MATH REQUIREMENTS IN ENGINEERING AND TECHNOLOGY PROGRAMS AT NYCCT (CUNY)

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STEM LIAISON, DEPARTMENT OF MATHEMATICS

ABSTRACT. This is a preliminary report outlining required math courses in the following departments:
- Computer Engineering Technology,
- Computer Systems Technology,
- Electrical and Telecommunications EngineeringTechnology, and
- Mechanical Engineering Technology.

This report is divided into two parts:
(1) For each program offered by these departments, this report includes a list of courses and their corresponding math prerequisites.
(2) Lists of topics covered in required math courses are also included.

These lists provide a jumping-off point for the STEM Liaisons and Math Liaisons in the engineering and technology departments to identify corresponding topics in math and engineering/technology classes.

INTRODUCTION

Goal. The goal of the STEM Liaison is twofold:

(1) to identify specific math topics for which students require extra support in their engineering and technology courses and compile a database of activities around these applications to be delivered in the required math classes and
(2) to identify the current alignment of topics in engineering and technology courses and corresponding required math courses and to suggest possible improvements to alignment, sequencing, or topics.

The STEM Liaison in the Math Department will work with the assigned Math Liaisons in the four engineering and technology departments towards these goals. The STEM Liaison will report to the Opening Gateways team.

Math Liaisons.

- *Computer Engineering Technology:* Aparicio Carranza, Yu Wang.
- *Computer Systems Technology:* Candido Cabo, Bader Oudjehane, Ashwin Satyanarayana.
- *Electrical and Telecommunications Engineering Technology:* Mohammed Kouar, Zory Marantz (on sabbatical Spring 2019).
- *Mechanical Engineering Technology:* Masato Nakamura, Akm S Rahma.

Organization. This document is split into two parts.

Part 1. Summaries of required math courses and prerequisites in engineering and technology programs.

Part 2. Lists of topics appearing in required math courses.

Degrees/requirements:

(1) Associate in Applied Science in Electromechanical Engineering Technology
  - MAT 1375 (semester 1)
  - MAT 1475 (semester 3)
(2) Bachelor of Technology in Computer Engineering Technology
  - MAT 1575 (semester 5)
  - MAT 2680 (semester 6)
  - MAT 2580 (semester 7)

Code	Course Title	MAT Prerequisite	Semester
EMT 1150	Electrical Circuits	MAT 1175 or higher	1
EMT 1255	Electronics	MAT 1375 or higher	2
EMT 2461	Electromechanical Systems: Software Interface	MAT 1475 or higher	4
CET 3510	Microcomputer Systems Technology	MAT 1575 or higher	5
CET 3525	Electrical Networks	Pre- or corequisite: MAT 1575 with a grade of C or higher	5
CET 3550	Analog and Digital Electronics	Pre- or corequisites: MAT 1575 or higher	
CET 3615	Instrumentation and Data Acquisition	MAT 1575 with a grade of C or higher	6
CET 3625	Applied Analysis Lab	This course is coordinated with MAT 2680 Differential Equations. Pre- or corequisite: MAT 2680	6
CET 3910	Mechanics of Materials	MAT 1475, with a grade of C or higher	
CET 4705	Component and Subsystem Design I	MAT 2680	7
CET 4762	Electromechanical Devices	MAT 2680 with grade of C or higher	elective?
CET 4864	Principles of Feedback Control Systems	MAT 2580	8
CET 4930	Applied Mechanics	MAT 1575 with a grade of C or higher	elective?
CET 4942	Economics of Engineering and Management	MAT 1575 with a grade of C or higher	elective?
CET 4950	Heating, Ventilation and Air Conditioning	MAT 2680 with a grade of C or higher	elective?
CET 4952	Robotics Technology	Pre- or corequisite: MAT 2580	elective?
CET 4960	Applied Digital Technology	MAT 1575 with a grade of C or higher	elective?
CET 4962	Applied Software Technology	MAT 1575 with a grade of C or higher	elective?
CET 4963	Modern Communications Electronics	MAT 2680 with a grade of C or higher	elective?
CET 4970	Design of Electrical Equipment Installations	MAT 1575 with a grade of C or higher	elective?
CET 4971	Linear Integrated Circuit Applications	MAT 2680	elective?
CET 4974	Introduction to ComputerAided Design	MAT 2680	elective?

Notes:

- There is no MAT 2440/2540 requirement; should CET students take this course?
- Are students integrating in courses requiring MAT 1575?
- MAT 2680 has a new course outline, so CET 3625 is not coordinated with it.

Degrees/requirements:

(1) Associate in Applied Science in Computer Information Systems
- MAT 1375 or higher (semester 1)
(2) Bachelor of Technology in Computer Systesm
- MAT 2440 (semester 5)
- MAT 2540 2 or MAT 1475 (semester 6)

- Database Track
- Networking and Security Track
- IT Operations Track
- Software Development Track

Code	Course Title	MAT Prerequisite	Semester
CST 1202	Sequential Mainframe Programming	MAT 1175 or higher; Corequisite: MAT 1275	elective?
CST 2206	Introduction to Information Systems and Technologies	Prerequisite: Eligibility for ENG 1101 and MAT 1275 or higher	required only for accounting majors?
CST 2302	Sequential Mainframe Programming II	Corequisite: MAT 1375	elective?
CST 2303	Online Programming (CICS)	MAT 1375	elective?
CST 2403	Introductory C++ Programming Language Part I	Prerequisites: (CST 1101 and (MAT 1275 or higher)) or MAT 1476 or (EMT 1111 and (MAT 1275 or higher))	
CST 3506	Object-Oriented Systems Analysis	MAT 1375 or higher	elective?
CST 3508	Design of Graphic User Interfaces Visual Basic	MAT 1375 or higher	elective?

Notes:

- Is the prerequisite for CST 2206 eligibility for MAT 1275 or is it MAT 1275 itself?
- CST 3650 Data Structures does not have a MAT prerequisite; should there be one? The course is listed just once in the catalog; who takes this course?
- MAT 2440 is a program requirement but not a prerequisite for any classes; should it be a prerequisite?
- A few CST classes have MAT 1375 as a prerequisite; are these classes program requirements?
- CST 2403 is a prerequisite for many courses (including MAT 2440); is it a prerequisite for any CST requirements?

Degrees/Requirements:

(1) Associate in Applied Science in Electrical Engineering Technology
- MAT 1375 or higher (semester 1)
- MAT 1475 or higher (semester 2)

(2) Bachelor of Technology in Electrical Technology (above for associate plus...)
- MAT 1575 (semester 5)
- MAT 1372 or MAT 2572 (semester 6)

(3) Associate in Applied Science in Telecommunications Engineering Technology
- MAT 1375 or higher (semester 1)
- MAT 1475 or higher (semester 3)

(4) Bachelor of Technology in Telecommunications Engineering Technology (above for associate plus...)
- MAT 1575 (semester 5)
- MAT 1372 (semester 6)

Code	Course Title	MAT Prerequisite	EET	TET
EET 1102	Techniques of Electrical Technology	Pre- or corequisite: MAT 1175 or higher	1	1
EET 1122	Circuit Analysis I	MAT 1275 or higher	1	1
EET 1222	Circuit Analysis II	MAT 1375 or higher	2	2
EET 2122	Advanced Circuit Analysis Corequisite: MAT 1475 or higher	3		
EET 2220	Electronic Controls MAT 1475 or higher	4		
EET 3102	Signals and Systems Pre- or corequisite: MAT 1575	5		
EET 3132	Remote Sensing MAT 1475 or higher	elective?		
EET 3202	Principles of Communications Systems	Pre- or corequisite: MAT 1372 or MAT 2572	6	
EET 3212	Control Systems	MAT 1575 or higher	6	
EET 4242	Remote Sensing (Special Topics)	MAT 1575 or higher, MAT 2580	elective?	
ETN 1102	Principles of Electricity and Electronics	MAT 1275 or higher		
ETN 1302	Principles of Electricity, Electronics and Computer Operation (for non-ET/TC majors)	Corequisite: MAT 1375 or higher		
TCET 2220	Transmission Systems	Pre- or corequisite: MAT 1475 or higher		4
TCET 3242	Advanced Communication Network	MAT 1575		elective?
TCET 4110	Electromagnetics and Antenna Design	MAT 1575		elective?
TCET 4132	Wireless Communications	MAT 1372 or MAT 1572, MAT 1575		7
TCET 4172	Telecommunication Protocols and Network Performance	MAT 1575		elective?
ETX 1212	Digital Systems for Telecommunications I	MAT 1215		
ETX 3122	Electronics for Telecommunications	MAT 1315		

Notes:

- Students should take MAT 1375, 1475, and 1575 (and 2680 if relevant) in consecutive semesters.
- What do students who place into MAT 1475 do about the MAT 1375 requirement in practice?
- MAT 2580 is not a program requirement but it is a prerequisite for EET 4242.
- TCET 4132 lists MAT 1572 as a choice for prerequisite; there is no such course. Is this 2572?
- ETX 1212 and ETX 3122 list MAT 1215 and MAT 1315 as prerequisites; these courses are no longer offered.
- What are ETN/ETX courses? They seem not to be required for either program.
- Should MAT 2680 be a program requirement?

Degrees/Requirements:

(1) Associate in Applied Science in Industrial Design Technology
- MAT 1275 (semester 1)
- MAT 1375 (semester 2)
- BTech:
    - MAT 1475 (semester 5)
    - MAT 1575 (semester 6)
    - MAT 2680 (semester 7)

(2) Associate in Applied Science in Mechanical Engineering Technology
- MAT 1375 (semester 1)
- MAT 1475 (semester 2)

(3) Bachelor of Technology in Mechanical Engineering Technology
- above plus
- MAT 1575 (semester 5)
- MAT 2680 (semester 6)

Code	Course Title	MAT Prerequisite	AAS/BTech MET	AAS industrial/BTech MET
IND 2313	Industrial Design I	MAT 1175 or higher	3	
MECH 1201	Computer-Aided Manufacturing Systems	Pre- or corequisite: MAT 1275 or higher	2	2
MECH 1222	Computer-Aided Engineering Graphics	MAT 1275 or higher	2	2
MECH 1233	Statics and Strength of Materials	MAT 1275 or higher	2	2
MECH 1240	Computer Applications in Mechanical Engineering Technology	MAT 1275 or higher	2	2
MECH 2333	Strength of Materials II	Pre- or corequisite: MAT 1375 or higher	3	5
MECH 2335	Kinematics and Dynamics of Machines	Pre- or corequisite: MAT 1375 or higher	3	
MECH 2410	Machine Design	MAT 1375 or higher		
MECH 2426	Materials Testing Laboratory	Pre- or corequisites: MAT 1475 or higher	4	
MECH 2430	Thermodynamics	Pre- or corequisites: MAT 1475 or higher	4	
MECH 3500	Computer Programming and Applications	MAT 1475 or higher	5	6
MECH 3501	Quality Control	MAT 1475	elective?	
MECH 3550	Simulation and Visualization	MAT 1475 or higher	elective	elective
MECH 3600	Mechanical Measurements and Instrumentation	MAT 1475 or higher	6	6
MECH 3650	Advanced Strength of Materials	MAT 1575 or higher	6	
MECH 4700	Fluid Mechanics	MAT 1575 or higher	7	7
MECH 4730	Finite Element Methods	MAT 2680	7	8
MECH 4760	Vibration and Advanced Dynamics	MAT 2680	7	8

Notes:

- Are there two different BTechs in MET or two different Associate degrees en route to BTech in MET?
- Students should take MAT 1275, 1375, 1475, 1575, and 2680 in consecutive semesters.
- MAT 1175 is replaced by MAT 1275CO.
- MECH 4700 has MAT 1575 as prerequisite but perhaps MAT 2680 is more appropriate.

The courses appearing as math requirements in the four engineering and technology programs listed above are grouped according to topic:

(1) **Calculus Sequence and Differential Equations**
    (a) MAT 1275: College Algebra and Trigonometry
    (b) MAT 1375: Precalculus
    (c) MAT 1475: Calculus I
    (d) MAT 1575: Calculus II
    (e) MAT 2680: Differential Equations
(2) **Probability and Statistics**
    (a) MAT 1372: Statistics with Probability
    (b) MAT 2572: Probability and Mathematical Statistics I
(3) **Discrete Structures and Algorithms**
    (a) MAT 2440: Discrete Structures and Algorithms I
    (b) MAT 2540: Discrete Structures and Algorithms II
(4) **Linear Algebra**
    (a) MAT 2580: Introduction to Linear Algebra

Brief overviews of each course, together with detailed lists of topics are given below.

Notes:

- MAT 1175 has been replaced by MAT 1275CO, a 0-credit corequisite course taken alongside MAT 1275.
- The Math Department is no longer offering MAT 1215 and 1315, which were exclusively for students of the Verizon program.

Calculus Sequence and Differential Equations.

MAT 1275: College Algebra and Trigonometry. Arithmetic and algebra; solving equations; introduction to trigonometry; introduction to exponential and logarithmic functions

- Properties of integer exponents
- Addition and subtraction of rational expressions
- Complex fractions
- Solving rational equations
- Roots
- Rational exponents
- Simplifying radical expressions
- Addition and subtraction of radicals
- Multiplication of radicals
- Division of radicals and rationalization
- Solving radical equations
- Complex numbers
- Solving equations by using the zero product rule
- Square root property and completing the square
- Quadratic formula
- Applications of quadratic equations
- Graphs of quadratic functions
- Vertex of a parabola
- Distance formula, midpoint formula, and circles
- Perpendicular bisector
- Systems of linear equations in three variables
- Determinants and Cramer's rule (optional)
- Nonlinear systems of equations in two variables
- Angle measure and special triangles
- The trigonometry of right triangles
- Solving right triangles
- Applications of static trigonometry
- Angle measure in radian
- Trigonometry and the coordinate plane
- Unit circles
- Graphs of the sine and cosine functions
- Graphs of the tangent and cotangent functions (optional)
- Fundamental identities and families of identities
- Trigonometric equations
- Oblique triangles and the law of sines
- The law of cosines
- Exponential functions
- Logarithmic functions
- Properties of logarithms
- Compound interest
- Logarithmic and exponential equations

MAT 1375: Precalculus. Functions and their graphs; polynomial, rational, trigonometric, exponential, and logarithmic functions.

Prerequisite: MAT 1275 or equivalent

- The absolute value
- Lines and functions
- Functions by formulas and graphs
- Introduction to the TI-84
- Basic functions and transformations
- Operations on functions
- The inverse of a function
- Dividing polynomials
- Graphing polynomials
- Roots of polynomials
- Rational functions
- Polynomial and rational inequalities
- Exponential and logarithmic functions
- Properties of exp and log
- Applications of exp and log
- Half-life and compound interest
- Trigonometric functions
- Addition of angles and multiple angle formulas
- Inverse trigonometric functions
- Trigonometric equations
- Sequences and series
- The geometric series
- Complex numbers
- Vectors in the plane
- The binomial theorem

MAT 1475: Calculus I. Limits and derivatives

Prerequisite: MAT 1375 or equivalent

- An Introduction to Limits
- Finding Limits Analytically
- One Sided Limits
- Continuity
- Limits Involving Infinity
- Instantaneous Rate of Change: The Derivative
- Interpretations of the Derivative
- Basic Differential Rules
- The Product and Quotient Rules
- The Chain Rule
- Implicit Differentiation
- Derivatives of Inverse Functions
- L'Hôpital's Rule
- Extreme Values
- The Mean Value Theorem
- Increasing and Decreasing Functions
- Concavity and the Second Derivative
- Curve Sketching
- Related Rates
- Optimization
- Differentials
- Antiderivatives and Indefinite Integration
- The Definite Integral
- Riemann Sums
- The Fundamental Theorem of Calculus

MAT 1575: Calculus II. Definite and indefinite integrals; integration techniques; series and power series; volumes of revolution

Prerequisite: MAT 1475

- Antiderivatives and Indefinite Integration
- The Definite Integral
- The Fundamental Theorem of Calculus
- Substitution
- Integration by Parts
- Trigonometric Integrals
- Trigonometric Substitution
- Partial Fraction Decomposition
- Improper Integration
- Taylor Polynomials
- The Mean Value Theorem
- Sequences
- Infinite Series
- Integral and Comparison Tests
- Ratio and Root Tests
- Alternating Series and Absolute Convergence
- Power Series
- Taylor Series
- Riemann Sums
- The Fundamental Theorem of Calculus
- Areas Between Two Curves
- Volume by Cross-Sectional area; Disk and Washer Methods
- The Shell Method
- Arc Length and Surface Area

MAT 2680: Differential Equations. Methods of solving ordinary differential equations; applications to various problems

Prerequisite: MAT 1575

- First Order Equations (Optional: Direction Fields for First Order Equations)
- Linear First Order Equations
- Separable Equations
- Transformation of Nonlinear Equations into Separable Equations
- Exact Equations
- Growth/Decay / Cooling and Mixing / Elementary Mechanics
- Euler's Method
- The Improved Euler Method / Related Methods
- The Runge-Kutta Method
- Homogeneous Linear Equations
- Constant Coefficient Homogeneous Equations
- Nonhomogeneous Linear Equations
- The Method of Undetermined Coefficients
- Reduction of Order
- Variation of Parameters
- Spring Problems
- The RLC Circuit
- Series Solutions Near an Ordinary Point
- Regular Singular Points Euler Equations
- Introduction to the Laplace Transform
- The Inverse Laplace Transform
- Solution of Initial Value Problems
- Convolutions

Probability and Statistics.

MAT 1372: Statistics with Probability. Sample spaces and probabilities, discrete probability distributions (Binomial, Hypergeometric), expectation and variance, continuous probability distributions (Normal, Student, Chi-Square), confidence intervals, hypothesis testing, and correlation and regression.

Pre- or corequisite: MAT 1375

- Introduction to Excel
- Graphical Descriptive Techniques
- Measures of Central Location and Variability
- Covariance and Coefficient of Correlation
- Least Squares Method and Regression
- Assigning Probabilities to Events; Probability
- Experiments Having Equally Likely Outcomes
- Conditional Probability and Independence
- Relative Frequency Distribution and z-scores
- Random Variables, Probability Distributions
- Expected Value and Variance
- Binomial Distribution
- Poisson Distribution
- Continuous Random Variables
- Normal Random Variables
- Finding Normal Probabilities
- Sample Mean
- Distribution of the Sample Mean
- Distribution of the Sample Variance of a Normal Population
- Estimating Population Means
- Testing with Known Standard Deviation
- Inference about a Population Mean with Unknown Standard Deviation
- Chi-Squared Goodness of Fit Test
- Chi-Squared Test for Independence - Contingency Table

MAT 2572: Probability and Mathematical Statistics I. The study of discrete and continuous probability distributions including the Binomial, Poisson, Hypergeometric, Exponential, Chi-Squared and Normal Distribution. Conditional distributions, covariance and correlation, confidence intervals, least square estimation, χ-square goodness of fit distribution and test for independence and randomness. Ends with an application to queuing.

Prerequisite: MAT 1575

- Sample Space and Algebra of Sets
- The Probability Function
- Conditional Probability
- Bayes Theorem
- Independence
- Combinatorics
- Combinatorial Probability
- Binomial and Hypergeometric Probabilities
- Discrete Random Variables
- Continuous Random Variables
- Expected Values
- Moment-Generating Functions
- Poisson Distribution
- The Normal Distribution
- The Geometric Distribution
- The Negative Binomial Distribution
- The Gamma Distributions
- Interval Estimation
- The Decision Rule
- Type I and Type II Errors (optional)
- Drawing Inferences About μ and σ^2
- Goodness-of-Fit Tests
- Contingency Tables

Discrete Structures and Algorithms.

MAT 2440: Discrete Structures and Algorithms I. Functions, relations, sets, simple proof techniques, Boolean algebra, propositional logic, elementary number theory, writing, analyzing and testing algorithms

Prerequisites: MAT 1374 and (CST 1201 or CST 2403 or MAT 1630)

- Propositional Logic and Applications
- Propositional Equivalences
- Predicates and Quantifiers
- Nested Quantifiers
- Rules of Inference
- Introduction to Proofs
- Sets
- Set Operations
- Functions
- Sequences and Summations
- Cardinality of Sets
- Algorithms
- The Growth of Functions
- Complexity of Algorithms
- Divisibility and Modular Arithmetic
- Integer Representations and Algorithms
- Primes and Greatest Common Divisors
- Solving Congruences
- Applications of Congruences
- Cryptography
- Mathematical Induction
- Program Correctness (optional)

MAT 2540: Discrete Structures and Algorithms II. Predicate logic, recurrence relations, graphs, trees, digital logic, computational complexity and elementary computability

Prerequisite: MAT 2440

- Strong Induction and Well-Ordering
- Recursive Definitions and Structural Induction
- Recursive Algorithms
- Permutations and Combinations
- The Basics of Counting
- The Pigeonhole Principle
- Applications of Recurrence Relations
- Solving Linear Recurrence Relations
- Divide-and-Conquer Algorithms and Recurrence Relations
- Graphs and Graph Models
- Graph Terminology and Special Types of Graphs
- Representing Graphs and Graph Isomorphism
- Connectivity
- Euler and Hamilton Paths
- Shortest-Path Problems
- Introduction to Trees
- Application of Trees
- Tree Traversal
- Spanning Trees
- Minimum Spanning Trees
- Recursive Definitions and Structural Induction (Recursively Defined Sets and Functions)

Linear Algebra.

MAT 2580: Introduction to Linear Algebra. Vectors, (vector spaces), solving systems of linear equations, (linear transformations), properties of matrices, determinants, eigenvalues and eigenvectors

Pre- or corequisite: MAT 1575

- Vectors in 2-Space, 3-Space, and n-Space
- Norm, Dot Product and Distance in $\mathbb{R}^n$
- Orthogonality
- Introduction to Systems of Linear Equations
- Gaussian Elimination
- Matrices and Matrix Operations
- Inverses; Algebraic Properties of Matrices
- Elementary Matrices and a Method for finding A^{-1}
- Diagonal, Triangular, and Symmetric Matrices
- Matrix Transformations
- Determinants by Cofactor Expansion
- Evaluating Determinants by Row Reduction
- Properties of Determinants; Cramer?s Rule
- Real Vector Spaces
- Subspaces
- Linear Independence
- Coordinates and Basis
- Row Space, Column Space, and Null Space
- Eigenvalues and Eigenvectors
- Diagonalization
- Orthonormal Sets
- Orthogonal Matrices
- Orthogonal Diagonalization (for 2×2 matrices)
- Quadratic Forms