جمهوری اسلامی ایران
وزارت علوم ،تحقیقات و فناوری
شورای گسترش و برنامه ریزی آموزش عالی

University of Tehran

College of Science

Department of Mathematics, Statistics and Computer Science

COMPUTER SCIENCE

LEVEL: UNDERGRADUATE

Chapter 1: General Specifications of the Curriculum

Title of the Major: Computer Science

Definition of the Major

Bachelor of Computer Science is the first university degree in which the student learns the theoretical topics of Computer Science and its practical applications. In this program, the student gets acquainted with a wide range of different fields of Computer Science.

Objectives of the Major

The purpose of this program is to train comprehensive specialists and experts who, in addition to the ability to understand analytical and solve mathematical problems and gain readiness for research and transfer of knowledge, also have the ability to quantitatively and qualitatively analyze current society issues in industrial, economic and managerial fields. Curriculum planning is such that students in all three majors of Mathematics and applications,

Statistics and Computer Science, pass a considerable common core of courses and by choosing the appropriate optional courses in higher years, catch the ability to continue their studies in graduate courses in each field. Some of the key points that have been considered in this program are:

Attracting students interested in Computer Science in other sciences and interdisciplinary trends.

1- Providing a suitable environment for a better career future for graduates.
2- Paying attention to the different abilities and interests of students.
3- Creating suitable conditions for students to continue their education in any of the fields of mathematical and interdisciplinary sciences.
4- Determining the compulsory courses in the program as necessary and usual in order to provide minimum educational requirements.
5- Allocating a suitable number of units in proportion to the necessary depth in each course and adjusting the number of courses in each semester.
6- Creating various and purposeful optional courses to increase students' scientific and skill abilities.
7- Optimal use of teachers' time and elimination of duplicate content of courses.
8- The possibility of offering new courses, according to the international standards in various fields of Mathematics.
9- Optimal use of faculty members' expertise and their educational and research abilities.

Necessity and Significance of the Major

Due to the growing scope of Computer Science and its various applications in other fields such as Mathematics, Statistics, Physics, Chemistry, Biology and Engineering Sciences and Economics, etc., and in order to achieve independence and access to modern science and technology in the world, it is undoubtedly one of the main tasks of the country's universities to establish this course and update its programs.

Duration of the Major and System

According to the upstream regulations, the duration of a continuous bachelor's degree is at least four years (maximum five years). Each academic year consists of two semesters and each semester includes 16 educational weeks. The educational system of this major is credit-based and for each credit of theoretical course, 16 hours of training are considered. The framework of the program has a general structure in which the compulsory courses are defined only as necessary and in order to provide the minimum educational requirements, and the rest of the courses are formulated in a flexible format with specific objectives in the tables of basic, technical and optional courses.

Type and Number of Courses

1- To graduate in Computer Science, it is necessary to pass at least 135 credits (maximum 140 credits). These 135 credits include 22 general credits, 24 basic credits, 69 technical credits (including projects) and 21 optional credits.

Table (1) - Distribution of Credits

Type of Courses	Number of Credits
General courses	22
Basic courses	24
Technical courses	69
Optional courses	20
Total	**135**

Graduates' Expected Roles and Credentials

Skills and Special Abilities	Related courses
Familiarity with the Basics of Computer Programming	Fundamentals of Computer and Programming, Advanced Programming
Familiarity with Applications Programs	Artificial Intelligence, Biological Computing, Data Mining, Introduction to Bioinformatics
Skills and General Abilities	**Related courses**
Familiarity with Basics of Mathematics	General Mathematics (1), General Mathematics (2), Fundamentals of Mathematics, Linear Algebra, Differential Equations
Familiarity with the Basics of Statistics and the Probability	Statistical Methods, Probability (1)

Student Admission Conditions

Students of this field are accepted by determining the field code in the national exam booklet and through the exam of the assessment organization and in accordance with the rules and regulations of the university.

Chapter 2: Tables of the Courses

No.	Course Title	No. of Credits	Type of Credits		No. of Hours		Prerequisite/Co-Requisite
			Theoretical	Practical	Theoretical	Practical	
1.	General Mathematics (1)	4	4	-	64	-	-
2.	General Mathematics (2)	4	4	-	64	-	General Mathematics (1)
3.	General Physics (1)	2	2	-	32	-	-
4.	General Physics (2)	2	2	-	32	-	General Physics (1)
5.	Fundamentals of Computer and Programming	4	4	-	64	-	-
6.	Fundamentals of Mathematics	4	4	-	64	-	-
7.	General Biology	2	2	-	32	-	-
	Total	**24**	**24**		**384**		

Table 2: Technical Courses

No.	Course Title	No. of Credits	Type of Credits		No. of Hours		Prerequisite/Co-Requisite
			Theoretical	Practical	Theoretical	Practical	
1.	Differential Equations	3	3	-	48	-	General Mathematics (2)
2.	Linear Algebra	4	4	-	64	-	Fundamentals of Mathematics
3.	Fundamentals of Combinatorics	4	4	-	64	-	-
4.	Probability (1)	4	4	-	64	-	-
5.	Statistical Methods	3	3	-	48	-	Probability (1)
6.	Scientific Writing	2	2	-	32	-	-
7.	Advanced Programming	4	4	-	64	-	Fundamentals of Computer and Programming
8.	Data Structures and Algorithms	4	4	-	64	-	Advanced Programming
9.	Algorithm Design and Analysis	4	4	-	64	-	Data Structures and Algorithms
10.	Fundamentals of Logic	3	3	-	48	-	Fundamentals of Mathematics
11.	Fundamentals of Theory of Computation	3	3	-	48	-	Fundamentals of Logic
12.	Theory of Computation	3	3	-	48	-	Fundamentals of Theory of Computation
13.	Principles of Computer Systems	3	3	-	48	-	Advanced Programming
14.	Machine Language and Assembly	3	3	-	48	-	Principles of Computer Systems
15.	Principles of Operating Systems	4	4	-	64	-	Data Structures and Algorithms
16.	Scientific Computations	4	4	-	64	-	Linear Algebra
17.	Artificial Intelligence	3	3	-	48	-	Data Structures and Algorithms
18.	Compiler	3	3	-	48	-	Fundamentals of Theory of Computation
19.	Project	3	3	-	48	-	Scientific Writing + Department Permission
	Total	**64**	**64**		**1024**		

Table 3: Optional Courses

No.	Course Title	No. of Credits	Type of Credits		No. of Hours		Prerequisite/Co-Requisite
			Theoretical	Practical	Theoretical	Practical	
1.	Principles of Software Design	3	3	-	48	-	Principles of Operating Systems
2.	Software Engineering	3	3	-	48	-	Principles of Software Design
3.	Object Oriented Systems	3	3	-	48	-	Advanced Programming
4.	Data Mining	3	3	-	48	-	Probability (1)
5.	Combinatorics for Computer Science	3	3	-	48	-	Fundamentals of Combinatorics
6.	Mathematics for Computer Science	3	3	-	48	-	General Mathematics (2) + Fundamentals of Combinatorics
7.	Combinatorics and Applications	3	3	-	48	-	Fundamentals of Combinatorics
8.	Graph Theory and its Applications	3	3	-	48	-	Fundamentals of Combinatorics
9.	Programming Languages	3	3	-	48	-	Data Structures and Algorithms
10.	Computer Networks	3	3	-	48	-	Principles of Operating Systems
11.	Internet Engineering	3	3	-	48	-	Computer Networks
12.	Computer Architecture	3	3	-	48	-	Machine Language and Assembly
13.	Microprocessor	3	3	-	48	-	Principles of Computer Systems
14.	Real Time Systems	3	3	-	48	-	Principles of Operating Systems
15.	Biological Computing	3	3	-	48	-	Advanced Programming + Department Permission
16.	Introduction to Bioinformatics	3	3	-	48	-	General Biology + Data Structures and Algorithms
17.	Introduction to Cryptography	3	3	-	48	-	General Mathematics (2) + Department Permission
18.	Introduction to Information Theory	3	3	-	48	-	Probability (1)
19.	Introduction to Coding Theory	3	3	-	48	-	General Mathematics (2)

20.	Computer Graphics	3	3	-	48	-	Linear Algebra + Data Structures and Algorithms
21.	Mathematical Softwares	3	3	-	48	-	Scientific Computations
22.	Computer Simulation	3	3	-	48	-	Probability (1)
23.	Database	3	3	-	48	-	Data Structures and Algorithms
24.	Linear Programming	3	3	-	48	-	Linear Algebra
25.	Nonlinear Programming	3	3	-	48	-	Linear Programming (or Department Permission)
26.	Dynamic Programming	3	3	-	48	-	Algorithm Design and Analysis
27.	Combinatorial Optimization	3	3	-	48	-	Linear Programming + Algorithm Design and Analysis
28.	Web Programming	3	3	-	48	-	Advanced Programming
29.	Secure Programming	3	3	-	48	-	Data Structures and Algorithms
30.	Multimedia Systems	3	3	-	48	-	Data Structures and Algorithms
31.	Advanced Data Retrieval	3	3	-	48	-	Data Structures and Algorithms
32.	Signals and Systems	3	3	-	48	-	Differential Equations
33.	Logic	4	4	-	64	-	Fundamentals of Logic
34.	Non-Classical Logic	4	4	-	64	-	Fundamentals of Logic
35.	An Introduction to Lattice Theory	4	4	-	64	-	Fundamentals of Logic
36.	Topics in Computer Science (1)	3	3	-	48	-	Department Permission
37.	Topics in Computer Science (2)	3	3	-	48	-	Department Permission
38.	General Physics Laboratory (1)	1	-	1	-	-	General Physics (1)
39.	General Physics Laboratory (2)	1	-	1	-	-	General Physics (2)
40.	Advanced General Mathematics	4	4	-	64	-	General Mathematics (2)
41.	Mathematical Analysis (1)	4	4	-	64	-	General Mathematics (1) + Fundamentals of Mathematics
42.	Mathematical Analysis (2)	4	4	-	64	-	Mathematical Analysis (1)

43.	Complex Functions	4	4	-	64	-	Mathematical Analysis (1)
44.	Algebra (2)	4	4	-	64	-	Algebra (1)
45.	General Topology	4	4	-	64	-	Mathematical Analysis (1)
46.	Elementary Number Theory	4	4	-	64	-	Algebra (1)
47.	Basics of Numerical Analysis	4	4	-	64	-	Mathematical Analysis (1)
48.	Linear Optimization (1)	4	4	-	64	-	Mathematical Analysis (1) + Linear Algebra
49.	Mathematics Lab	2	2	-	32	-	Fundamentals of Computer and Programming
50.	Probability (2)	4	4	-	64	-	Probability (1)
51.	Mathematical Statistics (1)	3	3	-	48	-	Probability (2)
52.	Mathematical Statistics (2)	3	3	-	48	-	Mathematical Statistics (1)
53.	Stochastic Process (1)	3	3	-	48	-	Probability (1)
54.	Sampling Methods (1)	3	3	-	48	-	Statistical Methods
55.	Sampling Methods (2)	3	3	-	48	-	Sampling Methods (1)
56.	Non-Parametric Methods	3	3	-	48	-	Probability (2)
57.	Time Series (1)	3	3	-	48	-	Stochastic Process (1)
58.	Design of Experiments (1)	3	3	-	48	-	Regression (1)
59.	Design of Experiments (2)	3	3	-	48	-	Design of Experiments (1)
60.	Statistical Multivariate Analysis	3	3	-	48	-	Mathematical Statistics (2)
61.	Categorical Data Analysis	3	3	-	48	-	Regression (1)
62.	Introduction to Statistical Learning	3	3	-	48	-	Regression (1)
63.	Computational Methods for Statistics	3	3	-	48	-	Design of Experiments (1)
64.	Fundamentals of Economics	4	4	-	64	-	-
65.	Algebra (1)	4	4	-	64	-	Fundamentals of Mathematics

Passing minimum 21 units from optional table is mandatory.

Chapter 3: Course Descriptions

Course Title	General Mathematics (1)		
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	Basic ■
		Practical □	Technical □
Number of Credits	4	Theoretical-Practical □	Optional □
Number of Hours	64		Thesis □

General Purpose:

General Mathematics (1) contains the main concepts of Calculus and one of the general courses in mathematical sciences. Its generalizations and more theoretical aspects of the subject will be discussed in the mathematical analysis. The following important points should be taken into consideration in teaching this course:

- There should be an emphasis on the mathematical rigor of arguments in the proof of any theorem or statement;
- There should also be an emphasis on applying the calculation techniques;
- Employing a Computer Algebra System (e.g., Maple, MATLAB, or Mathematica) would be of great help in understanding the key concepts.

Special Purpose:

- Introduction to Real and Complex Numbers;
- Introduction to Limit, Continuity, Differentiation and Integration of Functions, and their Applications;
- Introduction to Sequences and Series of Numbers and Convergence Theorems.

Course Description:

- Cartesian Coordinates; Polar Coordinates; Complex Numbers, their Addition, Multiplication, and Roots; Number Sequences;
- Limits: Limits at Infinity, and Infinite Limits; Left- and Right-hand Limits; Continuity; Sequential Continuity; Intermediate Value Theorem; Extreme Value Theorem;
- Differentiation: Differentiation Rules; Inverse Function and its Derivative; Derivatives of Trigonometric Functions and those of their Inverse Functions; Derivatives of Composite Functions (the Chain Rule);
- Applications of the Derivative: Fermat's Theorem on Stationary Points; Rolle's Theorem; Mean Value Theorem; Cauchy's Mean-Value Theorem; Derivative Tests; Concavity and Points of Inflection; Differentials; Taylor Series Expansion; Physical and Geometric Applications of the Derivative;

- The Transcendental Functions and their Derivatives: The Exponential Function; Natural Logarithm Function; Hyperbolic Functions;
- Integration: The Definite Integral; Mean Value Theorem for Integrals; The Fundamental Theorems of Calculus; Antiderivative/Primitive Functions; Basic Integration Rules;
- Applications of the Integral: Area between Curves; Arc Length; Surface Area; Average Value of a Function; Work; Center of Mass;
- Sequences and Series: Number Sequences; Convergence Theorems (namely, the Ratio and Root Tests); Taylor's Theorems (with/without Remainder).

Teaching and Learning Approaches:

Teaching the Main Topics in the Class, Following an Interactive Manner; Problem-Solving Classes by TA. If necessary, use the appropriate software and familiarize students with some of the connections of this course with other branches of Mathematics.

Equipment and Facilities:

Computer, Video Projector, Tablet Digital Pen, Black/White-Board

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 30%	Final Exam 50%	Project 0%
Writing Exam: 20%	30%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. Shahshahani, S.: *Calculus, Vol. 1*, Fatemi Publishing (in Persian), 1386.
2. Apostol, T. M.: *Calculus, Vol. 1: One-Variable Calculus, with an Introduction to Linear Algebra*, 2nd Ed., John Wiley & Sons, (IPU (in Persian), 1392, Translated by: Mehdi Rezaei).
3. Thomas, G. B., and Finney, R. L.: *Calculus & Analytic Geometry*, Part 1, 3rd Ed., Addison-Wesley Pub. Co., (Fatemi Publishing (in Persian), 1392, Translated by: Siamak Kazemi).
4. Stewart, J.: *Calculus*, 8th Ed., Cengage Learning, (Fatemi Publishing (in Persian), 1391, Translated by: Arashk Hamidi).

Course Title	**General Mathematics (2)**		
Prerequisite Courses	General Mathematics (1)	Type of the Course	
		Theoretical ■	Basic ■
		Practical □	Technical □
Number of Credits	4	Theoretical-Practical □	Optional □
Number of Hours	64		Thesis □

General Purpose:

This is a continuation of General Mathematics (1). It considers more advanced topics in Calculus such as multiple integrals, and vector analysis.

Special Purpose:

- Introduction to Vector Calculus;
- Introduction to Multiple Integrals and Related Theorems such as Divergence Theorem and Stokes Theorem.

Course Description:

- Parametric Equations; Coordinates of Three-Dimensional Space; Vectors in Three-Dimensional Space; Scalar Product; 3*3 matrices; Linear Transformations and their Associated Matrices; System of Linear Equations in Three Variables; Row Operations; Inverse of a Matrix; Solution of Linear Systems; Linear Independence; Basis; Determinants; Eigenvalues and Eigenvectors; Vector Product in Three Dimensional Space; Equations of Lines and Planes;
- Quadratic Surfaces; Vector Functions and their Derivative; Velocity and Acceleration; Curvature and Normal Vectors; Multi-Variable Functions; Directional Derivatives and Partial Derivatives; Tangent Plane and Normal Line; Gradient; Chain Rules for Partial Derivatives; Exact Differential;
- Double and Triple Integrals, and their Applications to Geometrical and Physical Problems; Changing the Order of Integrations (Without a Complete Proof); Cylindrical and Spherical Coordinates; Vector Fields; Line Integrals;
- Surface Integrals; Divergence; Curl; Laplacian; Potential; Green's Theorem, Divergence Theorem, and Stokes' Theorem.

Teaching and Learning Approaches:

Teaching the Main Topics in the Class, Following an Interactive Manner; Problem-Solving Classes by TA. If necessary, use the appropriate software and familiarize students with some of the connections of this course with other branches of Mathematics.

Equipment and Facilities:

Computer, Video Projector, Tablet Digital Pen, Black/White-Board

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 30%	Final Exam 50%	Project 0%
Writing Exam: 20%	30%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. Shahshahani, S.: *Calculus, Vol. 2*, Fatemi Publishing (in Persian), 1386.
2. Apostol, T. M.: *Calculus, Vol. 2: Multi-Variable Calculus and Linear Algebra with Applications to Differential Equations and Probability*; 2nd Ed., John Wiley & Sons, (IPU (in Persian), 1393, Translated by: Mehdi Rezaei).
3. Thomas, G. B., and Finney, R. L.: *Calculus & Analytic Geometry*, Part 2, 3rd Ed., Addison-Wesley Pub. Co., (Fatemi Publishing (in Persian), 1392, Translated by: Siamak Kazemi).

Course Title	General Physics (1)		
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	Basic ■
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Optional □
Number of Hours	32		Thesis □

General Purpose:

Introduction to General Physics Concepts

Special Purpose:

Familiarity with the Concepts of Motion, Force, Acceleration, Work and Energy, and Dynamics

Course Description:

- Measurement, Quantities and Units, Precision, Dimensional Analysis
- Motion in One Dimension; Velocity, Acceleration
- Motion in Plane; Velocity and Acceleration in Two Dimensions
- Force and Newton's Laws
- Dynamics of Circular Motion; Oscillation and Hook's Law
- Work and Energy; Conservation of Energy, Kinetic and Potential Energy
- System of Particles; Center of Mass, Momentum, Conservation of Momentum and Collision
- Rotational Kinematics and Dynamics
- Fluid Mechanics; Hydrostatic Pressure, Conservation Laws in Fluid Motion; Viscosity
- Thermodynamics and Heat
- Waves

Teaching and Learning Approaches:

Teaching the Main Topics in the Class, Following an Interactive Manner; Problem-Solving Classes by TA.

Equipment and Facilities:

Standard Requirements for the Classroom and Computer Site

Evaluation Approaches (Suggested):

Continuous Assessment 0%	Midterm Exam 50%	Final Exam 50%	Project 0%
Writing Exam: 0%	50%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. *Fundamentals of Physics Extended*, 10th Ed., D. Halliday, R. Resnick, J. Walker, (August 5, 2013), Wiley.
2. *Physics, Principles with Applications*, 7th Ed., D.G. Giancoli, Prentice Hall, (2014).
3. *University Physics with Modern Physics*, Technology Update, 13th Ed., H.D. Young and R.A. Freedman, (2013).

Course Title		General Physics (2)	
Prerequisite Courses	General Physics (1)	Type of the Course	
		Theoretical ■	Basic ■
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Optional □
Number of Hours	32		Thesis □

General Purpose:

Introduction to the Concepts of Electricity and Magnetism

Special Purpose:

- Familiarity with the Fundamental Forces of Nature: Electrical and Magnetic
- Learning the Classical Dynamics of Charged Bodies and the Fundamental Equations Describing Them
- Introduction to Elementary Applications of Electric and Magnetic Forces
- Introduction to Electromagnetic Waves

Course Description:

- Charge and Matter
- Coulomb's Law and the E field
- Gauss's Law and its Applications
- Electric Potential
- Capacitor and Dielectric
- Current and Resistance
- Electric Circuits
- The B Field
- Ampere's Law
- Faraday's Law
- Magnetic Properties of Matter
- Maxwell's Equations
- RLC Circuits
- AC Current
- EM Waves

Teaching and Learning Approaches:

Teaching the Main Topics in the Class, Following an Interactive Manner; Problem-Solving Classes by TA.

Equipment and Facilities:

Standard Requirements for the Classroom and Computer Site

Evaluation Approaches (Suggested):

Continuous Assessment 0%	Midterm Exam 50%	Final Exam 50%	Project 0%
Writing Exam: 0%	50%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. *Fundamentals of Physics Extended*, 10th Ed., D. Halliday, R. Resnick, J. Walker, (August 5, 2013), Wiley.
2. *Physics, Principles with Applications*, 7th Ed., D.G. Giancoli, Prentice Hall, (2014).
3. *University Physics with Modern Physics, Technology Update*, 13th Ed., H.D. Young and R.A. Freedman, (2013).
4. *Physics*, David Halliday, 5th Ed., Robert Resnick, Kenneth S. Krane (2001).

Course Title		**Fundamentals of Computer and Programming**	
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	Basic ■
		Practical □	Technical □
Number of Credits	4	Theoretical-Practical □	Optional □
Number of Hours	64		Thesis □

General Purpose:

The main purpose of this course is to acquaint students with the basics of computer programming. Since this course is the first course and the basis of courses related to the field of programming, it is first necessary to assume that students do not have special knowledge in the field of programming. It is recommended that Java be taught in this course. Of course, the subject is independent of the language being taught.

Special Purpose:

- Basic Introduction to Computer Structure
- An Introduction on the Basics of Programming and Theory of Algorithm

Course Description:

History of Computer, an Introduction on Computer Structure, General Introduction of hardware Components of a Computer as a Computational Model, Relationship between Different Components, Expression of the Simplest Basic Operations Performed by this Computational Model, Introduction of Simple Algorithms based on this Basic Operation, Review on Algorithms for Simple Problems such as: Addition of Several Numbers - Average - Search, etc., Introduction of a High-Level Programming Language to Run the Proposed Algorithms, Introduction of Variables and Constants, Basic Familiarity with Computer Structure, Programming and Providing a Language-Independent Algorithm, Introducing Variables and Constants, Conditional and Control Structures, Types of Loops, Functions and Parameters, Working with Arrays and Files, the Concept of Runtime and Memory Complexity, The Concept of Recursive Algorithms, Search and Sorting Algorithms.

Teaching and Learning Approaches:

Using a Structured, Predetermined Motivational Learning Process.

Equipment and Facilities:

Video Projector, Personal Computer, Digital Pen and Black Board

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 20%	Final Exam 30%	Project 30%
Writing Exam: 50%	20%	30%	0%
Practical Exam: 30%	0%	0%	30%

Course Sources:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, *Introduction to Algorithms*, The MIT Press, 2001.
2. P. J. Deitel and H. M. Deitel, *Java How to Program*, Prentice Hall, 2007.
3. B. Eckel, *Thinking in Java*, MindView Inc., 2003.

Course Title	**Fundamentals of Mathematics**		
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	Basic ■
		Practical □	Technical □
Number of Credits	4	Theoretical-Practical □	Optional □
Number of Hours	64		Thesis □

General Purpose:

The art of writing mathematical proofs and ability to analyze them, together with mathematical thinking is essential for every student. This course is aimed to cover such essentials.

Special Purpose:

- Introduction to Mathematical Logic
- Introduction to Set Theory

Course Description:

- Elementary Mathematical Logic: Predicate, Term, Proposition, Equivalence of Propositions, Connectives, Derivation and Deduction.
- Elementary Set Theory: Axioms for ZFC and Related Theorems, Union, Intersection, Subsets, Universal Set, Russel's Paradox, Cartesian Product, Relations, Functions (Domain and Co-Domain, Image and Inverse Image of Sets, Injective and Projective Functions, Union and Composition of Functions, Restriction and Extension of Functions), Equivalence Relation (Partition, Quotient Function), Orders (Partial and Total Orders, Maximal and Minimal Elements, Least Upper Bounds and Greatest Lower Bounds, Isomorphism for Ordered Sets, Well-Ordering, Induction and Strong Induction, Axiom of Choice, Choice Function and Zorn's Lemma).
- Redefining (Constructing) Numbers: Peano's Postulates, Natural Numbers, Integers and Quotient Numbers via Equivalence Relations, Real Numbers via Dedekind Cuts or Cauchy Sequences.
- Cardinal Numbers: Equinumerosity, Finite Sets, Elementary Methods for Counting Finite Sets, Infinite Sets Including Countable and Uncountable, Cantor's Theorem, Shröder–Bernstein Theorem, Ordering and Arithmetic of Cardinal Numbers.

Teaching and Learning Approaches:

Teaching in the Main Sessions of Course and also Solving Examples and Exercises in the Additional Exercise Sessions.

Equipment and Facilities:
Video Projector

Evaluation Approaches (Suggested):

Continuous Assessment 0%	Midterm Exam 50%	Final Exam 30%	Project 20%
Writing Exam: 0%	50%	30%	20%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. Herbert B. Enderton, *A Mathematical Introduction to Logic*, 2nd Ed. Acad. Press., 2001.
2. D. C. Goldrei, *Classic Set Theory*, Chapman & Hall/CRC Press, 1996.
3. Paul R. Halmos, *Native Set Theory*, Springer-Verlag, VII, 1974.
4. Ian Stewart & David Tall, *The Foundations of Mathematics*, 2nd Ed. Oxford Uni. Press, 2015.
5. B. Schroder, *Fundamentals of Mathematics*, John Wiley & Sons, 2010.

Course Title	**General Biology**		
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	Basic ■
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Optional □
Number of Hours	32		Thesis □

General Purpose:

In this subject, students get familiar with basic concepts of biology and problems raised in this major. As some computational methods are nature-inspired and on the other hand, many natural problems are solved using computational methods, learning the content of this subject could help students get closer to the both research fields.

Special Purpose:

- Introduction to Process Theories in Biology
- Introduction to the Characteristics of Organisms
- Introduction to Functional Units and Relationships Among them in Biology

Course Description:

- History of Biological Science, History of Life, Philosophy of Biology, Explanation of the Main Differences between Biology and Experimental Sciences (Physics and Chemistry)
- Process Theories in Biology, Process Theory of Evolution, and Process Theory of Speciation - Characteristics of Organisms
- Causality in Biology, Proximate and Ultimate Causes
- The Structure of Functional Units in Biology (Gene, Genome, Cell, Tissue, Organ, Individual, Species, and Meta-Species Groups)
- DNA Structure, Double Helix, Coiling Process, Replication, Chromatin Structure, Chromosome
- RNA Structure, Processing Mechanism and its Role in Cell, Types of RNA, Gene Expression, Transcription, Translation and Protein Production Processes
- Protein and its Composing Elements, Role of Protein, Protein Structure, Types of Proteins and Enzymes
- Cell Structure, Cell Classification, Different Parts of Cell and Macromolecules Inside, Cell Cycle of Mitosis and Meiosis
- Evolutionary Forces, Natural Selection, Genetic Drift and Random and Non-Random Events
- Evolutionary General Pattern in the Living World
- Systems Biology, Systems Ecology, and the Relationship between these Two Types of Hierarchical Systems in the Living World

Teaching and Learning Approaches:

Teaching the Main Concepts in Class Sessions and Holding Appropriate TA Session during the Semester.

Equipment and Facilities:

Video Projector

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 30%	Final Exam 50%	Project 0%
Writing Exam: 20%	30%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. Sadeqieh P (Translator), *Philosophy of Biology: A Contemporary Introduction*, By Alex Rosenberg and Daniel W. McShea, Payam Rooz Publication, 1392.
2. Alberts B., Johnson A., Lewis J., Raff M., Roberts K. and P. Walter (2002) *Molecular Biology of the Cell*, 4th Edition, Garland Science, 2002.
3. Lodish H., Berk A., Zipursky S. L., Matsudaira, P., Baltimore D. and Darnel J. (1999) *Molecular Cell Biology*, 4th Edition, Freeman.
4. Futuyma D., Kirkpatrick M. (2017) *Evolution*, 4th Edition, Oxford University Press.

Course Title	**Differential Equations**		
Prerequisite Courses	General Mathematics (2)	Type of the Course	
		Theoretical■	Basic □
		Practical□	Technical ■
Number of Credits	3	Theoretical-Practical□	Optional□
Number of Hours	48		Thesis□

General Purpose:

This is an introductory course on differential equations.

Special Purpose:

- An Introduction to Different Types of Ordinary Differential Equations;
- Introducing Methods for Solving Ordinary Differential Equations such as Integrating Factors, Operator Methods, Power Series Solutions, the Laplace Transform, etc.

Course Description:

- Introduction to Differential Equations: General Overview of Existence, Uniqueness and Classification of Solutions of Differential Equations.
- First-Order Differential Equations: Separable Differential Equations, Homogeneous Differential Equations, Reducible to Homogeneous Differential Equations, Exact Differential Equations, Integrating Factors, First-Order Linear Differential Equations, Important Nonlinear Differential Equations (Bernoulli, Lagrange, etc.), Families of Curves, Orthogonal Trajectories, Modeling.
- Higher Order Differential Equations: Reduction of Order, Introductory Concepts about Linear Equations, General Solution of Homogeneous and Nonhomogeneous Linear Differential Equations, Use a Known Solution to Find another Solution, Homogeneous Differential Equations with (Constant Coefficients, Second Order and Higher Order), Nonhomogeneous Linear Differential Equations, Operator Methods for Solving Differential Equations with Nonconstant Coefficients (Cauchy–Euler Equations, etc.), Introduction to Boundary Value Problems (Eigenvalues and Eigenfunctions).
- Power Series Solutions and Special Functions: Review of Power Series, Series Solutions Near an Ordinary Point, Legendre Equation, Legendre Polynomials, Properties of Legendre Polynomials, Series Solutions Near a Regular Singular Point (Frobenius Method), Bessel's Differential Equation, Gamma Function, Properties of Gamma Function.
- The Laplace Transform its Application: Introduction (a Few Remarks on the Theory), Existence Theorem, Laplace Transform, Derivative and Integral, Transformations Theorems, Unit Step Functions and Dirac Delta Function, Applications to Differential Equations, Derivative and Integral of Laplace Transform, Convolution, Integral Equation, Solving System of Differential Equations via Laplace Transform.

Teaching and Learning Approaches:

Teaching the Main Topics in the Class, Following an Interactive Manner; Problem-Solving Classes by TA.

Equipment and Facilities:

Video Projector and Computer

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 30%	Final Exam 50%	Project 0%
Writing Exam: 20%	30%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. George F. Simmons, *Differential Equations with Applications and Historical Notes* (3rd Edition), Chapman and Hall/CRC, 2016.
2. Masoud Nikookar, *Ordinary Differential Equations*, Azadeh Publication, 2013.

Course Title	**Linear Algebra**		
Prerequisite Courses	Fundamentals of Mathematics	Type of the Course	
		Theoretical■	Basic □
		Practical□	Technical ■
Number of Credits	4	Theoretical-Practical□	Optional□
Number of Hours	64		Thesis□

General Purpose:

Linear Algebra is a branch of Mathematics that studies matrices, vectors, vector spaces, linear transformations, and systems of linear equations. Linear Algebra has many different applications in Mathematics and discrete computations. In addition to its applications in Mathematics itself such as Abstract Algebra, Functional Analysis, Analytic Geometry, and Numerical Analysis, Linear Algebra is also widely used in Physics, Engineering, and other sciences. The main parts of this course include vector spaces, linear transformations, eigenvalues and eigenvectors, and a system of linear equations.

Special Purpose:

- Familiarity with Matrices and Solving the System of Linear Equations;
- Familiarity with Vector Spaces, Linear Transformations, and Basic Theorems.

Course Description:

- Matrix and System of Equations: Introduction to the Algebra of Matrices, Matrix Rank and Methods for Determining It. Row and Column Equivalences and Determining Them, Finding Inverse of Matrices, System of Linear Equations and their Solutions, Determinants, Calculation and Properties, Cayley-Hamilton Theorem, Determining Rank of Matrix.
- Vector Spaces: Vector Space and Examples, Subspace, Product, Quotient Space, Direct Sum, Linear Independence, Basis and Dimension.
- Linear Transformations and Matrices: Definition, Example, Basic Properties, Kernel, Image, Fundamental Theorem, Linear Transform Space and Linear Functionals, Linear Transformation Matrix, Basis Change, Rank of Linear Transforms, Eigenvector and Eigenvalue, Diagonalization of a Matrix, Triangulation of a Matrix, Inner Product Spaces.

Teaching and Learning Approaches:

Teaching the Main Topics in the Class, Following an Interactive Manner; Problem-Solving Classes by TA.

Equipment and Facilities:

Video Projector and Computer

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 30%	Final Exam 50%	Project 0%
Writing Exam: 20%	30%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. T. S. Blyth and E. F. Robertson, *Basic Linear Algebra*, 2nd Edition Springer Undergraduate Mathematics Series, 2004.

2. J. H. kwak and S.P. Hong, *Linear Algebra*, 2nd Edition, Birkhäuser, 2004.

3. S. H. Freidberg, A. J. Insel and L. E. Spence, *Linear Algebra*, 4th Edition, Pren. Hall, 2003.

Course Title	**Fundamentals of Combinatorics**		
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	4	Theoretical-Practical □	Optional □
Number of Hours	64		Thesis □

General Purpose:

As a general vague description, combinatorics is a branch of Mathematics which considers finite and countable structures. It has diverse connections to pure and applied Mathematics and Computer Science. In the last decades of the 20^{th} century general and powerful methods are proposed to solve scattered problems of combinatorics which originally appeared in different contexts.

Special Purpose:

Introduction to Concepts, Principles and Methods of Combinatorial Mathematics, Including Basic and Advanced Counting Techniques, Generating Functions, Relations, Graphs, Boolean Algebra.

Course Description:

- Basic Concepts such as Sequences, Algorithms, Relations.
- Counting: General Objects and Techniques, the Pigeonhole Principle, Permutations and Combinations, Principle of Inclusion-Exclusion, Recurrence Relations, Generating Functions.
- Relations and their Types: Equivalence Relations and Partitions, Partial and Linear Orders, Closure of a Relation, Representation of Relations.
- Matrices: A Combinatorial Viewpoint, Special (0, 1)-Matrices.
- Graphs, Related Concepts and Models: Basic Concepts, Connectivity, Trees, Digraphs and Tournaments, Eulerian and Hamiltonian Graphs, Matchings: Perfect and Maximal Matchings, Some Related Algorithms, Coloring and the Chromatic Polynomial.
- Latin Squares, Finite Geometries, BIBDs, Application of SDRs and Hall's Theorem in Latin Squares.

Teaching and Learning Approaches:

Stating Theorems, Proofs, Techniques and Algorithms, Solving Related Examples and Exercises.

Equipment and Facilities:
Video Projector

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 60%	Final Exam 20%	Project 0%
Writing Exam: 20%	30%	20%	0%
Practical Exam: 0%	30%	0%	0%

Course Sources:

1. R.P. Grimaldi, *Discrete and Combinatorial Mathematics: An Applied Introduction*, Addison-Wesley Pub. Co. Inc., 1994.
2. Garnier and J. Taylor, *Discrete Mathematics for New Technology*, IOP Publishing Ltd., Bristol, 2002.
3. R. Garnier and J. Taylor, *Discrete Mathematics*, 3rd Ed., CRC Press, Boca Raton, FL, 2010.
4. L. Lov'asz, J. Pelik'an, and K. Vesztergombi, *Discrete Mathematics*, Springer-Verlag, New York, 2003.

Course Title	**Probability (1)**		
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	4	Theoretical-Practical □	Optional □
Number of Hours	64		Thesis □

General Purpose:

This is the first basic course in Probability to introduce basic principles of counting and probability.

Special Purpose:

Introduction to Basic Principles of Counting, Probability, Random Variable, Univariate and Joint Distributions, and Expected Value.

Course Description:

- Combinatorial Analysis: Principle of Counting, Permutations, Combination, and Partitions.
- Probability: Random Experiments, Probability Function, and Probability Space Properties.
- Random Variable: Random Variable Definition, Distribution Function, Discrete and Continuous Random Variables.
- Discrete and Continuous Distributions: Binomial, Geometric, Hyper Geometric, Negative Binomial, Poisson, Uniform Discrete, Uniform Continuous, Gamma, Chi-Square, Normal, Beta, Cauchy, Logistic, Weibull, and Pareto Distributions.
- Expectation and Moments: Expected Value and its Properties, Median and Mode of a Distribution, Variance, Symmetry and Skewness, Moments of a Distribution, and Jensen's Inequality.
- Generating Function: Moment and Probability Generating Functions, Markov and Chebyshev's Inequalities.
- Multivariate Distributions

Teaching and Learning Approaches:

Main Introductory Textbooks in Probability.

Equipment and Facilities:

Video Projector

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 30%	Final Exam 50%	Project 0%
Writing Exam: 20%	30%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. Ross, S, 2010. *A First Course in Probability*, 10th Edition, Pearson Education Inc.
2. Ghahramani, S, 2001. *Fundamentals of Probability*, 1st Edition. Chapman and Hall.
3. Haghighi, A, Parsian, A, Alvandi, S, et al., 2014. *Introduction to Probability and Distribution Theory*, 1st Volume. Parsian Scientific Publication.

Course Title	**Statistical Methods**		
Prerequisite Courses	Probability (1)	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	3	Theoretical-Practical □	Optional □
Number of Hours	48		Thesis □

General Purpose:

In this course, a summary of statistical methods used in statistical inference is taught to the student in a simple and introductory way. In addition to Statistics students, this course is recommended for the students of Computer Science and Mathematics who seeking a single introductory course in both probability and Statistics.

Special Purpose:

The aim of this course is to get acquainted with basic statistical inference methods including confidence interval and test of hypotheses, basic topics of analysis of variance and regression and introductory topics of nonparametric inference.

Course Description:

- Random Sample, Sample Mean Distribution and Central Limit Theorem, Sample Distributions, Statistical Inference.
- Estimation Methods: Point Estimation, Interval Estimation, Confidence Interval with Large Sample Size.
- Introduction to the Concepts of Hypothesis Test: Simple Hypothesis Test, One-Sided Hypothesis Test, Two-Sided Hypothesis Test and Maximum Likelihood Method, Hypothesis Testing for Variance of Normal Distribution, Hypothesis Testing for Mean and Proportion with Larger Sample, Inference about Two Means, Inference about Paired Observations, Hypothesis Testing for Two Means and Proportions in the Large Population, One-Sided Analysis of Variance, Linear Regression and Correlation Coefficient, Goodness of Fit.
- Contingency Tables: Independence and Homogeneity, Simple Non-Parametric Test.

Teaching and Learning Approaches:

Applying a Structured and Predetermined Educational Process with Motivation.

Equipment and Facilities:

Standard Requirements for the Classroom and Computer Site

Evaluation Approaches (Suggested):

Continuous Assessment 0%	Midterm Exam 50%	Final Exam 50%	Project 0%
Writing Exam: 0%	50%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. Behboodian, J., 2004. *An Introduction to Probability and Statistics*. Astan Ghods Razavi Publications.
2. Parsian, A., 2009. *An Introduction to Probability and Statistics for Science and Engineering*. Isfahan University of Technology Publications.
3. Hogg R., Tanis, E., 2004. *Probability and Statistical Inference*. Translated by N. Izaddoostar and H. Pezeshk. Tehran University Publications.
4. Ott, R, L., Longnecker, M, T., 2015. *An Introduction to Statistical Methods & Data Analysis* (7th Edition, ISBN: 9781305269477).

Course Title	**Advanced Programming**		
Prerequisite Courses	Fundamentals of Computer and Programming	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	4	Theoretical-Practical □	Optional □
Number of Hours	64		Thesis □

General Purpose:

The main purpose of this course is to learn the principles of Advanced Programming. Given that the prerequisite for this course is the Fundamentals of Computer Science and Programming, it is necessary for students who choose this course to have basic knowledge in the field of programming and have acquired the necessary skills in this field to the extent of the basic concepts required for object-oriented programming.

Special Purpose:

- Learning the Principles of Advanced Programming
- Familiarity with Object-Oriented Programming and Search Algorithms
- Familiarity with Programming Languages such as Java and C++

Course Description:

Introduction to Programming, Familiarity with Programming Languages and Programming Language Selection Criteria, Familiarity with a Programming Language such as Java or C++, Object-Oriented Programming, Object and Class Definition, Inheritance, Access Levels, Encapsulation, Overriding and Overloading Methods, Statistic Methods and Variables, IO Structures, Graphical User Interface (GUI) Design, Error Handling (Exception Handling), Working with Files, Working with Data Structures (Array, ArrayList, HashMap, HashSet, Vector, etc.), Project Management and Teamwork Skills, Proposal Writing and Relevant Issues, Documenting Programs, Reviewing Algorithms and Solving Some Sample Problems, Familiarity with the Complexities of Algorithms and Time Complexity Order, Familiarity with Search and Sorting Algorithms and How to Analyze them Theoretically.

Teaching and Learning Approaches:

Teaching in the Main Sessions of Course and also Solving Examples and Exercises in the Additional Exercise Sessions.

Equipment and Facilities:

Video Projector, Personal Computer, Digital Pen and Black Board

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 20%	Final Exam 30%	Project 30%
Writing Exam: 20%	20%	30%	0%
Practical Exam: 0%	0%	0%	30%

Course Sources:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, *Introduction to Algorithms*, The MIT Press, 2001.
2. J. Deitel and H. M. Deitel, *Java How to Program*, Prentice Hall, 2007.
3. B. Eckel, *Thinking in Java*, MindView Inc., 2003.

Course Title	**Data Structures and Algorithms**		
Prerequisite Courses	Advanced Programming	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	4	Theoretical-Practical □	Optional □
Number of Hours	64		Thesis □

General Purpose:

In this course, Computer Science students will be introduced to the principles of data structure and will learn how to design appropriate data structures for problems.

Special Purpose:

- Familiarity with Common Data Structures and their Applications
- Familiarity with Algorithm Design Methods based on Data Structure

Course Description:

Definition and Importance of Data Structure in Problem Solving, Analysis of Algorithms, Static Data Structures including Variables, Arrays and their Applications, Semi-Static Data Structure including Stack and Queue, Methods of Displaying Stack and Queue and their Applications, Dynamic Data Structure including Types of Linked Lists, Lists and their Applications, Trees, Binary Tree, Binary Tree Traversing Methods, Binary Search Tree, Threaded Binary Tree, Application of Trees, Graphs including Types of Graph, Graph Traverse Methods and their Application, Data Search including Linear and Binary Search, AVL Trees, Red and Black, Splay and Trie, Hashing and its Applications, Data Sorting including Stable and Unstable Methods, Types of Sorting Methods, Statistical Ranking of Sorting Methods, External Sorting.

Teaching and Learning Approaches:

Teaching in the Main Sessions of Course and also Solving Examples and Exercises in the Additional Exercise Sessions.

Equipment and Facilities:

Video Projector, Personal Computer, Digital Pen and Black Board

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 20%	Final Exam 30%	Project 30%
Writing Exam: 20%	20%	30%	0%
Practical Exam: 0%	0%	0%	30%

Course Sources:

1. R. Lafore, *Data Structures and Algorithms in Java*, 2nd Edition, SAMS, 2002.
2. A. J. A. Stores, *An Introduction to Data Structures and Algorithms*, Birkhauser, 2001.
3. E. Horowitz and S. Sahni, *Fundamentals of Data Structures in C*, 2nd Edition, Computer Science Press, 2007.

Course Title	**Algorithm Design and Analysis**		
Prerequisite Courses	Data Structures and Algorithms	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	4	Theoretical-Practical □	Optional □
Number of Hours	64		Thesis □

General Purpose:

In this course, besides getting acquainted with the basic principles of algorithm analysis, such as the basic concepts of complexity theory, the algorithms of some fundamental problems will be provided and it is tried to analyze them by providing lower and upper time complexities for them. Also, different types of algorithms will be introduced and the basics of advanced algorithm theory will be provided.

Special Purpose:

- Familiarity with Algorithm Design and Analysis Methods
- Familiarity with Basic Algorithms in Computer Science
- Acquire Sufficient Knowledge to Design and Analyze Algorithms in Case of New Problems

Course Description:

Review of Basic Concepts such as Complexity and Asymptotic Analysis (Symbols θ, O, Ω, o, ω), Review of Basic Data Structures, Methods for Solving Recursive Equations, Review of Algorithm Design Methods such as Divide and Conquer Method (Quick Sort, Merge Sorting, Selecting k^{th} Smallest Element, Fast Multiplication of Numbers and Matrices), Dynamic Programming Method (Longest Common Sub-Sequence, 0/1-Knapsack, Optimal Binary Search Tree, Binary Tree Counting), Greedy Method (Fractional Knapsack, Hoffman Coding, Time Scheduling, etc.), Backtracking and Branch-and-Bound Methods (0/1-Knapsack, N-Queen, etc.), Graph Algorithms (BFS, DFS, Shortest Path, Minimum Spanning Tree, Connected Components, Topological Sorting, etc.), String Matching Algorithms, Randomized Algorithms (Randomized Quick Sort, etc.), Approximation Algorithms (Knapsack, Graph Vertex Cover, etc.), Familiarity with the Concepts of Deterministic and Nondeterministic Algorithms, Reduction, Introducing Important Categories of Problems (P, NP, NP-Hand and NP-Complete), Proving the Difficulty of Problems (SAT, 3SAT, Hamiltonian Cycle, K-Clique, K-Vertex-Cover, Graph Coloring, Subset Sum, etc.), Introduction to Parallel Algorithms, Introduction of Parallel Computer Models, Parallel Algorithms for Searching and Sorting.

Teaching and Learning Approaches:

Teaching Concepts in the Main Sessions of the Course and Organizing the Appropriate Problem Solving Sessions during the Semester.

Equipment and Facilities:

Standard Facilities for Teaching

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 20%	Final Exam 30%	Project 30%
Writing Exam: 20%	20%	30%	30%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1.T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, *Introduction to Algorithms*, The MIT Press, 2001.

2.D. Kozen, *The Design and Analysis of Algorithms*, Springer-Verlag, 1992.

Course Title	**Fundamentals of Logic**		
Prerequisite Courses	Fundamentals of Mathematics	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	3	Theoretical-Practical □	Optional □
Number of Hours	48		Thesis □

General Purpose:

This course is an extension for what we have learnt in "Fundamentals of Mathematics". The student is supposed to learn how to reason in formal systems, how to model facts in formal languages and finally verify her/his modeling. Also set theory is introduced as a foundation for all Mathematics and Computer Sciences. The familiarity with mathematical logic and basic steps in set theory and also ability to describe and verify mathematical systems or computational systems via formal methods is desired.

Special Purpose:

- Introduction to Mathematical Logic and Set Theory
- Reasoning in Formal Systems, Modeling in Formal Systems and their Verification

Course Description:

- Introduction to Logic: Introduction to Propositional Logic, the Language for Propositional Logic, Natural Deduction System, Semantics, Soundness and Completeness Theorems, Normal Forms and SAT Algorithms, Introduction to First-Order Language, Natural Deduction Systems for the First-Order Logic, Introduction to the Language Prolog.
- Introduction to Set Theory: A Survey on Sets and Union, Intersection and Complement Operators, Function and Relation, ZFC Axioms, the Russel's Paradox.
- Set Theory as Basis: Construction of Natural Numbers, Rational Numbers and Real Numbers.
- Infinite Sets: Cardinal Number, Ordinals, Well-Ordering.

Teaching and Learning Approaches:

Teaching in the Main Sessions of Course and also Solving Examples and Exercises in the Additional Exercise Sessions. Moreover, utilizing some related programming languages and the relationship between this course and other courses in Mathematics or Computer Sciences.

Equipment and Facilities:

Video Projector, Personal Computer, Digital Pen and Black Board

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 30%	Final Exam 50%	Project 0%
Writing Exam: 20%	30%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. J. M. Henle, *An Outline of Set Theory*, Springer-Verlag, 1986.
2. M. Huth, M. Ryan, *Logic in Computer Sciences, Modeling and Reasoning about Systems*, Cambridge University Press, 2004.

Course Title		**Fundamentals of Theory of Computation**	
Prerequisite Courses	Fundamentals of Logic	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	3	Theoretical-Practical □	Optional □
Number of Hours	48		Thesis □

General Purpose:

This is a first course in theory of computations and aims to teach basic concepts in computability and various models of computation. Also the interactions between algorithms and computability is desired.

Special Purpose:

- Introduction to Core Concepts in Computation
- Introduction to Some Basic Concepts in Computability

Course Description:

Discussion on Basic Concepts, Problem, Computation, Solution, Computational Model, Algorithm, Deterministic Finite Automaton DFA, Nondeterministic Finite Automaton NFA, Equivalence of Finite Automata, Irregular Languages, Minimal Automata for Context-Free Languages and Push-Down Automaton, Context-Free Grammars and their Properties, Derivation Tree and Ambiguity for Grammars, Chomsky Normal Form, Pumping Lemma, Context-Sensitive Languages, Turing Machine, Recursively Enumerable Languages, Variety of Turing Machines and their Equivalence, Universal Turing Machine, Undecidability and Post's Corresponding Problem.

Teaching and Learning Approaches:

Teaching in the Main Sessions of Course and also Solving Examples and Exercises in the Additional Exercise Sessions.

Equipment and Facilities:

Video Projector, Personal Computer, Digital Pen and Black Board

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 30%	Final Exam 50%	Project 0%
Writing Exam: 20%	30%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. R. Greenlaw and H. J. Hoover, *Fundamentals of the Theory of Computation: Principles and Practice*, Morgan Kaufmann, 1998.
2. J. Martin, *Introduction to Languages and the Theory of Computation*, McGraw Hill, 2010.
3. M. Sipser, *Introduction to the Theory of Computation*, Thomson Course Technology, 2006.

Course Title	**Theory of Computation**		
Prerequisite Courses	Fundamentals of Theory of Computation	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	3	Theoretical-Practical □	Optional □
Number of Hours	48		Thesis □

General Purpose:

This course is a sequel to "Basis for Theory of Computation" and aims to introduce proof methods and essential reasoning techniques in computability. This course covers deep and complex computational methods and concepts.

Special Purpose:

- Introduction to Concepts in Computation
- Introduction to Some (More) Models of Computation
- Introduction to Computable Functions

Course Description:

Exploring Semigroup for Words in an Alphabet, Simple Models of Computation, Automaton as Algebra and Sub-Automaton, Quotient Automaton and Product of Automatons, Fundamental Theorem of Minimal Automata, More Inspections in Push-Down Automaton and Context-Free Languages and their Equivalence, More Precise Inspection in Turing Machines and Halting Problem, Precise Definition of Linear Bounded Turing Machines and Context-Sensitive Grammars, Primitive Recursive Functions and Recursive Functions and their Relationship to Turing Machines, Bounded Recursion and Double Recursion and Diagonalization for Partial Recursive Functions.

Teaching and Learning Approaches:

Teaching in the Main Sessions of Course and also Solving Examples and Exercises in the Additional Exercise Sessions.

Equipment and Facilities:

Video Projector, Personal Computer, Digital Pen and Black Board

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 30%	Final Exam 50%	Project 0%
Writing Exam: 20%	30%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. J. Martin, *Introduction to Languages and the Theory of Computation*, McGraw Hill, 2010.
2. M. Sipser, *Introduction to the Theory of Computation*, Thomson Course Technology, 2006.
3. G. Rozenberg and A. Salomaa, *Handbook of Formal Languages*, Springer-Verlag, 1997.

Course Title	**Principles of Computer Systems**		
Prerequisite Courses	Advanced Programming	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	3	Theoretical-Practical □	Optional □
Number of Hours	48		Thesis □

General Purpose:

In this course, students will be introduced to the concepts of logic circuits and computer hardware, and by passing this course, the student will gain the necessary information about computer hardware.

Special Purpose:

Introduction to Logic Circuits, General Organization of Computer and its Design Principles, and the Organization of Input/Output Devices, Memory and Communication Protocols.

Course Description:

- Digital Logic Circuits (Digital Computers, Logic Gates, Boolean Algebra, Map Simplification, Sequential Circuits and Flip-Flops)
- Digital Component of Computers (Integrated Circuits, Decoders, Multiplexers, Registers, Binary Counters, and Memory Units), Data Representations and Micro Instructions
- Organization and Design of a Basic Computer (Instruction Codes, Computer Registers, Computer Instructions, Scheduling and Control, Instruction Cycle, Memory Reference Instructions, Input-Output and Interrupt)
- Central Processing Unit and Arithmetic Algorithms (Addition, Subtraction, Multiplication, and Division), Input-Output Organization and Direct Memory Access (DMA), Memory Organization (Main Memory and Secondary Memories)

Teaching and Learning Approaches:

Teaching Main Concepts in the Class and Solving Appropriate Exercises during the Semester.

Equipment and Facilities:

Video Projector

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 30%	Final Exam 50%	Project 0%
Writing Exam: 10%	30%	50%	0%
Practical Exam: 10%	0%	0%	0%

Course Sources:

1. M. Mano, *Computer System Architecture*, 3rd Edition, Prentice hall, 1992.
2. D. A. Patterson and J. L. Hennessey, *Computer Organization and Design*, 3rd Edition, Morgan Kaufmann, 2005.

Course Title		**Machine Language and Assembly**	
Prerequisite Courses	Principles of Computer Systems	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	3	Theoretical-Practical □	Optional □
Number of Hours	48		Thesis □

General Purpose:

In this course, the student will be introduced to the hardware structure of today's computers and machine language programming. In addition, the implementation of various functions, drivers, and interrupt calls will be discussed in detail, and several examples will be considered.

Special Purpose:

Introduction to the Components of Today's Computers, and Assembly Language.

Course Description:

- Computer History (Generations of Computers and their Variants)
- Data Representation
- Computer Components (CPU, ALU, Registers, CU, Bus, Input/Output)
- Types of Memory
- Introduction to CISC and RISC Computers
- Memory Addressing Modes (Direct, Indirect, Relative, Implicit)
- Assembly Language Programming, and Some Examples Interrupts,
- Polling, and Types of Access to Input/Output Units

Teaching and Learning Approaches:

Teaching Main Concepts in the Class and Solving Appropriate Exercises during the Semester.

Equipment and Facilities:
Video Projector

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 20%	Final Exam 30%	Project 30%
Writing Exam: 10%	20%	30%	0%
Practical Exam: 10%	0%	0%	30%

Course Sources:

1. R. Hyde, *The Art of Assembly Language*, No Starch Press, 2010.
2. N.K. Srinath, *8085 Microprocessor Programming and Interfacing*, Prentice Hall, 2005.

Course Title	**Principles of Operating Systems**		
Prerequisite Courses	Data Structures and Algorithms	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	4	Theoretical-Practical □	Optional □
Number of Hours	64		Thesis □

General Purpose:

In this course, the student will be introduced to the basic concepts and principles of operating system as an interface layer which connects user and applications to hardware.

Special Purpose:

- Familiarity with the Computer Organization and the Operating System
- Familiarity with Operating System Services
- Familiarity with Theoretical and Algorithmic Issues related to Designing and Building an Operating System

Course Description:

Definition, Importance and History of Operating Systems, Computer System Organization, Operating System Services, System Calls, Operating System Segmentation in Terms of Function including Single-User and Single-Task Systems, Multitasking Systems, Time-Sharing Systems, Distributional, Networking and Real-Time Systems, Input/Output Operations Management, Process Management, Critical Sector and Implementation Methods, Deadlock and Prevention Methods, Avoidance, Detection and Repair, In-Process Communication, Processor Management and Scheduling Methods, Memory Management, Obtaining Methods, Placement and Replacement, Virtual Memory Organization, File Management.

Teaching and Learning Approaches:

Teaching in the Main Sessions of Course and also Solving Examples and Exercises in the Additional Exercise Sessions.

Equipment and Facilities:

Video Projector, Personal Computer, Digital Pen and Black Board

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 20%	Final Exam 30%	Project 30%
Writing Exam: 50%	20%	30%	0%
Practical Exam: 30%	0%	0%	30%

Course Sources:

1. P.B. Silberschatz, G. Gavlin, and G. Gange, *Operating System Concepts*, Addison-Wiley, 2009.
2. A. S. Tanenbaum, *Moderm Oprating Systems*, Prentice Hall, 2008.
3. A. S. Tanenbaum and A. Woodhull, *Operating Systems: Design and Implementation*, Pearson, 2009.

Course Title	**Scientific Computations**		
Prerequisite Courses	Data Structures and Algorithms	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	4	Theoretical-Practical □	Optional □
Number of Hours	64		Thesis □

General Purpose:

Scientific Computations includes Numerical Linear Algebra and the basics of Numerical Analysis, is very important in many fields of science and engineering. Many applications in the fields of image and signal processing, system theory and control, Statistics and Probability, and random processes lead to system of linear questions. In this course, different algorithms for decomposing different types of matrices, solving systems of equations, finding vectors and eigenvalues, solving Least Squares Problems and other computational algorithms related to matrices are expressed and their stability and convergence are discussed.

Special Purpose:

- Familiarity with the Concepts of Stability, Convergence and Efficiency of Numerical Algorithms to Solve Systems of Linear Equations
- Familiarity with Different Types of Matrices and Numerical Algorithms to Solve Systems of Linear Equations or Approximate their Answers
- Familiarity with Algorithms for Finding Eigenvalues and Eigenvectors, and their Convergence Analysis

Course Description:

In this course we investigate the following topics: Floating-Point Numbers and their Numerical Errors in Computations. Stability of Algorithms and Conditioning of Problems. Efficient Algorithms and Mathematical Softwares. Matrix LU Factorization; without Pivoting, Partial Pivoting, Full Pivoting and their Stability Analysis. Householder Transformation, QR Factorization, and its Generalization to Nonsquare Matrices. Numerical Solutions of Linear Systems using LU and QR Factorizations. Cholesky Algorithm for Symmetric and Positive Definite Matrices. Jacobian and Gauss-Seidel Algorithms. The Least Squares Problem for Systems of Linear Equation and the Normal Method. The QR Method for Systems of Higher Orders. The Numerical Solutions of Eigenvalues and Eigenvector Problems. Singular Value Decomposition (SVD) and its Applications. Polynomial Interpolation, Numerical Differentiation and Integration and their Error Analysis.

Teaching and Learning Approaches:

Teaching Concepts in the Main Sessions of the Course and Organizing the Appropriate Problem Solving Sessions during the Semester.

Equipment and Facilities:

Standard Facilities for Teaching

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 30%	Final Exam 50%	Project 0%
Writing Exam: 20%	30%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. B. N. Datta. *Numerical Linear Algebra and Applications*. 2nd Edition. SIAM, January 2010. ISBN: 978-0898716856.
2. L. N. Trefethen and D. Bau. *Numerical Linear Algebra*. 1st Edition. SIAM, June 1997. ISBN: 9780898713619.
3. W. Ford. *Numerical Linear Algebra with Applications: Using MATLAB*. 1st Edition. Academic Press, September 2014. ISBN: 978-0.123944351.
4. G. Strang. *Introduction to Linear Algebra*. 4th Edition. Wellesley-Cambridge Press, February 2009. ISBN: 978-0980232714.

Course Title	**Artificial Intelligence**		
Prerequisite Courses	Data Structures and Algorithms	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	3	Theoretical-Practical □	Optional □
Number of Hours	48		Thesis □

General Purpose:

This course covers aspects of Computer Science related to human intelligence-related tasks such as playing chess and problem solving.

Special Purpose:

- Familiarity with the Concepts of Artificial Intelligence
- Familiarity with First-Order Logic as a Language of Knowledge Presentation in Knowledge-based Agents
- Familiarity with Solving Artificial Intelligence Problems in Uncertain Environments

Course Description:

History, Application, Goals and Limitations of Artificial Intelligence, Understanding of Intelligent Agents and the Structure of an Intelligent Agent, State Space and Search Methods, Understanding of Solving Artificial Intelligence Problems by Search Methods, Understanding the Concept of Heuristics in Solving Artificial Intelligence Problems. Understanding the Concept of Discovery and Initiative in Solving Artificial Intelligence Problems, Knowledge Display, Game Theory, Expert Systems, Concepts of Hearing, Seeing and Talking and Computer Learning and Familiarity with the Concept of Learning using Observation, the Concept of Robot, the Concept of Perception and Inference and Execution by Robot, Systems based on the Usefulness of Knowledge and Awareness.

Teaching and Learning Approaches:

Teaching Concepts in the Main Sessions and Solve Appropriate Exercises during the Semester in Extra Sessions.

Equipment and Facilities:
Video Projector

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 20%	Final Exam 30%	Project 30%
Writing Exam: 50%	20%	30%	0%
Practical Exam: 30%	0%	0%	30%

Course Sources:

1. Peter Norvig, Stuart Russell, *Artificial Intelligence: A Modern Approach*, Pearson; 32.41 Edition, 2015.
2. N. C. Rowe, *Artificial Intelligence through Prolog*, Prentice Hall, 1988.
3. D. W. Patterson, *Introduction to Artificial Intelligence and Expert Systems*, Prentice Hall, 1990.

Course Title	**Compilers**		
Prerequisite Courses	Fundamentals of Theory of Computation	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	3	Theoretical-Practical □	Optional □
Number of Hours	48		Thesis □

General Purpose:

This course is an introduction to the details of the translation of programs written in high-level languages to the executable machine codes. Beyond implementations, some theoretical concepts are taught. Moreover, students will see in this course applications and motivations of some theoretical notions in Computer Science (like theory of languages).

Special Purpose:

- Introduction to Theoretical and Practical Concepts in Compilers
- Introduction to Separate Logical Parts in Compilers
- Ability for Generating Efficient Programs

Course Description:

Introduction to Compilers, its Logical Parts, Structure of Programming Languages and the Role of Grammars in it, Lexical Analyzers, Deterministic Automatons and their Interaction with Lexical Analyzers, Error Handling in Lexical Analyzers, Syntax Analyzers and Error Handling in them, Top-Down and Buttom-Up Algorithms, Run Time Data Structure, Symbol Tables, Code Generation, Intermediate Code, Semantic Analyzers, Compiler for Compilers (Lex and Yacc).

Teaching and Learning Approaches:

Teaching in the Main Sessions of Course and also Solving Examples and Exercises in the Additional Exercise Sessions.

Equipment and Facilities:

Video Projector, Personal Computer, Digital Pen and Black Board

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 20%	Final Exam 30%	Project 30%
Writing Exam: 0%	20%	30%	0%
Practical Exam: 20%	0%	0%	30%

Course Sources:

1. V. Aho, R. S. and J. D. Ullman, *Compilers: Principles, Techniques, and Tools*, Addison-Wesley, 2007.
2. W. Appel and J. Palsberg, *Modern Compiler Implementation in Java*, Cambridge University Press, 2002.
3. Y. Su and S. Y. Yan, *Principles of Compilers: A New Approach to Compiler*, Springer, 2011.

Course Title	**Scientific Writing**		
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	2	Theoretical-Practical □	Optional □
Number of Hours	32		Thesis □

General Purpose:

Due to the importance of language skills in mathematical studies and writing scientific reports, this course with the following syllabus is recommended for presentation in all disciplines. This course is organized so that it can be used by all sections of the Faculty of Mathematics.

Special Purpose:

Develop Skills in How to Use Persian and English Languages in and Use Software for Scientific (Mathematical) Writing.

Course Description:

Introducing the Types of Reference Books, including Types of Dictionaries and General Dictionaries, Types of Dictionaries and Mathematical Dictionaries.

- Introducing the Names of the Main and Sub-Branches of Mathematics based on Math. Subj. Classification,
- Description of Language Skills in Expressing Mathematical Concepts with Emphasis on Reading and Writing (Reading and Writing),
- Writing for the Preparation of a Scientific Biography (CV),
- Practice Writing Persian and English with the Aim of Describing or Proving
- Math Writing in Persian and Foreign Languages (English),
- Concerning the Principles of Consistency and Parallelism, Summary (Contraction), Elegant Variation of Words and Avoiding Errors such as Dangling,
- Principles Required for Writing Proof, Formulation and Symbolism,
- The Roles of Theorems, Propositions, Lemmas, Conjecture, Hypothesis, etc.,
- Explaining the List of Common Mathematical Expressions for Writing Mathematical Concepts and Explaining Some Common Mistakes in Mathematical Writings and Providing More Appropriate Forms,
- Introduction for Writing Mathematical, Statistics and Computer Science Texts, Similarities and Differences,
- Steps of Preparing, Editing, Reviewing and Publishing a Mathematical Work,

- Examples of Editing the Work by Some Great Mathematicians,
- How to Prepare the Initial Project, Dissertation and Thesis, Project Review, Dissertation and Thesis, Project Delivery, Dissertation and Thesis,
- Preparing a Talk, Making Slides for a Talk and Presenting a Talk,
- Poster Preparation, Poster Writing and Poster Presentation,
- Learning to Use Latex and Farsi-Tex.

Teaching and Learning Approaches:

Explaining the details with examples and proposing exercises to be discussed and solved. Giving several writing projects according to the above syllabus. Using latex editors and Xepersian.

Equipment and Facilities:
Video Projector, Using Latex and Xepersian

Evaluation Approaches (Suggested):

Continuous Assessment 30%	Midterm Exam 0%	Final Exam 30%	Project 40%
Writing Exam: 30%	0%	30%	40%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. Franco Vivaldi, *Mathematical Writing: An Undergraduate Course*, Uni. Lond. (Queen Mary), 2011.
2. N. J. Higham, *Handbook of Writing for Mathematical Science*, Siam, 1998.
3. *Dictionary of Mathematics: In Four Languages - English, German, French, Russian*, 2000.
4. M. Swan, *Oxford Practical Usage*, 2009.
5. *Oxford Advanced Learner's Dictionary*, the Latest Edition.
6. *Longman Dictionary of Common Errors*, 1999.
7. *Encyclopedic Dictionary of Mathematics: The Math*. Society of Japan, (English Translation), 1993.
8. *Encyclopedia of Mathematics*, Springer, Latest Edition.

Course Title	**Project**		
Prerequisite Courses	Department Permission	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical ■
Number of Credits	3	Theoretical-Practical □	Optional □
Number of Hours	48		Thesis ■

General Purpose:

Taking this course is respected to the permission of the faculty, the appointment of the supervisor, as well as the submission of a proposal by the student. The approval of the faculty is necessary for finalizing the project.

Evaluation Approaches (Suggested):

Continuous Assessment 0%	Midterm Exam 0%	Final Exam 0%	Project 100%
Writing Exam: 0%	0%	0%	50%
Practical Exam: 0%	0%	0%	50%

Course Title	**Data Mining**		
Prerequisite Courses	Probability (1)	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical □
Number of Credits	3	Theoretical-Practical □	Optional ■
Number of Hours	48		Thesis □

General Purpose:

Data Mining is one of the subfields of Data Science that has many commonalities between Statistics and Computer Science, and in this regard, this course is of great importance for students of Statistics and Computer Science.

Special Purpose:

Familiarity with the Principles of Data Mining, Data Analysis with the Help of Data Mining Algorithms including Regression, Classification, Clustering and Association Rule Mining.

Course Description:

- Introduction to Data Mining, Data Preprocessing, Data Analysis
- Univariate, Multivariate Statistical Analysis and Linear Regression Model
- KNN Algorithm
- Naive Bayes Algorithm
- Support Vector Machine Algorithm
- Decision Tree Algorithm
- Neural Network Algorithm
- Clustering Algorithms
- Association Rule Mining
- Evaluation of Models
- Data Stream Clustering
- Graph Mining

Teaching and Learning Approaches:

Teaching Concepts in the Main Sessions and Solve Appropriate Exercises during the Semester in Extra Sessions.

Equipment and Facilities:
Video Projector

Evaluation Approaches (Suggested):

Continuous Assessment 15%	Midterm Exam 30%	Final Exam 45%	Project 15%
Writing Exam: 10%	30%	45%	0%
Practical Exam: 5%	30%	0%	15%

Course Sources:

1. Larose D.T. and Larose C.D. (2014) *Discovering Knowledge in Data: An Introduction to Data Mining* (2nd Edition). John Wiley & Sons.
2. P. Tan, V. Kumar, and M. Steinbach, *Introduction to Data Mining*, Pearson International Edition, 2005.
3. J.Han and M. Kamber, *Data Mining: Concepts and Techniques*, 3rd Edition, Morgan Kaufmann, 2011.

Course Title	**Principles of Software Design**		
Prerequisite Courses	Principles of Operating Systems	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical □
Number of Credits	3	Theoretical-Practical □	Optional ■
Number of Hours	48		Thesis □

General Purpose:

This course presents basic concept of Software Engineering techniques. In this course, the student is introduced to the methods of Computer System Analysis and by performing a team project, experiences the analysis and design of a relatively large Computer Systems.

Special Purpose:

Introduction to Large Software Production Methods and Systems Analysis and Design Methods.

Course Description:

- Introduction to Software Production Models (Cascading, etc.).
- Introduction to Requirement Definition Methods (Formal and Non-Formal).
- Software Verification and Validation Methods.
- Software Design Methods (Top-Down, Bottom-Up, Thematic, Process and Data).
- Introduction to Implementation, Testing, Debugging, Maintenance, Reliability, Reusability, Portability of Software.

Teaching and Learning Approaches:

Teaching Main Concepts in the Class and Solving Appropriate Exercises during the Semester.

Equipment and Facilities:

Video Projector

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 20%	Final Exam 30%	Project 30%
Writing Exam: 10%	20%	30%	0%
Practical Exam: 10%	0%	0%	30%

Course Sources:

1. I .Sommerville, *Software Engineering*, 9th Edition, Addison-Wesley, 2010.
2. C .Ghezzi, M .Jazayeri, D .Mandrioli, *Fundamentals of Software Engineering*, Prentice Hall, 2003.
3. P .A. B. Ng and R. T. Yeh, *Modern Software Engineering: Foundations and Current Perspectives*, Van Nostrand Reinhold, 1990.
4. R. S. Pressman and P. Roger, *Software Engineering: A Practitioner's Approach*, 7th Edition, McGraw Hill, 2009.

Course Title		**Graph Theory and its Applications**	
Prerequisite Courses	Fundamentals of Combinatorics	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical □
Number of Credits	3	Theoretical-Practical □	Optional ■
Number of Hours	48		Thesis □

General Purpose:

The field of graph theory has been grown extensively in the 20th century. One of the main reasons of such a huge growth is the ability of graphs in modeling different types of problems as well as connections of graphs to Computer Science. In this course the student get familiar with basic concepts of graphs theory as well as some of its connections with other fields.

Special Purpose:

Introduction to Concepts, Techniques and Algorithms of Graph Theory.

Course Description:

(Some of Subtitles can be Ignored and Modified according to Priorities Considered by the Instructor)

- Basic Concepts: Graphs and their Representations (Incidence and Adjacency Matrices, Adjacency Lists), Subgraphs, Paths and Connectivity, Isomorophism of Graphs, Operations on Graphs, Digraphs and Tournaments.
- Connectivity: Cut-Vertices and Cut-Edges, Connectivity and Edge-Connectivity, Blocks, Cutsets and Edge-Cutsets.
- Trees: Directed and Rooted Trees, Traversing Trees, Depth-Search and Breadth-Search, Some Enumeration Problems in Graphs, Finding Minimum Spanning Trees in a Connected Weighted Graph (Kruskal and Prim Algorithms).
- Distances of Vertices: Application of BFS in Finding Distance of Vertices, Finding Shortest Paths in Weighted Graphs (Dijestra Algorithm).
- Matchings and Independent Sets: Independent Sets of Vertices, Independent Sets of Edges, Berge Theorem about Maximum Matchings, Matchings and Factors, Hall theorem, Maximum Matchings in Bipartite Graphs, Petersen Theorem, Tutte-Berge Theorem.
- Eulerian and Hamiltonian Graphs, Euler Theorem, Dirac Theorem, Ore Theorem, Chinese Postman Problem, Traveling Salesman Problem.
- Network Flows: Max-Flow Min- Cut Theorem, Menger Theorem.
- Colorings of Graphs: Vertex-Coloring, Chromatic Number, Brooks Theorem, Edge-Coloring, Edgechromatic Numbers, Vizing Theorem, Chromatic Polynomial.
- Planarity: Planar Graphs, Euler Formula and Some Consequences, Dual of a Plane Graph, Kuratowski Theorem.

Teaching and Learning Approaches:

Stating Theorems, Proofs, Techniques and Algorithms, Solving Related Examples and Exercises.

Equipment and Facilities:

Video Projector

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 60%	Final Exam 20%	Project 0%
Writing Exam: 50%	30%	20%	0%
Practical Exam: 30%	30%	0%	0%

Course Sources:

1. J. A. Bondy and U.S.R. Murty, *Graph Theory*, Springer, 2008.
2. R. Diestel, *Graph Theory*, Springer, 2006.
3. D. B. West, *Introduction to Graph Theory*, Prentice Hall, 2001.
4. R. Balakrishnan, and K. Ranganathan, *A Text Book of Graph Theory*, Springer, 2000.

Course Title	**Biological Computing**		
Prerequisite Courses	Advanced Programming	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical □
Number of Credits	3	Theoretical-Practical □	Optional ■
Number of Hours	48		Thesis □

General Purpose:

Nowadays, evolutionary and biological computations and nature-inspired algorithms are used in a wide range of sciences to solve optimization and search problems, the simplicity of which has been an effective factor in this success. This course provides students with familiarity with this type of calculations and how to use them effectively in solving problems in the world of Computer Science.

Special Purpose:

- Introduction of concepts, applications of Evolutionary Algorithms and Biological Calculations.
- Introduction of Concepts, Applications of Artificial Neural Network Algorithms.
- Familiarity with Nature-Inspired Search and Optimization Algorithms.

Course Description:

Introduction to Soft Computing, Introduction to Neural Networks, History of Neural Networks, Mcculloch-Pitts Neuron, Hebb Network, Perceptron and Adaline Network, Multilayer Perceptron Network, Error Backpropagation Algorithm, Brief Overview of Search Algorithms and Metaheuristic Optimization, Concepts of Search Space and Exploration and Exploitation, Concepts and Definitions of Evolutionary Computing, Stages of Evolutionary Algorithms, Genetic Algorithm Theory, Convergence and Applications, Genetic Programming, Evolutionary Strategy, Evolutionary Programming, Cultural Algorithms, Artificial Immune System, Overview of Concepts and Definitions of Swarm Intelligence, Ant Colony Algorithms, Particle Swarm Optimization, Non-Biological Algorithms (Simulated Annealing, Tabu Search), Scatter Search and Local Search, an Overview on Today's Evolutionary Algorithms.

Teaching and Learning Approaches:

Teaching Concepts in the Class Sessions and Holding TA Classes to Solve Exercises during the Semester.

Equipment and Facilities:

Standard Classroom Requirements

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 20%	Final Exam 30%	Project 30%
Writing Exam: 20%	20%	30%	0%
Practical Exam: 0%	0%	0%	30%

Course Sources:

1. Funsett L., 1994. *Fundamentals of Neural Networks*, Prentice Hall, London.
2. Goldberg D. E., 1984. *Genetic Algorithms in Search, Optimization, and Machine Learning*, Addison-Wesley.
3. Karray F., & De Silva C., 2004. *Soft Computing and Intelligent Systems Design: Theory, Tools, and Applications*, Addison-Wesley.
4. Simon D., 2013. *Evolutionary Optimization Algorithms*, John Wiley & Sons.

Course Title	**Database**		
Prerequisite Courses	Data Structures and Algorithms	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical □
Number of Credits	3	Theoretical-Practical □	Optional ■
Number of Hours	48		Thesis □

General Purpose:

Data and its storage and making a database is one of the core concepts in Computer Science. An introduction to the fundamentals of these topics is aimed in this course. The students learn in this course how to design, implement and analyze a database.

Special Purpose:

- Introduction to Basic Concepts of Database.
- Designing Information Systems based on Database.
- Introduction to Theoretical Notions in Database.

Course Description:

History and Principles of Database Management Systems, Principles and Stages of Database Construction, Requirements Analysis, Conceptual and Semantic Models, Information Requirements, Relationship-Entity Diagram, Relational Model and Relational Algebra, Operations on Sets in Query of Relational Model, Entity-Relational Model Mapping to Relational Model, SQL Query Language, Functional Dependency, Database Normalization and Normal Levels. From a theoretical and algorithmic point of view, items include huge databases as well as knowledge extraction.

Teaching and Learning Approaches:

Teaching in the Main Sessions of Course and also Solving Examples and Exercises in the Additional Exercise Sessions. Moreover, utilizing some related programming languages and the relationship between this course and other courses in Mathematics or Computer Sciences.

Equipment and Facilities:

Video Projector, Personal Computer, Digital Pen and Black Board

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 20%	Final Exam 30%	Project 30%
Writing Exam: 50%	20%	30%	0%
Practical Exam: 30%	0%	0%	30%

Course Sources:

1. C. J. Date, *An Introduction to Database Systems*, Addison-Wesley, 2000.
2. R. Elmasri and S. B. Navathe, *Fundamentals of Database Systems*, Addison-Wesley, 2010.
3. D. Kroenke, *Database Processing Fundamentals, Design and Implementation*, Prentice Hall, 2009.
4. S. H. F. Korth, S. Sudarshan, *Database System Concepts*, McGraw Hill, 2010.

Course Title	**Nonlinear Programming**		
Prerequisite Courses	Linear Programming (or Department Permission)	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical □
Number of Credits	3	Theoretical-Practical □	Optional ■
Number of Hours	48		Thesis □

General Purpose:

In this course, students will be introduced to Nonlinear Programming problems, how to solve nonlinear problems, and examine changes in nonlinear problems.

Special Purpose:

- Familiarity with Modeling Problems in the Form of Nonlinear Programming Problems
- Familiarity with Optimizing Functions

Course Description:

Unbounded Problems and First- and Second-Order Conditions, Optimization of Convex Functions, Global Convergence, Convergence Velocity, Descending Slope Methods, Gradient, Newton and Quasi-Newton, Linear Search in Descending Path, Square Programming and Numerical Methods to Solve it, Development and Implementation of Numerical Algorithms. Modeling Real Problems in the Form of Linear Programming Problems, How to Solve these Linear Problems and Examine Changes in Linear Problems, Networks and Transportation Models, and to some Extent Familiarity with Nonlinear Programming and Integer-Valued Variable Problems.

Teaching and Learning Approaches:

Teaching Concepts in the Main Sessions of the Course and Organizing the Appropriate Problem Solving Sessions during the Semester.

Equipment and Facilities:
Standard Facilities for Teaching

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 30%	Final Exam 50%	Project 0%
Writing Exam: 20%	30%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. I.E. Denis and R.B. Schnabel, *Numerical Methods for Unconstrained Optimization and Nonlinear Equations*, Prentice Hall, 1983.
2. P.E. Gill, M. Murray, and M. Wright, *Practical Optimization*, Academic Press, 1981.
3. D. Luenberger, *Linear and Nonlinear Programming*, 2nd Edition, Addison-Wesley, 1989.

Course Title	**Advanced Data Retrieval**		
Prerequisite Courses	Data Structures and Algorithms	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical □
Number of Credits	3	Theoretical-Practical □	Optional ■
Number of Hours	48		Thesis □

General Purpose:

This course covers the concepts in the field of Information Retrieval with an emphasis on web search engines and discusses the basic structures for implementing a search engine.

Special Purpose:

- Familiarity with the Concepts of Information Retrieval and Web Search Engines.
- Familiarity with Three Basic Recovery Models: Boolean, Vector and Probabilistic.
- Familiarity with Current Topics in the Field of Information Retrieval.

Course Description:

Introduction of Information Retrieval, Boolean Model of Information Retrieval, Vocabulary Dictionary Construction Process, Flexible Retrieval, Index Construction, Index Compression, Vector Model, Calculation of Points in a Complete Search System, How to Evaluate Information Retrieval Systems, Related Feedback and Query Modification Development, XML Document Retrieval, Probabilistic Data Retrieval Model, Linguistic Models for Data Retrieval, Document Classification and Bayesian Categorization, Vector Space Classification, Support Vector Machines, Clustering Documents (Flat, Hierarchical), Matrix Analysis and Latent Semantic Indexing, Web Attributes, Web Properties, Web Search Principles, Web Crawler Architecture, Web Link Analysis.

Teaching and Learning Approaches:

Teaching Concepts in the Main Sessions and Solve Appropriate Exercises during the Semester in Extra Sessions.

Equipment and Facilities:
Video Projector

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 20%	Final Exam 30%	Project 30%
Writing Exam: 50%	20%	30%	0%
Practical Exam: 30%	0%	0%	30%

Course Sources:

1. C.D. Manning, P. Raghavan, and H. Schutze, *Introduction to Information Retrieval*. Cambridge University Press, 2008.
2. R. Baeza-Yates and E. Berthiier Ribeiro-Neto, *Modern Information Retrieval*. Addison-Wesley, 1999.

Course Title	**Mathematics Lab**		
Prerequisite Courses	Fundamentals of Computer and Programming	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Optional ■
Number of Hours	32		Thesis □

General Purpose:

Due to the need to implement numerical algorithms with the Mathematics software, it is necessary that the students be familiar with some mathematical software to perform numerical implementations with some suitable softwares and in addition, be able to use the toolboxes in the software and compare them with the numerical results obtained from the new algorithms.

Special Purpose:

- Familiarity with Writing Algorithms in Mathematical Softwares and Comparison of Results with the Functions in the Softwares.
- In this course, the student is required to determine a computational problem in industry and Engineering Sciences in consultation with the course instructor, implement it by means of the numerical algorithms discussed in the classroom and compare it with other existing algorithms.

Course Description:

Various math softwares such MATLAB, Maple, Mathematica and GAMS are introduced in this class. The course involves; various math computations such as floating point arithmetic with single and double precisions, algorithms in Numerical Linear Algebra and their numerical errors and ill conditioned problems, introduction to various computational methods for dynamical systems, differentiation and integration, Linear and Nonlinear Optimization (such as simplex method, gradient, newton and conjugate gradient methods), function approximation, interpolation and random numbers, some of the signal and image processing techniques such as Fourier analysis and various filtering schemes.

Teaching and Learning Approaches:

Use MATLAB, Python, R or Octave to Solve Computer Assignments and the Class Project.

Equipment and Facilities:

Computer Facilities

Evaluation Approaches (Suggested):

Continuous Assessment 30%	Midterm Exam 30%	Final Exam 40%	Project 0%
Writing Exam: 30%	30%	40%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. G. H. Golub and C. F. Van Loan, *Matrix Computations*, Johns Hopkins Press, 4th Edition, 2013. ISBN: 978-1421407944.
2. S.R. Otto and J. P. Denier, *An Introduction to Programming and Numerical Methods in MATLAB*, Springer, 2005. ISBN: 978-1852339197.
3. W. P. Petersen and P. Arbenz, *Introduction to Parallel Computing*, Oxford Uni. Press, 1st Edition, 2004. ISBN: 978-0198515760.

Course Title	**Fundamentals of Economics**		
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical □
Number of Credits	4	Theoretical-Practical □	Optional ■
Number of Hours	64		Thesis □

General Purpose:

To Give a Deeper Understanding of Economic Concepts and Principles of Management.

Special Purpose:

Introduction to Basic Principles of Economic Science, Consumption Basics, Production and Balance Models in Economics, Monetary Policy, Fiscal Policy, Banking Policy, and Identify Main Challenges of Economics such as Unemployment and Inflation.

Course Description:

- Economic Science and System
- Consumer Behavior and Demand Concept in Economics
- Producer Behavior and Supply in Economics
- Demand and Supply Equilibrium and Price Determination in Different Markets
- Government Role in Economics
- Elements of GDP
- Aggregate Supply and Fiscal Policy
- Money, Central Bank, and Monetary Policy
- Inflation and General Price Levels
- Employment and Policy Against Unemployment
- Economics Growth and Development

Teaching and Learning Approaches:

Main Textbooks in Economics.

Equipment and Facilities:
Video Projector

Evaluation Approaches (Suggested):

Continuous Assessment 20%	Midterm Exam 30%	Final Exam 50%	Project 0%
Writing Exam: 20%	30%	50%	0%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. Dadgar, Y. and Rahmani, T, *Fundamentals and Principles of Economics: Economics for Everyone*. Boostan Ketab Publication, 17th Edition, 2018.
2. Asli, B. Q., *Economics Science: Brief Analysis of Microeconomics and Macroeconomics*. Sepehr Publication, 2012.
3. Taqavi, M. and Kosari, A, *Fundamentals of Economics*. Kosar Publication, 12th Edition, 2014.

Course Title	**Strategy Games (1)**		
Prerequisite Courses	Department Permission	Type of the Course	
		Theoretical■	Basic □
		Practical□	Technical □
Number of Credits	4	Theoretical-Practical□	Optional■
Number of Hours	64		Thesis□

General Purpose:

Game Theory and especially "Strategic Games" is one of the tools that has been used in the last seventy years in the fields of Economics, Political Science and international relations. Also, this tool and especially evolutionary games in recent decades used by biologists. Game Theory can be examined from different perspectives, which are:

- Theoretical Approach
- Algorithmic Approach
- Applied Approach

Undoubtedly, offering such undergraduate and graduate courses can be a great help in updating the courses of these courses.

Special Purpose:

- Familiarity with Strategic Games with a Theoretical and Practical Approach
- Creating the Ability to Analyze and Optimize Environmental Phenomena in the Field of Economics, Management, Political Science and International Relations, Engineering

Course Description:

- Strategic Games and Nash Equilibrium: Defining Strategic Games and Defining Nash Equilibrium and Presenting their Applications.
- Mixed Equilibrium: Introduction of Mixed Strategies and Mixed Nash Equilibrium, Calculation and Application of Mixed Equilibria.
- Extensive Games with Complete Information: Definition of Extensive Games with Complete Information, the Concepts of "Strategy and Output of a Strategy" in such Games. Nash Equilibrium.
- Generalization of Games Extended with Complete Information: Definition of "Extensive Games with Complete Information and Simultaneous Movements", Definition of "Extensive Games with Complete Information and Random Movements", Provide Examples.
- Bayesian Games: Definition of Bayesian games, Definition of Nash Equilibrium for Such Games, Examples.

- Extensive with Incomplete Information: In this chapter, after defining games extended with incomplete information, we will define the strategy and Nash equilibrium for such games.

Teaching and Learning Approaches:

Teaching the Main Topics in the Class, Following an Interactive Manner; Problem-Solving Classes by TA.

Equipment and Facilities:

Video Projector and Computer

Evaluation Approaches (Suggested):

Continuous Assessment 10%	Midterm Exam 0%	Final Exam 40%	Project 50%
Writing Exam: 10%	0%	40%	50%
Practical Exam: 0%	0%	0%	0%

Course Sources:

1. M. J. Osborne, *An Introduction to Game Theory*, Oxford University Press, Inc., 2004.
2. A. Dixit, and S. Susan, *Games of Strategy*, W. W. Norton & Company, 2004.

Course Title	**Persian Language**		
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	General ■
		Practical □	Technical □
Number of Credits	3	Theoretical-Practical □	Optional □
Number of Hours	48		Thesis □

General Purpose:

Familiarity with Persian language and reading literary texts, poetry and prose in Iranian Persian literature.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

Course Title	**English Language**		
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	General ■
		Practical □	Technical □
Number of Credits	3	Theoretical-Practical □	Optional □
Number of Hours	48		Thesis □

General Purpose:

General Language courses, offered at all levels of the Intensive Language Program, seek to improve students' language skills in a great variety of discourse settings. Language skills addressed include: listening, fluency development, oral intelligibility, reading, grammar, writing, and vocabulary development.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

Course Title	**Physics Education**		
Prerequisite Courses	-	Type of the Course	
		Theoretical □	General ■
		Practical □	Technical □
Number of Credits	1	Theoretical-Practical ■	Optional □
Number of Hours	16		Thesis □

General Purpose:

Physics Education classes are designed to practice and develop skills in activities that will help the students maintain fitness throughout their life. During the year, they will set and monitor personal fitness goals that will aid in the development of a personal fitness plan.

Equipment and Facilities:

Computer Facilities and Sports Equipment

Course Title	**Sport (1)**		
Prerequisite Courses	Physics Education	Type of the Course	
		Theoretical □	General ■
		Practical ■	Technical □
Number of Credits	1	Theoretical-Practical □	Optional □
Number of Hours	16		Thesis □

General Purpose:

This course aims to provide students with knowledge and skills in sports.

Equipment and Facilities:

Sports Equipment

Course Title		**Family Knowledge and Population**	
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	General ■
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Optional □
Number of Hours	32		Thesis □

General Purpose:

Familiarity of students with the basics of family knowledge and how to form, consolidate, and excel it and demographic characteristics and their role in improving the quality of life.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

Course Title		**Islamic Thought (1) (Genesis and Afterlife)**	
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	General ■
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Optional □
Number of Hours	32		Thesis □

General Purpose:

The objectives of this course include studying the concept of origin and the concept of the afterlife in Islamic philosophy.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

Course Title		**Islamic Thought (2) (Prophethood and Imamate)**	
Prerequisite Courses	Islamic Thought (1) (Genesis and Afterlife)	Type of the Course	
		Theoretical ■	General ■
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Optional □
Number of Hours	32		Thesis □

General Purpose:

This course aims to introduce the concepts of prophecy and Imamate in Islam, exploring their significance and principles in Islamic thought and theology.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

Course Title		**Thematic Interpretation of Quran**	
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	General ■
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Optional □
Number of Hours	32		Thesis □

General Purpose:

Analyzing the Thematic Aspects of the Quran.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

Course Title		**History of Islamic Culture and Civilization**	
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	General ■
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Optional □
Number of Hours	32		Thesis □

General Purpose:

Familiarity with the formation of Islamic civilization and internal and external elements effective in its advancement and decline in order to strengthen self-confidence and consolidate Islamic national identity.

Course Description:

Basic Topics; Terminology of Cultural History, Civilization and Modernity, The Constituent Elements of Culture and Civilization, Definition of Islamic Civilization and its Historical and Geographical Scope, Islamic Civilization and its Causes and Factors, Characteristics of Islamic Civilization, Scientific Flourishing Movement in Islamic Civilization, Political, Social and Scientific Institutions of Islamic Civilization, Religious, Cultural and Social Causes and Factors of the Emergence and Prosperity of Islamic Civilization, The Influence of Previous Cultures and Civilizations in the Emergence of Islamic Civilization (Greece, Iran, etc.), Mutual Services of Islam and Iran, Backgrounds of Decline, Causes and Factors of Stagnation of Islamic Civilization, Invasion of Foreign Enemies, Aristocracy and Autocracy and the Caliphate's Departure from Authentic Islamic Standards, Petrification and Political and Social Restrictions, Worldliness and Moral Degeneration and Deviation from True Islam, The Influence of Islamic Civilization on Western Civilization and the Emergence of the Renaissance, Available Capacities in the Islamic World, Geographical and Geopolitical Position of Islamic Countries, Underground and Human Resources of Islamic Countries, Cultural and Spiritual Capital of Islam, Spiritual Degeneration and Internal Crises of the Modern World.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

Course Title	**Islamic Revolution of Iran**		
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	General ■
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Optional □
Number of Hours	32		Thesis □

General Purpose:

Theoretical acquaintance with the causes and factors of the emergence of the Islamic Revolution and the study of the cultural, social and political developments of the Islamic Revolution and the issues after it.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

Course Title		**Islamic Ethics (Principles and Concepts)**	
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	General ■
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Optional □
Number of Hours	32		Thesis □

General Purpose:

The objectives of this course include understanding the principles and fundamentals of Islamic ethics.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

Course Title		**Personal Financial and Economic Literacy**	
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Elective ■
Number of Hours	32		Thesis □

Course Description:

Develop a Basic Understanding of Financial Concepts, including Income, Expenses, Budgeting, Saving, Investing, and Debt Management, Explore the Financial System, including Banks, Credit Unions, Credit Cards, Loans, and Mortgages, Develop a Basic Understanding of Financial Markets, including Stocks, Bonds, and Mutual Funds, Develop Critical Thinking Skills and the Ability to Evaluate Financial Information and Make Informed Decisions about Personal Finances, Understand the Importance of Financial Planning and Goal Setting, and Develop Strategies for Achieving Financial Goals, Understand the Impact of Taxes, Inflation, and Interest Rates on Personal Finances, Develop an Understanding of the Role of Insurance in Financial Planning and Risk Management, Understand the Ethical and Legal Responsibilities of Financial Decision-Making, Develop the Ability to Use Financial Tools and Technology to Manage Personal Finances, Develop a Lifelong Commitment to Financial Literacy and Responsible Financial Management.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

Course Title	**Introduction to Environment**		
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Elective ■
Number of Hours	32		Thesis □

General Purpose:

Explore fundamental concepts and issues surrounding environmental studies. Topics include ecological principles, sustainability, resource management, and human impact on the environment.

Course Description:

Environmental Ethics, Explore Ethical Perspectives on Human Interactions with the Environment, including Debates on Anthropocentrism and Biocentrism, Ecosystem Dynamics, Study the Interactions between Biotic and Abiotic Factors within Ecosystems, Emphasizing Energy Flow and Nutrient Cycling. Climate Change, Examine the Science behind Climate Change, its Causes, Impacts on Ecosystems and Human Societies, and Mitigation Strategies, Biodiversity Conservation, Discuss Strategies for Conserving Biodiversity, including Protected Areas, Habitat Restoration, and Species Management, Environmental Policy and Regulation, Analyze the Development and Implementation of Environmental Policies, including International Agreements and Regulatory Frameworks, Environmental Economics, Explore the Economic Aspects of Environmental Issues, including Cost-Benefit Analysis, Market-based Instruments, and Sustainable Development, Environmental Justice, Examine the Fair Distribution of Environmental Benefits and Burdens Among Different Social Groups, Considering Issues of Equity and Human Rights, Case Studies in Environmental Science, Investigate Real-World Examples of Environmental Challenges and Solutions, Applying Theoretical Knowledge to Practical Situations.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

Course Title	**History of Iran**		
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	Basic □
		Practical □	Technical □
Number of Credits	2	Theoretical-Practical □	Optional ■
Number of Hours	32		Thesis □

Course Description:

Understanding the History and Culture of the Early Islamic Centuries - the Dynasties of the Sassanids, Ghaznavids, Saffarids, Al-Buwayh, Deilman and the Governments of Tabarestan, the Ismaili Movement in Connection with Castles and Tourist Attractions. Knowledge of the History of the Seljuks and Khwarezmshahs, Knowledge of the History of the Ilkhanids and Timurids, Qaraqunilos and Safavids, History of Afshari, Zandieh and Qajar. Bibliography and Introduction of Sources.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

Course Title		**Workshop on Life Skills Training and Prevention of Social Harm (1)**	
Prerequisite Courses	-	Type of the Course	
		Theoretical ■	General ■
		Practical □	Technical □
Number of Credits	0	Theoretical-Practical □	Optional □
Number of Hours	4		Thesis □

General Purpose:

Familiarity with Self-Awareness Skills, Empathy Skills, Communication Skills, Boldness, Anger Management, Stress Management, Depression Prevention, Creative Thinking, Critical Thinking, Problem Solving and Decision Making.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

Course Title		**Workshop on Life Skills Training and Prevention of Social Harm (2)**	
Prerequisite Courses	Workshop on Life Skills Training and Prevention of Social Harm (1)	Type of the Course	
		Theoretical ■	General ■
		Practical □	Technical □
Number of Credits	0	Theoretical-Practical □	Optional □
Number of Hours	4		Thesis □

General Purpose:

Familiarity with Self-Awareness Skills, Empathy Skills, Communication Skills, Boldness, Anger Management, Stress Management, Depression Prevention, Creative Thinking, Critical Thinking, Problem Solving and Decision Making.

Equipment and Facilities:

Computer, Video Projector, Black/White-Board

This is the End.