areas such as Business Statistics, Operations Management and Financial Management. Topics include mathematical modeling, limits and continuity, the derivative, differentiation and the differential, the definite integral and integration, partial derivatives and functions of more than one variable.

Course Objectives:

At the end of the course, the student should be able to:

1. Have an intuitive notion of the concepts of limit and continuity of a function; apply the limit theorems and obtain the asymptotes of the graph of a function.
2. Find the derivative of algebraic, exponential and logarithmic functions; interpret the derivative as a measure of slope and as a rate of change; use derivatives as an aid in sketching the graph of a function and to solve optimization problems.
3. Determine both the definite and the indefinite integrals of functions; interpret the integral as a measure of an area of a region; apply different techniques of integration; solve differential equations.
4. Find the partial derivatives and the higher order partial derivatives of functions of more than one variable; determine the maximum and minimum values of multivariate functions and use the method of Lagrange multipliers to solve constrained optimization problems.

Course Outline:

Topics	Chapter/Section
1. The Derivative	
Introduction to Limits	3.1
Infinite Limits and Limits at Infinity	3.2
Continuity	3.3
The Derivative	3.4
Basic Differentiation Properties	3.5
Derivatives of Products and Quotients	4.3
The Chain Rule	4.4
Differentials	3.6
Marginal Analysis in Business and Economics	3.7
2. Additional Derivative Topics	
The Constant e and Continuous Compound Interest	4.1
Derivatives of Logarithmic and Exponential Functions	4.2
Implicit Differentiation	4.5
Related Rates	4.6
3. Graphing and Optimization	
First Derivative and Graphs	5.1
Second Derivative and Graphs	5.2
L'Hôpital's Rule	5.3
Curve Sketching Techniques	5.4
Absolute Maxima and Minima	5.5
Optimization	5.6
4. Integration	
Antiderivatives and Indefinite Integrals	6.1
Integration by Substitution	6.2
Differential Equations – Growth and Decay (no slope fields)	6.3
The Definite Integral	6.4
Fundamental Theorem of Calculus (no error bounds)	6.5
5. Additional Integration Topics	
Area between Curves	7.1
Applications in Business and Economics	7.2
Integration by Parts	7.3

6. Multivariable Calculus

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Loyola Schools
Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 20
Course Title	Calculus for Economists
No. of Units	6 units

Course Description:

Ma 20 is a 6-unit calculus course taken primarily by Economics, Management Economics, and Management Information Systems majors. The course is a preparation for Ec 115 (Introduction to Mathematical Economics) and other courses in Economics that require calculus. Topics include the following: limits and continuity, the derivative, differentiation and the differential, antidifferentiation, the definite integral, the fundamental theorem of calculus, some techniques of integration, partial derivatives and calculus of functions of more than one variable.

Course Objectives:

At the end of the course, the student should be able to:

1. Have an intuitive notion of the concepts of limit and continuity of a function; apply the limit theorems and obtain the asymptotes of the graph of a function.
2. Find the derivative of algebraic, exponential and logarithmic functions; interpret the derivative as a measure of slope and as a rate of change; use derivatives as an aid in sketching the graph of a function and to solve optimization problems.
3. Determine both the definite and the indefinite integrals of functions; interpret the integral as a measure of an area of a region; apply different techniques of integration; solve differential equations.
4. Find the partial derivatives and the higher order partial derivatives of functions of more than one variable; determine the maximum and minimum values of multivariate functions and use the method of Lagrange multipliers to solve constrained optimization problems.

Course Outline:

Topics	Chapter/Section
1. The Derivative	
Introduction to Limits	3.1
Infinite Limits and Limits at Infinity	3.2
Continuity	3.3
The Derivative	3.4
Basic Differentiation Properties	3.5
Derivatives of Products and Quotients	4.3
The Chain Rule	4.4
Differentials	3.6
Marginal Analysis in Business and Economics	3.7
2. Additional Derivative Topics	
The Constant e and Continuous Compound Interest	4.1
Derivatives of Logarithmic and Exponential Functions	4.2
Implicit Differentiation	4.5
Related Rates	4.6
3. Graphing and Optimization	
First Derivative and Graphs	5.1
Second Derivative and Graphs	5.2
L'Hôpital's Rule	5.3
Curve Sketching Techniques	5.4
Absolute Maxima and Minima	5.5
Optimization	5.6
4. Integration	
Antiderivatives and Indefinite Integrals	6.1
Integration by Substitution	6.2
Differential Equations – Growth and Decay (no slope fields)	6.3
The Definite Integral	6.4
Fundamental Theorem of Calculus (no error bounds)	6.5
5. Additional Integration Topics	
Area between Curves	7.1
Applications in Business and Economics	7.2
Integration by Parts	7.3

6. Multivariable Calculus

ATENEO DE MANILA UNIVERSITY
Loyola Schools
Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 20.2
Course Title	Calculus for Computer Science
No. of Units	6 units

Course Description:

Ma 20.2 is a 6-unit calculus course designed for Computer Science majors. Topics include limits and continuity, derivatives and differentials, anti-differentiation and the definite integral, partial derivatives and the total differential of functions of more than one variable. Discussions include applications of calculus to the different branches of science such as biology, chemistry and physics as well as applications to business and economics.

Course Objectives:

At the end of the course, the student is expected to be able to:

1. Have an intuitive notion of the concepts of limit and continuity of a function; apply the limit theorems and obtain the asymptotes of the graph of a function.
2. Find the derivative of algebraic, exponential and logarithmic functions; interpret the derivative as a measure of slope and as a rate of change; use derivatives as an aid in sketching the graph of a function and to solve optimization problems.
3. Determine both the definite and the indefinite integrals of functions; interpret the integral as a measure of an area of a region; apply different techniques of integration; solve differential equations.
4. Find the partial derivatives and the higher order partial derivatives of functions of more than one variable; determine the maximum and minimum values of multivariable functions and use the method of Lagrange multipliers to solve constrained optimization problems.
5. Apply technology (e.g., computer algebra systems) in solving calculus problems.

Course Outline:

I. Limits and Continuity

1. The Concept of a Limit and Limit Theorems
2. Limit of Trigonometric Functions
3. Infinite Limits and Limits at Infinity
4. Some Additional Limit Theorems
5. Continuity of a Function
6. Squeeze Theorem and Applications

II. The Derivative

1. Definition of the Derivative

2. Basic Differentiation Rules
3. Tangent Lines and Rates of Change
4. Derivatives of the Trigonometric, Exponential, and Logarithmic Functions
5. The Chain Rule
6. Additional Differentiation Techniques
7. Related Rates

III. Applications of the Derivative

1. Increasing, Decreasing Functions and the First-Derivative Test
2. Concavity, Points of Inflection, and the Second-Derivative Test
3. Sketching Graphs of Functions
4. Optimization; Absolute Maxima and Minima
5. Approximation by Differentials

IV. The Integral

1. Antiderivatives and the Indefinite Integral
2. Integration by Substitution
3. Differential Equations
4. The Riemann Sum and Definite Integration
5. The Fundamental Theorems of Calculus

V. Additional Integration Topics

1. Area Between Curves
2. Volumes of Solids
3. Integration by Parts
4. Integration of Rational Functions by Partial Fractions

VI. Multivariable Calculus

1. Functions of More Than One Variable
2. Partial Derivatives
3. Extrema of Functions of Two or More Variables
4. Lagrange Multipliers
5. Double Integration

ATENEO DE MANILA UNIVERSITY
Loyola Schools
Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 20.3A
Course Title	Applied Calculus for Life Sciences I
No. of Units	3 units

Course Description:

Ma 20.3a is the first in a series of two 3-unit calculus courses taken primarily by majors in the life sciences. The course introduces the student to differential calculus and its applications such as rate of change, related rates, graphing, and optimization. There is strong emphasis on applications to life sciences. Topics include limits and continuity, derivatives, differentials and applications of the derivative.

Course Objectives:

At the end of the course, the student is expected to be able to:

6. Have an intuitive notion of the concepts of limit and continuity of a function; apply the limit theorems and obtain the asymptotes of the graph of a function.
7. Find the derivative of algebraic, exponential and logarithmic functions; interpret the derivative as a measure of slope and as a rate of change; use derivatives as an aid in sketching the graph of a function and to solve optimization problems.

Course Outline:

Sections	Topics
Precalculus	
6.1 – 6.5 7.1 – 7.3	1. Trigonometric Functions and Applications of Trigonometry Angles and their Measurement Trigonometric Functions of Angles Trigonometric Functions of Real Numbers Graphs of Sine and Cosine Functions Inverse Trigonometric Functions Trigonometric Equations Solving Right Triangles
Calculus	
3.1 – 3.6	2. Limits and the Derivative Introduction to Limits Infinite Limits and Limits at Infinity Continuity The Derivative

Basic Differentiation Properties
Differentials and Applications

4.1 – 4.6, 9.2

3. Additional Derivative Topics

The Constant e a*nd Continuous Compound Interest*
Derivatives of Logarithmic and Exponential Functions
Derivatives of Trigonometric Functions
Derivatives of Products and Quotients
The Chain Rule
Implicit Differentiation
Related Rates

5.1 – 5.2
5.4 – 5.6

4. Graphing and Optimization

First Derivative and Graphs
Second Derivative and Graphs
Curve Sketching Techniques
Absolute Maxima and Minima
Optimization

ATENEO DE MANILA UNIVERSITY
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Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 21
Course Title	Mathematical Analysis I
No. of Units	6 units

Course Description:

Ma 21 is the first of a series of three calculus courses taken by science and engineering majors. It focuses on differential and integral calculus of functions of one variable. Analysis and reasoning in mathematics are stressed and hence, emphasis is placed on the formal statement of definitions and proofs of the different theorems presented in the course. Topics include limits and continuity, derivatives and differentiation, applications of derivatives, antidifferentiation, the definite integral, the fundamental theorems of calculus, applications of the definite integral, logarithmic and exponential functions, inverse trigonometric functions.

Course Objectives:

At the end of the course, the student should be able to

1. Prove the limit of a function using the definition.
2. Evaluate the limit of a function using the limit theorems.
3. Define continuity at a point and on an interval.
4. Use the definition to get the derivative of a function.
5. Differentiate sums, products, and quotients of functions.
6. State and apply the Mean Value Theorem and its corollaries.
7. Apply the derivative tests for maxima/minima.
8. State and apply the fundamental theorems of calculus.
9. Compute antiderivatives of various functions.
10. Compute the areas of regions and volumes of solids of revolution.
11. Define the logarithmic and exponential functions, inverse trigonometric functions, hyperbolic functions and apply the related differentiation and integration formulas.
12. Relate the polar and Cartesian coordinate systems and sketch graphs of polar equations.

Course Outline:

Topics	Sections
Review of Functions and Graphs	
Introduction to Limits	2.1 – 2.2
Calculating Limits	2.3
Definition of Limits	2.4
Continuity, Limits at Infinity, Horizontal Asymptotes	2.5 – 2.6
Tangents, Rates of Change, Derivatives	2.7 – 2.8
Derivatives of Polynomials & Exponential Functions, Product and Quotient Rules	3.1 – 3.2
Derivatives of Trigonometric Functions	3.3
Chain Rule, Implicit Differentiation, Higher Derivatives	3.4 – 3.5
Derivatives of Logarithmic Functions	3.6
Rates of Change (Applications)	3.7
Related Rates, Linear Approximation and Differentials	3.9 – 3.10
Maximum and Minimum Values	4.1
Mean-Value Theorem	4.2
Optimization Problems, Applications to Business and Economics, Newton's Method (If there is time)	4.7 – 4.8
Derivatives and Graphs	4.3
L'Hopital's and Indeterminate Forms	4.4
Graph Sketching	4.5 – 4.6
Antiderivatives	4.9
Areas and Distance	5.1
The Definite Integral	5.2
Fundamental Theorem of Calculus, Indefinite Integral	5.3 – 5.4
Substitution Rule	5.5
Areas Between Curves	6.1
Average Value	6.5
Volumes (Disk and Washer Method, Cylindrical Shells)	6.2 – 6.3
Exponential Growth and Decay, Logistic Equation	3.8, 9.4
Arc Length	8.1
Area and Arc Length in Polar Coordinates	10.4

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Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 22
Course Title	Mathematical Analysis II
No. of Units	3 units

Course Description:

Ma 22 is the second in a series of three calculus courses. It focuses on integration and its various applications, sequences and infinite series, and the calculus of functions of several variables. Topics include techniques of integration, improper integrals, differential equations and initial value problems, series and tests for convergence, power and Taylor series, functions of several variables, partial derivatives, and multiple integrals.

Course Objectives:

At the end of the course, the students should be able to

1. Evaluate integrals by the use of some basic techniques of integration.
2. Evaluate integrals with infinite limits of integration.
3. Evaluate integrals of functions with a discontinuity at an interior number.
4. Evaluate the limit of a sequence.
5. Test some series for convergence.
6. Determine the convergence of a power series.
7. Formulate the power series expansion of a smooth function.
8. Solve for partial derivatives and apply the multivariate chain rule.
9. Solve for the maxima and minima of functions of several variables and apply the method of Lagrange multipliers to constrained optimization problems.
10. Evaluate double integrals, and evaluate area and volume using double integrals.

Course Outline:

Chapter 7
7.1 Integration by Parts
7.2 Trigonometric Integrals
7.3 Trigonometric Substitution
7.4 Integration of Rational Functions by Partial Fractions
7.8 Improper Integrals

Chapter 11
11.1 Sequences
11.2 Series

11.3 The Integral Test
11.4 The Comparison Tests
11.5 Alternating Series
11.6 Absolute Convergence and the Ratio and Root Tests
11.7 Strategy for Testing Series

Chapter 11
11.8 Power Series
11.9 Representations of Functions as Power Series
11.10 Taylor and Maclaurin Series

Chapter 14
14.1 Functions of Several Variables
14.2 Limits and Continuity
14.3 Partial Derivatives
14.5 The Chain Rule

Chapters 14 and 15
14.7 Maximum and Minimum Values
14.8 Lagrange Multipliers
15.1 Double Integrals over Rectangles
15.2 Iterated Integrals
15.3 Double Integrals over General Regions
15.4 Double Integrals in Polar Coordinates

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Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 101
Course Title	Mathematical Analysis III
No. of Units	3 units

Course Description:

Ma 101 is the third in a series of three calculus courses. The course generalizes the calculus of functions of one or several variables to the calculus of vector valued functions. Topics include vectors, the geometry of curves and surfaces, directional derivatives, vector fields, line and surface integrals, Green's Theorem, Gauss's Divergence Theorem, and Stokes's Theorem.

Course Objectives:

At the end of the course, the student should be able to:

1. Define vectors, and perform algebraic operations involving vectors; graphically represent vectors; graph lines and planes having given equations, and determine equations describing given lines and planes; sketch graphs of parametric curves.
2. Use vector functions to represent curves and motion in the plane and in space; define curvature of plane curves and space curves.
3. Define the directional derivative and the gradient vector; define a vector field, its gradient, divergence, and curl; evaluate line and surface integrals.
4. State and apply Green's Theorem, Gauss' Divergence Theorem, and Stokes' Theorem.

Course Outline:

Topic	Section
Vectors and the Geometry of Space	12.1-12.5
Vector Functions	10.1, 13.1-13.3
Directional Derivatives, Vector Fields, Line Integrals	14.6, 16.1-16.3
Curl and Divergence, Green's, Stokes' and the Divergence Theorem, Surface Integrals	16.4-16.5, 16.7-16.9

ATENEO DE MANILA UNIVERSITY
Loyola Schools
Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 121
Course Title	Fundamental Concepts of Algebra
No. of Units	3 units

Course Description:

This course introduces abstract algebra. It emphasizes on algebraic structures and their associated structure-preserving maps (homomorphisms). Discussions of theorems and proofs are rigorous and complete. Topics include groups and group homomorphisms, permutation groups, subgroups and normal subgroups, factor groups, rings, integral domains and fields.

Course Objectives:

The course is intended to

1. to introduce the basic algebraic structures, give specific examples and derive some general properties; and
2. to improve students' skills to be able to follow the axiomatic development of these structures and to write their own mathematical proofs.

Course Outline:

1. Introduction (Integers; Equivalence Relations; Mappings)
2. Groups (Definition and Examples; Properties)
3. Subgroups (The Subgroup Tests)
4. Cyclic Groups (Properties of Cyclic Groups; Classification of Cyclic Groups)
5. Permutation Groups (Definition and Notation; Cycle Notation; Properties of Permutations)
6. Isomorphisms (Definition and Examples; Cayley's Theorem; Properties of Isomorphisms and Automorphisms)
7. Cosets and Lagrange's Theorem (Properties of Cosets; Lagrange's Theorem; Applications to Permutation Groups)
8. External Direct Products (Definitions and Examples; Properties of External Direct Products)
9. Normal Subgroups and Factor Groups (Normal Subgroups; Factor Groups; Applications; Internal Direct Product)
10. Group Homomorphisms (Definition and Examples; Properties of Homomorphisms)
11. Finite Abelian Groups (The Fundamental Theorem of Finite Abelian Groups; Isomorphism Classes)
12. Rings and Subrings (Definitions and Examples; Properties
13. Integral Domains (Definitions and Examples; Fields; Characteristic
14. Ideals and Factor Rings (Ideals; Factor Rings; Prime and Maximal Ideals)

ATENEO DE MANILA UNIVERSITY
Loyola Schools
Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 122
Course Title	Linear Algebra
No. of Units	3 units

Course Description:

Ma 122 is a linear algebra course for mathematics majors and economics (honors) majors. The course discusses vector spaces, matrices and linear transformations together with applications. Topics include matrices and matrix operations, solutions of systems of linear equations, vector spaces and linear transformations; Eigenvalues, diagonalization of matrices and linear transformations.

Course Objectives:

At the end of the course, the student should be able to:

1. Perform the basic matrix operations.
2. Use matrices to solve systems of linear equations.
3. Define and give standard examples of vector space, basis, dimension and isomorphism
4. Define and give standard examples of linear transformation, kernel and range.
5. Obtain the matrix of a linear transformation.
6. State the basic properties of a determinant and use determinants to solve systems of linear equations.
7. Obtain the eigenvalues, eigenvectors and characteristic polynomial of a linear transformation; diagonalize a matrix.

Course Outline:

Topic	Section
1. Systems of Linear Equations and Matrices	
Introduction to Systems of Equations	1.1 – 1.3, 2.1-2.5
Gaussian Elimination and Gauss-Jordan Elimination	
Applications of Systems of Linear Equations	
Operations with Matrices	
Properties of Matrix Operations	
The Inverse of a Matrix	
Elementary Matrices	
Applications of Matrix Operations	
2. Vector Spaces	
Vector Spaces	4.2-4.7

Subspaces
Spanning Set and Linear Independence
Basis and Dimension
Rank of a Matrix and systems of Linear Equations
Coordinates and Change of Basis

3. Inner Product Spaces

Length and Dot Product in Rn	5.1-5.4
Inner Product Spaces	
Orthonormal Bases: Gram-Schmidt Process	
Mathematical Models and Least Squares Analysis	

4. Linear Transformations

Introduction to Linear Transformations	6.1-6.4
The Kernel and Range of a Linear Transformation	
Matrices for Linear Transformation	
Transition Matrices and Similarity	

5. Determinants and Eigenvalues and Eigenvectors

The determinant of a Matrix	3.1-3.3, 7.1-7.3
Evaluation of a Determinant Using Elementary Operations	
Properties of determinants	

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Generic Course Syllabus for 2nd Semester, School Year 2012-2013

Department	Mathematics	School	Science & Engineering

Course No.	MA 124
Course Title	Discrete Mathematics I
No. of Units	3 units

Course Description:

This course is the first of a two-part course on discrete mathematics. It introduces foundational concepts along with fundamental discrete and combinatorial methods necessary for undergraduate mathematics. It covers two main areas: (1) counting techniques, the principle of inclusion and exclusion and generating functions, and (2) fundamental concepts of mathematics such as sets, logic, methods of proof, and relations and functions.

Course Objectives:

At the end of the course, the student should be able to

1. Use the correct symbolic logic notations in writing propositions and mathematical statements.
2. Determine the validity of mathematical propositions, using truth tables, rules of inference and other tools.
3. Apply the different methods of proof in proving mathematical theorems.
4. Define some basic terms in mathematics such as function, prime, greatest common divisor, etc, and explore operations associated with them, e.g. division algorithm, Euclidean algorithm, modular arithmetic, etc.
5. Apply the fundamental techniques of counting objects, e.g. permutations and combinations.
6. Apply more advanced techniques of counting: using recurrence relations, generating functions and the principle of inclusion and exclusion.

Course Outline:

Topics	Sections
Propositional Logic Predicates and Quantifiers Rules of Inference	1.1-1.5
Methods of Proof	1.6-1.7
Sets and Functions	2.1-2.3
Counting Techniques	

	5.1, 5.3-5.5
Recurrence Relations,Generating Functions,Inclusion & Exclusion	7.1-7.6

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Department	Mathematics	School	Science & Engineering

Course No.	MA 151
Course Title	Elementary Probability Theory
No. of Units	3 units

Course Description:

Ma 151 is a 3-unit course taken primarily by Mathematics majors and Management Engineering majors. The course introduces the students to the science and mathematics of chance. It develops both the intuitive and numerical notions of probability. Topics include basic probability theory, the random variable and its probability distribution function, mathematical expectation, some special types of probability distributions, moment-generating function of random variables, probability distribution functions of functions of random variables, and limit theorems.

Course Objectives:

At the end of the course, the student must have obtained an understanding, appreciation, and good, working knowledge of:

1. set algebra and set operations; basic combinatorics and counting techniques such as permutations and combinations and how to solve problems involving these techniques;
2. classical probability theory, rules of probability, the concept of statistical independence, conditional probabilities and Bayes' Theorem;
3. discrete and continuous-type random variables and their probability distribution/density functions; the joint distribution of several random variables; marginal distributions and conditional distributions given the joint distribution;
4. the concept of expected value of a random variable and how it is computed; special mathematical expectations such as variance, covariance, and moments; properties of expectation;
5. the derivation of the distributions of functions of random variables using CDF-technique, the transformation technique, and the moment-generating function technique;
6. some discrete probability distribution functions with special names: binomial, and Poisson; derivation of the expectations of these distributions and how to solve problems involving these distributions;
7. some continuous probability density functions with special names: uniform, gamma, and exponential; derivation of the expectations of these distributions and how to solve problems involving these distributions.
8. the normal distribution and its properties; standardization of normal random variables; areas under the normal curve, derivation of the expectations of the normal distribution; solve application problems involving the normal distribution; approximate the binomial distribution using the normal distribution

Course Outline:

Chapter 2 – Probability
2.1 Introduction
2.2 Sample Spaces and the Algebra of Sets
2.3 The Probability Function
2.4 Conditional Probability
2.5 Independence
2.6 Combinatorics
2.7 Combinatorial Probability

Chapter 3 – Random Variables
3.1 Introduction
3.2 The Binomial and Hypergeometric Distributions

3.3 Discrete Random Variables
3.4 Continuous Random Variables
3.5 Expected Values
3.6 The Variance
3.7 Joint Densities
3.9 Further Properties of the Mean and Variance
3.10 Order Statistics
3.11 Conditional Densities

3.8 Combining Random Variables
3.12 Moment-Generating Functions

Chapter 4 – Special Distributions
4.1 Introduction
4.2 The Poisson Distribution
4.3 The Normal Distribution
4.4 The Geometric Distribution
4.5 The Negative Binomial Distribution
4.6 The Gamma Distribution

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Department	Mathematics	School	Science & Engineering

Course No.	MA 161
Course Title	Differential Equations
No. of Units	3 units

Course Description:

This course introduces the theory of ordinary differential equations and dynamical systems. Some classical methods of solving ordinary differential equations are included but the emphasis of the course is on qualitative analysis of ordinary differential equations. Topics include phase portrait of autonomous systems, linearization at fixed point and stability analysis of equilibrium solutions. Discussions also include models of some physical phenomena using ordinary differential equations.

Course Objectives:

Course Outline:

1. Introduction

(a) Classification of ordinary differential equations and systems
(b) Solutions and basic existence theorems
(c) Direction field

2. Some Techniques of Solving Ordinary Differential Equations

(a) Separation of variables
(b) Leibniz's formula for first-order linear equations
(c) Second-order linear ordinary differential equations with constant coefficients
(d) Series solutions

3. Laplace Transforms

(a) Definition and Examples
(b) Properties of the Laplace Transform
(c) Inverse Laplace Transform
(d) Solving Initial Value Problems
(e) Convolution

4. Qualitative Analysis of Autonomous Differential Equations

(a) First-order autonomous equations
(b) Autonomous systems
(c) Jordan canonical forms for 2 _ 2 matrices
(d) Phase portraits of canonical linear systems in the plane

(e) Phase portraits of noncanonical linear systems in the plane
(f) Linearization at a fixed point
(g) First integrals

5. Additional Topics and Group Reports

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Department	Mathematics	School	Science & Engineering

Course No.	MA 187
Course Title	Real Analysis
No. of Units	3 units

Course Description:

The course is an introductory course to real analysis. The first part is a review of the properties of the set of real numbers and some topological concepts. This is followed by an introduction to Lebesgue measure and integration, and L^p-spaces.

Course Objectives:

At the end of the course, the student is expected to:

1. define and give examples of measure, sigma algebra, Borel sets, and LP spaces
2. enumerate and illustrate properties of measure and Lebesgue measure
3. define and give examples of Lebesgue integral
4. state and prove fundamental theorems of measure theory, Lebesgue integration, and LP spaces.
5. justify the use of Lebesgue integration instead of Riemann integration and cite useful applications of spaces of functions.

Course Outline:

1. Measure

2. Measurable Functions

3. Integral

4. Lp Spaces

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Department	Mathematics	School	Science & Engineering

Course No.	STAT 107
Course Title	Introduction to Statistical Analysis
No. of Units	3 units

Course Description:

Stat 107 is a 3-unit statistics course taken by BS MIS students. It includes descriptive statistics, elementary probability theory and applications, sampling theory and applications, estimation and hypothesis testing, regression and correlation analysis, and analysis of variance.

Course Objectives:

At the end of the course, the student should be able to:

1. Summarize and interpret data in terms of measures of central tendency, dispersion, and graphical measures such as frequency distributions, box plots, and scatterplots.
2. Apply probability distribution functions in modeling random phenomena.
3. Estimate population parameters and test hypothesis using appropriate techniques.
4. Determine how variables affect each other by utilizing statistical methods such as regression, correlation, and analysis of variance.
5. Use a statistical package that facilitates computation and analysis.

Course Outline:

Topics
I. Introduction (Chapter 1) Importance of Statistics in everyday life Statistics as a branch of Science Types of Variables Levels of Measurement
II. Summarizing Data (Chapter 2) The Frequency Distribution Graphing Presentation of a Frequency Distribution Other Graphing Presentations of Data
III. Descriptive Statistics for grouped and ungrouped data (Chapters 3 to 4) Measures of Central Tendency The Arithmetic Mean and its Properties The Median and its Properties The Mode and its Properties Other Measures of Central Tendencies (Harmonic, geometric) Measures of Dispersion

Range Average Deviation Standard Deviation Measures of Location Quartiles, Deciles and Percentiles Box Plots Skewness
IV. Counting Principles and Probability Concepts (Chapter 5) Principles of Counting Probability Defined Approaches to Assigning Probabilities Some Rules for Computing Probabilities
V. Random Variables and Probability Distribution Functions (Chapter 6 and 7) Random Variables Discrete and Continuous Distribution Functions Expectations of distribution functions (introduce mgf) Binomial Probability Distribution Poisson Probability Distribution The Standard Normal Distribution
VI. Sampling Methods and the Central Limit Theorem (Chapter 8) Sampling Methods Sampling Distribution of the Sample Mean The Central Limit Theorem Using the Sampling Distribution of the Sample Mean
VII. Estimation and Confidence Intervals (Chapter 9) Point Estimates and Confidence Intervals A Confidence Interval for Proportion Choosing an Appropriate Sample Size
VIII. Test of Hypothesis(Chapter 10) What is a Hypothesis? What is Hypothesis Testing? Five-Step Procedure for Testing a Hypothesis One-Tailed and Two-Tailed Tests of Significance *p*-value in Hypothesis Testing One sample Test for Population Mean (unknown parameters) and Proportions
IX. Two-Sample Tests of Hypothesis(Chapter 11) Independent Samples and Related Samples (include test of proportions)
X. Analysis of Variance (Chapter 12) The *F* Distribution ANOVA Assumptions The ANOVA Test Inferences about Pairs of Treatment Means
XI. Linear Regression and Correlation (Chapter 13) The Coefficient of Correlation Regression Analysis
XII. Basic Multiple Linear Regression (Chapter 14) Multiple Regression Analysis Inferences in Multiple Linear Regression Assumption about Multiple Linear Regression

ANOVA table and t-test for coefficients