

# Course Descriptions

## Pure Mathematics Semnan University

Number of Credits: 111 credits

Program: Bachelor's Degree

Faculty: Mathematics, Statistics, Computer Science.

### **MATH 100:** General Mathematics I

**Number of Credits:** 4

**Course:** 68 hours

#### **Syllabus:**

Cartesian coordinates - Polar coordinates - Algebra of functions - Limits and related theorems - Derivatives and derivation instructions - Trigonometric functions and their inverse functions - Basic theorems of differential and integral calculus - Definition of integral and its application - Integration methods - Hyperbolic functions - Numerical series and convergence theorems - Power series and Taylor theorem.

### **MATH 101:** General Mathematics II

**Number of Credits:** 4

**Prerequisites:** General Mathematics I

**Course:** 68 hours

#### **Syllabus:**

Parametric equations - Spatial coordinates - Vector in space - Numerical multiplication - Linear equations of three unknowns - Inverse of the matrix - Solving the equation - Determinant  $3 \times 3$ - Multiplication - Equations of line and plane – Second degree procedure - vector function and its derivative - gradient - multivariate function – tangent plane and vertical line - Double and triple integrals and their applications – full differential-cylindrical and spherical coordinates - Vector field – Procedural integral - Divergence - Laplacian - Green theorems - Side and partial derivatives.

### **MATH 102:** General Mathematics III

**Number of Credits:** 4

**Prerequisites:** General Mathematics II

**Course:** 68 hours

#### **Syllabus:**

Vector functions and derivatives -Curvature and tangent and vertical vectors of a curve - Multivariate functions - Side and partial gradient derivatives - Tangent plane and perpendicular line -Chain base for derivatives of multivariate functions - Full differential - Taylor command for multivariate functions – Change the order of integration - vector field and linear curve integral calculation of arc length and surface integral-divergence-Cycle-Laplacian–Potential-Green and Divergence and Stokes theorems.

### **MATH 103:** Fundamentals of Mathematics

**Number of Credits:** 4

**Prerequisites:** -

**Course:** 68 hours

**Syllabus:**

Propositions, exponential propositions, inference, sets, equivalence relations, combination of relations, Cartesian product of sets, selection principle, index, spanning function- One-to-one function, two-sided function, cardinal, countable set, algebraic structure, number structure, prime numbers, integers, rational numbers, upper and lower bounds, integrity principle, Archimedes principle- Making real numbers with the help of Archimedes.

**MATH 104:** Differential Equations

**Number of Credits:** 3

**Prerequisites:** General Mathematics II

**Course:** 51 hours

**Syllabus:**

Differential equations and their solutions -First order linear differential equations - Homogeneous equation - Second order linear equation - Homogeneous equation with constant coefficients - Indeterminate coefficient method - Parameter change method - Application of second order equations in mechanics and physics -Solving differential equation with series And gamma -A few Legendre sentences -Introduction to the system of differential equations -Laplace transform and its application in solving differential equations.

**MATH 105:** Basic Physics I

**Number of Credits:** 4

**Prerequisites:** General Mathematics I Requirement

**Course:** 68 hours

**Syllabus:**

Measurement - Universal unit - Unit conversion - Vector quantities - Force quantities - One-dimensional motion (moving along a line) - Average speed and average speed - Instantaneous velocity - Moving in two or three dimensions -Speed and average speed-Acceleration and average acceleration-throwing motion-uniform circular motion- Dynamics-Newton's laws-Labor and energy-Conservation theorem-Mechanical energy-Zero law of thermodynamics-The first law of thermodynamics-The second law of thermodynamics-Health balance-Thermal expansions.

**MATH 106:** Basic Physics II

**Number of Credits:** 4

**Prerequisites:** Basic Physics I and General Mathematics II Requirement

**Course:** 68 hours

**Syllabus:**

Familiarity with electricity - Electric field - Gaussian law - Electric potential - Capacity - Current and resistance - Circuit - Magnetic field - Magnetic field due to electric current - Induction and induction - Electromagnetic oscillation and alternating current - Muscular equations; Magnetic property of matter - electromagnetic wave.

**MATH 107:** Probability and Statistics I

**Number of Credits:** 4

**Prerequisites:** General Mathematics II

**Course:** 68 hours

**Syllabus:**

Descriptive statistics- elements of probability theory-and basic ideas of statistical inference- Topics include frequency distributions- measures of central tendency and dispersion-commonly occurring distributions (binomial, normal, etc.)- Estimation -Basics of probability-random variables-binomial and normal distributions- central limit theorem-hypothesis testing-simple linear regression- Probability space - Algebra of events - Discrete and continuous probability space - Conditional probability - Bayesian theorem - Independence of events - Bernoulli sequence of experiments - Bernoulli Random variables (variance - moments, etc.) - binomial distribution - normal distribution - binomial approximation of binomial theorem - central limit theorem and the relationship between statistics and probability.

**MATH 108:** fundamental of computer and programming

**Number of Credits:** 4

**Prerequisites:** -

**Course:** 68 hours

**Syllabus:**

Organization and main components of computer - machine language - data display - algorithms and consecutive flowcharts - selection and repetition of operations under algorithms - data structure - familiarity with a programming language Includes constants, variables, conditional operations, vectors and matrices, subroutines, input and output instructions, common algorithms such as search and sorting methods. Practical examples of programming.

**MATH 109:** Algebra I

**Number of Credits:** 4

**Prerequisites:** Fundamentals of Mathematics

**Course:** 68 hours

**Syllabus:**

Group theory - Lagrange theorem - Permutation group - Normal subgroup - Out of group - Types of convergences - Convergence theorems - Direct product of groups – Field Theory- Sub-ideal loop - Out-of-section loop - First and maximum ideals - Fractions board - Characteristics of a board and first board - Polynomial loop - Division algorithm for polynomials - Unique decomposition domains - Main ideal domains and Euclidean constituency

**MATH 110:** Linear Algebra

**Number of Credits:** 4

**Prerequisites:** Fundamentals of Mathematics- General Mathematics II

**Course:** 68 hours

**Syllabus:**

Basic concepts (over real or complex numbers): vector spaces, basis- dimension- linear transformations and matrices- change of basis- similarity- Study of a single linear operator: minimal and characteristic polynomial- eigenvalues- invariant subspaces- triangular form,-Cayley-Hamilton theorem- Inner product spaces and special types of linear operators (over real or complex fields): orthogonal, unitary- self-adjoint, Hermitian- Diagonalization of symmetric matrices, applications.

**MATH 111:** Mathematical Analysis I

**Number of Credits:** 4

**Prerequisites:** Fundamentals of Mathematics- General Mathematics II

**Course:** 68 hours

**Syllabus:**

Reminiscent of real number structure -  $\mathbb{R}^n$  space - open and closed set - BOLTSANO theorem - Heine theorem - BORELL - sequence and numerical series - KUSHI sequence - lower and upper limit - series with non-negative sentences - convergence tests - continuous functions - continuity and compression - Uniform functions - derivative - hospital rule.

**MATH 112:** Mathematical Analysis II

**Number of Credits:** 4

**Prerequisites:** Mathematical Analysis I

**Course:** 68 hours

**Syllabus:**

Riemann integrals - upper and lower integrals - functions with finite changes - integrality - integrals and derivatives - basic theorems of differential and integral calculus - integer integrals and uniform convergence in them - sequence and series and their convergence.

**MATH 113:** Numerical Analysis I

**Number of Credits:** 4

**Prerequisites:** fundamental of computer and programming- Linear Algebra- Mathematical Analysis I

**Course:** 68 hours

**Syllabus:**

Representation of real numbers - Different types of errors - Error analysis - Local and general estimates - Solving linear equations - Newton and Lagrange interpolation - Fitting by least linear squares - Fixed point and relationship with solving nonlinear equations and minimum nonlinear functions through iterative methods - Derivatives and numerical integrations and solving normal differential equations.

**MATH 114:** Discrete Mathematics

**Number of Credits:** 4

**Prerequisites:** Fundamentals of Mathematics

**Course:** 68 hours

**Syllabus:**

Principle of Inclusion and Exclusion - Differential Equation and Recursive Relationship - Generator Function - Graph and Matrix - Tree - Adaptation and Other Graph Applications - Boolean Algebra and Its Applications.

**MATH 115:** Numbers Theory

**Number of Credits:** 4

**Prerequisites:** Fundamentals of Mathematics

**Course:** 68 hours

**Syllabus:**



Introduction and brief history of number theory - Reminder of principles (mathematical order and induction) - Division algorithm - Euclidean algorithm - Prime numbers - Basic principle of arithmetic - Compatibility and their properties - Remaining category - Euler theorems - Quasi-prime numbers - Arithmetic functions ( Euler function - sum function and number of counters, etc.) - Integers - Fluid equations and their solution.

### **MATH 116:** Algebra II

**Number of Credits:** 4

**Prerequisites:** Algebra I

**Course:** 68 hours

#### **Syllabus:**

Groups and theorem of Jordan's Holder - Solvable groups - Algebraic elements - Polynomials  
Ambush of algebraic elements - Divisor of a polynomial on a board - Structure of finite bodies -  
Normal distribution - Galois fundamental theorem - Solvability of a polynomial equation With  
Radicals - Constructability with a ruler and compass, especially a necessary and sufficient  
condition for the regular polygons.

### **MATH 117:** Algebra III

**Number of Credits:** 4

**Prerequisites:** Algebra II

**Course:** 68 hours

#### **Syllabus:**

A group operation on a set and related theorems - Sylow theorems -  $p$  groups - Abelian group fundamental theorem with finite generating set - Modular structure with finite generating set on the original ideal domains - Conventional forms of matrices - Absolute radical and Jacobson radical in circles.

### **MATH 118:** Mathematical Analysis III

**Number of Credits:** 4

**Prerequisites:** Mathematical Analysis II

**Course:** 68 hours

#### **Syllabus:**

Linear transformation and its analytical properties - Multivariate function derivative - Chain rule - Partial derivatives - Inverse mapping theorem - Implicit function theorem - Rank theorem - Maximum and minimum theorems - Maximum and minimum bound theorems - Lagrange theorem - Multiple derivative forms And repeated for multivariate functions and proving its independence from the order of integration in the case of continuous functions - elementary mappings - unit separation - PHOBIN theorem of closed forms and complete forms and the application of this topic in vector analysis.

### **MATH 119:** Complex functions

**Number of Credits:** 4

**Prerequisites:** Mathematical Analysis I

**Course:** 68 hours

#### **Syllabus:**

Complex number system - fractional or two-line transformations - Analytical functions - Cauchy Riemann equations - Integration and Cauchy theorem - Cauchy integral formula - Principle of absolute maximum value - Power Fields - TILRO Lauren Field - Poles - Arithmetic and its Application - Mapping Theory - SCHUARTES Formula - Christopher - Normal Family - Riemann Mapping Theorem.

**MATH 120:** General topology

**Number of Credits:** 4

**Prerequisites:** Mathematical Analysis I

**Course:** 68 hours

**Syllabus:**

Topological space - base and sub-base - product topology - sub topological spaces - off-top topology - continuous functions - connective spaces - Local correlation - compact spaces - local compression - principles of countability - Tikhonov theorem - metric space - complete metric space.

**MATH 121:** Local differential geometry

**Number of Credits:** 4

**Prerequisites:** Mathematical Analysis I-Linear Algebra I

**Course:** 68 hours

**Syllabus:**

1- Theory of curves in  $R^2$  &  $R^3$  FARNA angle - Curvature and radiance - Local representation of a curve in the neighborhood of a normal point - The fundamental theorem of curves.

2- Local theory of procedures in  $R^3$ : first and second basic forms - main curvatures - mean curvatures.

Lined Procedures - Minimal Procedures - MAYNARDI - Cow Theorem - Intrinsic Geometry of Procedures and Two-Dimensional Riemannian geometry - HAMVERD Derivation - ZEODZIK Curvature of a Curve on a Procedure - DARBO Corner.

## **MATH 122:** Overall differential geometry

**Number of Credits:** 4

**Prerequisites:** Local differential geometry

**Course:** 68 hours

### **Syllabus:**

1- Universal theory of curves: rotational number and theorem of rotating tangents - unequal perimeter - convex curves - theorem of four vertices - FARI theorem – MILNER.

2- Theory of universal procedures: Euler index - Universal form of GAWIE theorem - Boone - HOPF theorem - Renoir - Jacobian fields and conjugate points - Cover procedures - CARTAN theorem - DAMARD theorem - Hilbert theorem.

## **MATH 123:** Pictorial Geometry

**Number of Credits:** 4

**Prerequisites:** Algebra I- Linear Algebra I

**Course:** 68 hours

**Syllabus:**

Historical Introduction - Plane and Visual Spaces - Thematic and Analytical Principle Methods in Visual Geometry - DEZAREG Theorems - PAPUS and FANO and Their Algebraic Interpretation - Visual Transformations -Geometry of Conical Sections and Quadratic Supernaturals - Polar and Polar.

**MATH 124:** Operations Research I**Number of Credits:** 4**Prerequisites:** Linear Algebra I**Course:** 68 hours**Syllabus:**

Introduction to the field of operations research - types of models and mathematical models - linear programming (modeling - simple drawing methods - two-phase large M -Duality - Sensitivity analysis) - Networks and transportation models - Other similar models - Familiarity with correct variable programming - Familiarity with dynamic programming - Familiarity with nonlinear programming - Familiarity with possible models.

**MATH 125:** Operations Research II**Number of Credits:** 4**Prerequisites:** Operations Research I**Course:** 68 hours**Syllabus:**

A- Overview of linear programming by vector method.

B- Programming the correct variables: Modeling problems one-zero- Solving problems one-zero by explicit and implicit counting methods- Modeling problems of correct variables- Solving models of correct variables by the method of bifurcation threat and cutting plates.

C- Dynamic planning: Principles and definitions- Modeling of non-probability problems- Recursive equations- Methods of solving models with discontinuous state variable- Method of solving models with continuous state variable- Practical cases.

D- Nonlinear programming: Classical principles of optimization - Unconditioned problems - Constrained problems (Lagrange method) - Quadratic program - Detachable problem planning - Search methods.

**MATH 126:** Numerical Analysis II

**Number of Credits:** 4

**Prerequisites:** Numerical Analysis I

**Course:** 68 hours

**Syllabus:**

Vertical Matrix Decompositions - Iterative Methods for Solving Linear Devices - Problem of Specific Values - LR QR Methods - Single Value Problem and Single Value Decomposition - Solving normal and partial differential equations - Differential and approximate methods - Stiff differential equations - Convergence and convergence rates in iterative methods.

**MATH 127:** Probability and Statistics II

**Number of Credits:** 4

**Prerequisites:** Probability and Statistics I

**Course:** 68 hours

**Syllabus:**

Descriptive Statistics - Set Theory, Sample Space, Combined Analysis - Conditional Probability - Random Variables - Discrete Random Variables - Continuous Random Variables -Combined probability distribution - Function of random variables - Mathematical hope and moments - Torque generating function..