Shiraz University
Computer Science and Engineering
Course Catalog

(Updated on 17 March, 2021)

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Principles of Computational Intelligence

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Green Computing

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Configurable Architectures

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Advanced Database Systems

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Data Mining

Modeling of Biological Systems

Intro to Computational Biology and Bioinformatics

Text Mining

Information Networks

Advanced Engineering Mathematics

Business Intelligence

E-Commerce Security

Knowledge Management Systems

Scientific computations and data analysis

Computer Graphics

Calculus 1

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0

Description:
Cartesian coordinates; polar coordinates; complex numbers; summation, multiplication, radical and geometrical representation of complex numbers; polar representation of complex numbers; function; algebra of functions; limit and related theories; infinite limit and limit at infinity; left-hand and right-hand limit; continuum; derivative; derivative rules; inverse function and its derivative; derivative of trigonometric functions and their inverse functions; Roll's theorem; mean; value theorem; geometrical and physical applications of derivative; curves and acceleration in polar coordinates; application of derivative in approximation of equations roots; definition of integral of continuous and piecewise continuous functions; fundamental theorems of differential and integral calculus; primary function; approximation estimate methods of integral; application of integral in calculation of surface area and volume and curve length and momentum and center of gravity and work, etc. (in Cartesian and polar coordinates); logarithm and exponential function and their derivatives; hyperbolic functions; integration methods such as change of variables and by parts and partial fractions decomposition; special variable replacement of sequence, numerical series and convergence theories; power series and Taylor theorem with residual, Taylor expansion.

Suggested Textbooks:

1. Stewart, James. Calculus: Concepts and contexts. Cengage Learning, 2015.

Calculus 2

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Calculus 1

Description:
Parametric equations; space coordinates; vector in space; scalar product; 3×3 matrices; linear equations system with 3 unknowns; operation on rows; inverse matrix; solving of linear equations system; linear independence; base in R^2, R^3; linear transformation and its matrix; 3 × 3 determinant; characteristic vector and value; vector product; equations of line and plane; second order surface; vector function and its derivative; velocity and acceleration; curvature and normal vectors on curves; multivariable functions; total and partial derivative; tangent plane and normal line; gradient; chain rule for partial derivative; exact differential of double and triple integrals and their applications in geometrical and physical problems; change of variable in integration (without proof of accuracy); spherical and cylindrical coordinates; vector field; curvilinear integral; surface integral; divergence; curl; Laplacian; potential, Green and Stokes and divergence theorems.

Suggested Textbooks:

1. Stewart, James. Calculus: Concepts and contexts. Cengage Learning, 2015.

Physics 1

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0

Description:
Measurement, vectors, one-dimensional motion, motion in one plane, dynamics of particle, work and energy, energy preservation, dynamics of particles systems, rotary kinematics, balance of solid bodies, temperature fluctuation, heat, 1st thermodynamics law, gas kinetic theory, and 2nd thermodynamics law.

Suggested Textbooks:

1. Halliday, David, Robert Resnick, and Jearl Walker. Principles of physics. John Wiley & Sons, New Jersey, 2020.

Physics 2

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Physics 1 (Heat and Mechanics), Calculus 1

Description:
Charge & matter, electrical field, Gauss law, electrical potential, capacitors and dielectric, current & resistance, electrical kinetics and circuits, magnetic field, Ampere's law, Faraday induction law, matter magnetic properties & oscillations, alternate currents, Maxwell equations, electromagnetic waves.

Suggested Textbooks:

1. Halliday, David, Robert Resnick, and Jearl Walker. Principles of physics. John Wiley & Sons, New Jersey, 2020.

Engineering Probability and Statistics

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Calculus 2

Description:
Introduction to set theories, samples and table representation with mean, power, variance, conversion & probabilities combination with related theorems, intermediate random variables, average & variance, distributions, binomial Poisson' distribution, geometric difference, normal distribution, multivariate random distribution, random sampling and random numbers, sampling from small society, estimation of statistical parameters, confidence interval, hypothesis test of decision-making, assumption test, variance experience regression, correlation test, non-parametric methods, direct data fitting line, momentum generator functions, large number theorem, central limit test, sum of independent random variables, conditional probability, total probability theorem.

Suggested Textbooks:

1. Papoulis, A., and S. Unnikrishna Pillai. *Probability, Random Variables and Stochastic Processes*. 4th Edition, McGraw Hill, 2002 (Chapters 1 through 8).
2. Ross, Sheldon M. *A First Course in Probability*. 10th Edition, Prentice Hall, 2019.

Differential Equations

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Calculus 2

Description:
Nature of differential equations and solving, family of curves and normal trajectories, physical models, separable equation, first-order linear differential equation, homogeneous equation, second-order linear equation, homogeneous equation with constant coefficient, method of undetermined coefficients, parameter changing method, application of second-order equations in physics and mechanics, solving differential equation with series, Bessel and Gamma functions, Legendre' polynomial, introduction to differential equation systems, Laplace transformation and its application in solving differential equations.

Suggested Textbooks:

1. Boyce, William E., Richard C. DiPrima, and Douglas B. Meade. *Elementary differential equations and boundary value problems*. 9th edition, 2008.

Computer Workshop

Credit Hours: 1.0
Lecture Contact Hours: 0 Lab Contact Hours: 1
Prerequisite: Fundamentals of Computer Programming

Description:
History, kinds and applications of computer including personal computer, working station, minicomputers, big and super-computers, structures and accessories including motherboard, output and input board, keyboard, screen, printer, scanner, platter, modem, series and parallel gates, secondary memories, introduction to media DOS, windows 95, windows NT, editors such as vi and edit, introduction to internet including mail, ftp, Telnet, web, introduction to some applied software such as Word, Latex, Excel and Corel.

Suggested Textbooks:

1. C. Newman, *SAMS Teach Yourself PHP in 10 Minutes*. Sams Publishing, 2005.
2. D. Hayes, *Sams Teach Yourself HTML in 10 Minutes*. 4th Edition, Sams publishing, 2006.
3. R. Weakley, *Sams Teach Yourself CSS in 10 Minutes*. Sams Publishing, 2005.
4. B. Forta, *Sams Teach Yourself Regular Expressions in 10 Minutes*. Sams Publishing, 2004.
5. R. Shimonski, *SAMS Teach Yourself Unix in 10 Minutes*. Sams Publishing, 2005.
6. J. Andrews, *A+ Guide to Managing & Maintaining Your PC*. 7th Edition, Course Technology, 2009.
7. Cisco Networking Academy, *IT Essentials PC Hardware and Software Course Booklet*. Version 4.1, 2nd Edition, Cisco Press, 2010.

Physics Lab

Credit Hours: 1.0
Lecture Contact Hours: 0 Lab Contact Hours: 1
Prerequisite: Physics 2

Description:
According to the syllabus presented in physics II.

Suggested Textbooks:

Fundamentals of Computer Programming

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0

Description:
problem solving, algorithm presentation using pseudocode, introduction to an organized programming language, constants, variables, computational and logical phrases, types of instructions, types of loops, conditional operations, vectors and matrices, subprograms (functions and procedures), input and output instructions, common algorithm such as methods of search and sort

Suggested Textbooks:

1. Downey, Allen, et al. *How to think like a computer scientist: learning with python 3*. 2016.
2. Wentworth, Peter, Jeffrey Elkner, Allen B. Downey, and Chris Meyers. *How to Think Like a Computer Scientist*. 2011.

Assembly and Machine Language

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Description:

- Numerical systems: representation of negative numbers, characteristics of binary complementary systems, representation of BCD numbers, representation of floating-point numbers.
- Assembly language: methods of addressing (implicit, real time, direct, indirect, benchmarking, base, shifting against contents of counter program, paging program), instructions of work with registers, instructions of work with machine memory (work with words and their combinations, work with characters and bits), instructions related to distribution and loop control, logic instructions, retrieval and transfer of routines, regressive type, assembler facilities at time of translation including macros, iteration and conditional blocks, dump assessment, application of assembly instruction in high-level programming languages, connection of high level programs and assembly language.

Suggested Textbooks:

1. Irvine, Kip R., and Lyla B. Das. *Assembly language for x86 processors*. 2014.
2. Kusswurm, Daniel. *Modern X86 Assembly Language Programming*. Springer, 2018.

Numerical Analysis

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Description:
Programming numerical solution of problems in linear algebra; system of linear equations, matrix inversion, and Eigenvalue problems, solution of equations, polynomial approximations, and initial value problems of ordinary differential equations.

Suggested Textbooks:

1. Burden, Richard L., J. Douglas Faires, and Annette M. Burden. *Numerical analysis. 10th Ed., Cengage learning*, 2015.
2. Young, Todd, and Martin J. Mohlenkamp. *Introduction to numerical methods and Matlab Programming for Engineers*. Department of Mathematics Ohio University, 2021.

Principles of Computer Programming

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0

Description:
More advanced problem solving, algorithm presentation using pseudocode, system level introduction to an organized programming language, constants, variables, computational and logical phrases, types of instructions, types of loops, conditional operations, vectors and matrices, subprograms (functions and procedures), input and output instructions, common algorithm such as methods of search and sort. Pointer and pointer manipulations. Basics of data structures.

Suggested Textbooks:

1. Ritchie, Dennis M., Brian W. Kernighan. *The C Programming Language*. 2nd Edition, Prentice Hall, 1988.
2. Deitel, Harvey M., Paul J. Deitel. *C: How to Program*. 8th Edition, Prentice-Hall, 2016.

Electrical Circuits

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Differential Equations

Description:
Compact circuits & Kirchhoff's Laws, approximation & modeling of circuit elements including: registers, unclosed and reclosed resources (voltage & current) capacitors, selves, power, energy, operational amplifiers (OPAMP) as a circuit element, simple circuits such as: resistor circuits, analytical methods of resistor circuits, labeling two terminals of a circuit, Tonen, Norton equivalent circuit & commutative theorem in resistor circuits, resources conversion, arranging selves, capacitors, application of spice in solving resistor circuits, first order circuits including RL & RC circuits, zero input responses, response at zero state, complete, transient and permanent responses, time coefficients and circuits with several time coefficients, switching, plateau & impulse responses, 2^{nd} order circuits, stability, oscillation negative resistance concepts, double circuits, similarity of electrical & mechanical systems.
Application of spice in solving 1^{st} and 2^{nd} logic circuits and OPAMP, analytical methods for linear circuits (network and node analysis(, importance of impulse response and estimation in general linear circuits (time domain analysis) & convolution theorem, permanent sinusoidal state analysis including: concepts of phasor and impedance, admittance, phasor diagram, concepts of resonance and series & parallel resonance circuits, network functions frequency responses, power at permanent sinusoidal state, average, real and reactive power, maximum power transfer theorem, effective values & RMS, scale change in a circuit, application of spice in solving permanent sinusoidal circuits, tri-phase circuit analysis-conjugated circuits including conjugated selves, circuits equivalent of T, π conjugated selves, inductance matrix, connecting conjugated selves, transformers, circuit models & their applications, application of spice in solving selves administrated circuits and transformers

Suggested Textbooks:

1. Desoer, C. A., and E. S. Kuh. Basic Circuit Theory. 16th printing Singapore, 1987, translated in Farsi by Parviz Jabehdar Maralani. Published by Tehran University Press, *34th Ed, 2021*.
2. Desoer, C. A., and E. S. Kuh. Basic Circuit Theory. 16th printing Singapore, 1987.
3. Chua, Leon O., Charles A. Desoer, and Ernest S. Kuh. *Linear and nonlinear circuits*. McGraw-Hill College, 1987.

Discrete Mathematics (**Discrete Structures**)

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Description:

-Introduction: mathematical logic, algebra of expressions, well-structured formula, a review of theory of sets, proof methods.
-Relations and functions: binary relations, compatibility and equivalence relations, relations representation matrix, graphs of relations, functions, coverage functions, one to one functions.
-Recursive functions, deduction, generator functions.
-Algebraic structures: semi-groups and monoids, grammars and languages, Polish marking, groups, homomorphism, isomorphism, lattices, Boolean Algebra, Carnot table, grammar and language, grammar as an example of monoids
-Combinatorial analysis, nest principles, introduction to combinatorial algorithm, regressive and reciprocal functions and applications.
-Graph theory: directional graphs, unidirectional graphs, Eulerian and Hamiltonian paths, optimal paths, finding algorithm for optimal paths, connected graphs, matrix of relation and related theorems, application of graphs in activity analysis.
-Trees: minimal overlapping trees, surveying of trees, application of trees, algebraic expressions and representation of their trees.

Suggested Textbooks:

1. Rosen, Kenneth H. *Discrete Mathematics and Its Applications*. 8th Edition, McGraw Hill, 2018.
2. Grimaldi, Ralph P. *Discrete and Combinatorial Mathematics: An Applied Introduction*. 5th Edition, Pearson Addison Wesley, 2004.
3. Engel, Arthur. *Problem-Solving Strategies*. Springer, 1998.

Advanced Programming

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Fundamentals of Computer Programming
Description:
Basics of object-oriented design and analysis. Students are given a simple real-world problem and principles of quality design and analysis is taught by examples. The students are given variety of programming assignments to practice the fundamentals taught at the class.

Suggested Textbooks:

1. Eckel, Bruce. *Thinking in Java*. 4th Edition, Prentice Hall, 2006.
2. Fowler, Martin, K. Beck, J. Brant, W. Opdyke, D. Roberts. *Refactoring: Improving the Design of Existing Code*. Addison-Wesley, 1999.
3. Deitel, H. M., and P. J. Deitel. *Java: How to Program*. 11th Edition, Pearson Education, 2017.

Data Structures

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Advanced Programming, Engineering Mathematics

Description:
Introduction to various data structures (stacks, queues, lists, hash tables, trees, heaps, and graphs); sorting and searching; design, analysis, and comparison of algorithms.

Suggested Textbooks:

1. Leiserson, Charles Eric, Ronald L. Rivest, Thomas H. Cormen, and Clifford Stein. *Introduction to Algorithms*. 3rd Edition, MIT Press, 2011.

Digital Circuits (**Logic Design**)

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Data Structures

Description:
Number representation system and coding, representation of negative numbers, key logic, negative test and triple state logic, overall structure of logical gates and its types, logic functions and simplification of them including: Carnot's methods and scheduling and tabulation method, computerized procedures for simplification of combination functions, decoding and coding circuits design, code converters, subtractions, summation, selectors, and comparators, collectors and destructors, logical and computational units, use of decoders, selectors and other packages for drawing combinatorial circuits, PAL, PLA & ROM, and other regular structures, leach and flip-flaps structures, synchronous circuits, comparison between state circuits under Moore & Mealy, numerators, shift registers, asynchronous circuits, study of hazards and race, allotting state without race, common chips in, sequential circuits, and designing or study of one type of machines or control and data section, modern designing methods.

Suggested Textbooks:

1. Mano, M. Morris. *Digital Design*. 5th Edition, Prentice Hall, 2006.
2. Nelson, Victor P., H. Troy Nagle, Bill D. Carroll, and J. David Irwin. *Digital Logic Circuit Analysis and Design*. Prentice Hall, 1995.
3. Prosser, Franklin P., and David E. Winkel. *The Art of Digital Design: An introduction to top-down design*. Prentice Hall, 1987.

Theory of Computation[1]

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Data Structures

Description:
Finite automata, Pushdown automata, touring machine, different types of grammars and languages, Chomsky classification, relation between languages and machines and the relevant theorems.

Suggested Textbooks:

1. Sipser, Michael. *Introduction to the Theory of Computation*. 3rd Edition, Cengage Learning, 2013.
2. Linz, Peter. *An introduction to formal languages and automata*. Jones & Bartlett Learning, 2006.
3. Hopcroft, John E., Rajeev Motwani, and Jeffrey D. Ullman. *Introduction to automata theory, languages, and computation*. 2nd Edition, Addison-Wesley, 2001.
4. Denning, Peter J., Jack B. Dennis, and Joseph E. Qualitz. *Machines, languages, and computation*. Prentice-Hall, 1978.
5. Cameron, Peter J. *Sets, logic and categories*. Springer Science & Business Media, 2012.

[1] Aka, Theory of Automata and Formal Languages

English for Computer Engineers(**English for Computing**)

Credit Hours: 2.0
Lecture Contact Hours: 2 Lab Contact Hours: 0
Prerequisite: General English

Description:
This subject aims at raising students' specific language ability in reading and writing academic texts of their own major disciplines. The subject will use reading texts from chapters of books or journal articles recommended by teachers of different majors for reading comprehension. These texts will also be used for analysis to enable students to develop an awareness of the genre in that particular discipline.

Suggested Textbooks:

1. Fabré, Elena Marco, and Santiago Remacha Esteras. Cambridge University Press, 2007. (Main Textbook)
2. Glendinning, Eric H., John McEwan. *Oxford English for IT*. Oxford University Press, 2006.

Technical Writing and Presentation (Scientific and Technical Presentation)

Credit Hours: 2.0
Lecture Contact Hours: 2 Lab Contact Hours: 0
Prerequisite: English for Computer Engineers(English for Computing)

Description:
Different types of scientific and technical subjects (letters, reports, pamphlets, manual and etc.), common points in all scientific and technical writings: specifying the objective of writing and its eventual readers, organizing the subjects, abstract of essay together with report, the role of a good introduction, dividing the subjects into parts and chapters, discussion and conclusion, preparing source and reference index, attachments, preparing the pictures and diagrams and tables. Important points in translation of scientific and technical subjects, writing style, marking and its importance, preparing final format of writing by typing machine or computer, foot-article, notes and other lateral subjects, an introduction to research methods, presenting subjects orally, effective use of audio-visual devices, the rules and process of drawing up graduation diploma including the main parts of thesis and details of each part, preparing and presenting a scientific essay (as assignment).

Suggested Textbooks:

1. Day, Robert A., and Barbara Gastel. *How to Write and Publish a Scientific Paper*. 8th Edition, Cambridge University Press, 2016.
2. Alley, Michael. *The Craft of Scientific Presentations Critical Steps to Succeed and Critical Errors to Avoid*. 2nd Edition, Springer, 2013.

Engineering Mathematics

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Calculus 2, Differential Equations

Description:

Fourier series and its integral and Fourier transform: definition of Fourier series, Euler's formula, expansion in half range, rebound oscillations, Fourier integral.
Partial derivatives equations: vibratory string, univariate wave equation, method of decomposition of variables, D'Alembert solution of the wave equations, heat propagation equation, univariate wave equation, equation in Cartesian, spherical and polar coordinates, elliptical, parabolic and hyperbolic equations, application of Laplace transformations in solving equations with partial derivatives, solution of partial derivatives using Fourier integrals.
Analytical functions and conformal mapping and complex integrals: limit and continuity, derivative of complex functions, exponential, trigonometric hyperbolic and logarithmic functions, inverse trigonometric and exponential functions with different power, conformal preposition-mapping.
Integral of line on complex plane, Cauchy's integral theorem, calculation of line integral using indefinite integral, Cauchy' formula, Taylor and Mac-Lauren' expansions, integration using residual methods, residuals theorems, calculation of certain real integrals.

Suggested Textbooks:

1. Kreyszig, Erwin. *Advanced engineering mathematics*, 10th edition, 2009.

Computer Architecture

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Digital Circuits(Logic Design)

Description:
Logic design, principles of operation of digital computers, and analysis of major components: arithmetic processing, memory, control and input/output units, instruction pipelining, SIMD and multiprocessor systems.

Suggested Textbooks:

1. Patterson, David A., and John L. Hennessy. *Computer organization and design*. 3rd Edition, Elsevier (Morgan Kaufmann), 2005.
2. Mano, M. Morris. *Computer system architecture*. Prentice-Hall, Inc., 1993.

Algorithm Design

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Data Structures

Description:
Algorithm analysis and design, heuristics; advanced tree structures; advanced hashing techniques; sorting and searching; graphs, sets. NP-Completeness, Time and Space complexities.

Suggested Textbooks:

1. Kleinberg, Jon, and Eva Tardos. *Algorithm Design*. Addison Wesley, 2005.
2. Cormen, Thomas H., Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. *Introduction to Algorithms*. 3rd Edition, MIT Press, 2009.
3. Manber, Udi. *Introduction to algorithms: a creative approach*. Addison-Wesley Longman Publishing Co., Inc., 1989.
4. Brassard, Gilles, and Paul Bratley. *Algorithmics: theory & practice*. Prentice-Hall, Inc., 1988.

Computer Aided Design[2]

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Computer Architecture

Description:
Applications of hardware description languages (HDLs) for the design of complex digital systems. Topics include designing and simulating using HDLs, logic synthesis into FPGAs and ASICs, optimization techniques, timing issues, hardware verification, and design for testability.

Suggested Textbooks:

1. Bobda, Christophe, and Reiner Hartenstein. *Introduction to reconfigurable computing: architectures, algorithms, and applications*. Vol. 1. No. 1.5. Netherlands: Springer, 2007.
2. Palnitkar, Samir. *Verilog HDL: A Guide to Digital Design and Synthesis*. 2nd Edition, SunSoft Press, 2003.
3. Brown, Stephen, and Jonathan Rose. *FPGA and CPLD Architectures: A Tutorial*. IEEE Design and Test of Computers, pp. 42-57, 1996.
4. *Altera Data Sheets*. available at www.altera.com.
5. *Xilinx Data Sheets*. available at www.xilinx.com.
6. *Actel Data Sheets*. available at www.actel.com.

[2] Also known as: Design of Digital Systems

Microprocessors and Assembly Language

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Computer Architecture

Description:

Reviewing history, types and developing trend of microprocessors, organization of a microprocessor and method of executing instructions, introduction to the architecture of 8085 bit processor and Z80 and their differences, introduction to programming methods, addressing modes, calculating timing of processing and designing system relying on microprocessors such as clock pulse producing circuit, types of EPROM and RAM memories, decoders circuits, output and input, surveying 8086 microprocessor and properties of 16 bites microprocessors, system supporting chips including timer 8254 and 8255 parallel bus, 8251 USART bus, interrupt control.

Suggested Textbooks:

1. Triebel, Walter A., and Avtar Singh. *The 8088 and 8086 Microprocessors*. Prentice-Hall, 2003.
2. Mazidi, Muhammad Ali, and Janice Gillispie Mazidi. 80x86 IBM PC and Compatible Computers, The, 2000.
3. Mazidi, Muhammad Ali, et al. *The AVR Microcontroller and Embedded Systems: Using Assembly and C*. Prentice Hall, 2011.
4. Kirk, David B., and W. Hwu Wen-Mei. *Programming massively parallel processors: a hands-on approach*. Morgan kaufmann, 2016.

Computer Networks

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Operating Systems

Description:
Data communications; network protocols and architecture; local and wide-area networks; internetworking.

Suggested Textbooks:

1. Peterson, Larry L., and Bruce S. Davie. *Computer Networks: A Systems Approach*. 5th Edition, 2011.

Artificial Intelligence and Expert Systems

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Data Structures

Description:
Topics include search techniques, reasoning with logic, planning, decision making, machine learning.

Suggested Textbooks:

1. Russell, Stuart, and Peter Norvig. *Artificial Intelligence: A Modern Approach*. 3rd Edition, 2009.

Principles of Compiler Design

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Data Structures

Description:

Preliminaries (various types of translators including compilers and interpreters), structure and components of compilers (tokenizers, syntactic analyzer, semantic analyzer, symbols table management, middle and final code generation, optimization, errors management).

Parsers: LR and LL(1), SLR(1), LALR(1) and similar parsing algorithms. Syntax errors.

Symbol table management and their structure. Memory allocation techniques (static and dynamic). Code generation. Translation of several structures of imperative languages such as statements, control structures, routines call.

A brief discussion of code optimization.

Suggested Textbooks:

1. Aho, Alfred V., Monica S. Lam, Ravi Sethi, and Jeffrey D. Ullman. *Compilers: Principles, Techniques, and Tools*. 2nd Edition, Addison Wesley, 2007.
2. Grune, Dick, Kees Van Reeuwijk, Henri E. Bal, Ceriel JH Jacobs, and Koen Langendoen. *Modern Compiler Design*. Springer Science & Business Media, 2012.
3. Tremblay, Jean-Paul, and Paul G. Sorenson. *Theory and Practice of Compiler Writing*. McGraw-Hill, Inc., 1985.
4. Fischer, Charles N., and Richard J. LeBlanc Jr. *Crafting a Compiler with C*. Benjamin-Cummings Publishing Co., Inc., 1991.

Operating Systems

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Data Structures, Computer Architecture

Description:
Operating system; sequential processes, concurrent processes, deadlock, mutual exclusion, semaphores; memory management, processor management, peripheral device management.

Suggested Textbooks:

1. Silberschatz, Abraham, Peter B. Galvin, and Greg Gagne. *Operating System Concepts*. 10th Edition, Wiley Publishing, 2018.
2. Anderson, Thomas, and Mike Dahlin. *Operating Systems: Principles and Practice, volume 1: Kernel and Processes*. Recursive books, 2014.

Operating Systems Lab

Credit Hours: 1.0
Lecture Contact Hours: 0 Lab Contact Hours: 1
Prerequisite: Operating Systems

Description: Hands-on exercises based on topics covered in the Operating Systems course

Suggested Textbooks:

1. Salzman, Peter Jay, Michael Burian, and Ori Pomerantz. *The linux kernel module programming guide*. 2007.
2. Wall, Kurt, Mark Whitis, and Mark Watson. *Linux Programming Unleashed, Macmillan Computer Publishing*. 1999.
3. Mitchell, Mark, Jeffrey Oldham, and Alex Samuel. *Advanced linux programming*. New Riders Publishing, 2001.
4. Rodriguez, Claudia Salzberg, and Gordon Fischer. *The Linux® Kernel Primer: A Top-Down Approach for x86 and PowerPC Architectures*. Prentice-Hall, 2005.
5. Corbet, Jonathan, Alessandro Rubini, and Greg Kroah-Hartman. *Linux device drivers*. O'Reilly Media, Inc, 2005.

Digital Circuits and Computer Architecture Lab

Credit Hours: 1.0
Lecture Contact Hours: 3 Lab Contact Hours: 1
Prerequisite: Digital Circuits(Logic Design), Computer Architecture

Description:
Hands-on exercises based on topics covered in the courses.

Suggested Textbooks:

1. Patterson, David A., and John L. Hennessy. *Computer organization and design ARM edition: the hardware software interface*. Morgan kaufmann, 2016.
2. Mano, M. Morris. *Computer system architecture*. Prentice-Hall, Inc., 1993.

Microprocessors Lab

Credit Hours: 1.0
Lecture Contact Hours: 0 Lab Contact Hours: 1
Prerequisite: Microprocessors and Assembly Language

Description:

Hands-on exercises based on topics covered in the Microprocessors course

Suggested Textbooks:

Computer Networks Lab

Credit Hours: 1.0
Lecture Contact Hours: 0 Lab Contact Hours: 1
Prerequisite: Computer Networks

Description:
Hands-on exercises based on topics covered in the course.

Suggested Textbooks:

1. Kurose, James, and Keith Ross. *Computer Networking: A Top-Down Approach*. 7th Edition, Pearson, 2016.
2. Peterson, Larry L., and Bruce S. Davie. *Computer Networks: A Systems Approach*. 5th Edition, 2011.
3. Tanenbaum, Andrew S. *Computer Networks*. 5th Edition, Pearson, 2010.

Electronic Circuits

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Electrical Circuits

Description:

Characteristics of ideal diode, π type and P type semiconductor, linkage between Pπ, electrical characteristics of actual diode, diode rectifier circuits, diode jumping and chopper circuits, Zener' diode specifications, Zener voltage modulator.

BJT bipolar transistor, structure and electrical behavior, biasing of BJT (dc analysis), small signal model, BJT amplifier, CB, CE, CC amplifier (small signal analysis), multi layers amplifiers and magnitude.
Field effect transistor, structure and electrical behavior, introducing CMOS, biasing FET, FET amplifiers.

Suggested Textbooks:

Digital Electronics

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Electronic Circuits

Suggested Textbooks:

Data Transmission

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Engineering Probability and Statistics, Signals and Systems

Description:

Suggested Textbooks:

1. Stallings, William. *Data and computer communications*. Pearson Education India, 2007.
2. Halsall, Fred. *Data Communications, Computer Networks, and Open Systems*. 4th Edition, Addison Wesley, 1996.
3. Tanenbaum, Andrew S. *Computer networks*. Pearson Education India, 2002.

Linear Control Systems

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Signals and Systems

Suggested Textbooks:

Electronic Circuits Lab

Credit Hours: 1.0
Lecture Contact Hours: 0 Lab Contact Hours: 1
Prerequisites: Electronic Circuits

Suggested Textbooks:

Digital Electronics Lab:

Credit Hours: 1.0
Lecture Contact Hours: 0 Lab Contact Hours: 1
Prerequisites: Digital Electronics

Suggested Textbooks:

Computer Aided Design Lab

Credit Hours: 1.0
Lecture Contact Hours: 0 Lab Contact Hours: 1
Prerequisites: Computer Aided Design

Description:

Hands-on exercises based on topics covered in the course.

Suggested Textbooks:

1. Palnitkar, Samir. *Verilog HDL: a guide to digital design and synthesis*. Vol. 1. Prentice Hall Professional, 2003.
2. ACEX 1K Programmable Logic Family Data Sheet. Available at www.altera.com.
3. ModelSim User's Manual. Available at www.actel.com.
4. Introduction to the Quartus II Software. Available at www.altera.com.

Signals and Systems

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Engineering Mathematics

Description:

Signals and system representation. Convolution and impulse response. Fourier series, Fourier transform, and Laplace transform. State variable analysis of continuous and discrete systems.

Suggested Textbooks:

1. Oppenheim, Alan V., et al. *Signals & systems*. Pearson Educación, 1997.

Undergraduate Project

Credit Hours: 3.0
Lecture Contact Hours: 0 Lab Contact Hours: 3

Description:
Developing a software system using all or part of the knowledge and materials that were gained through bachelor program based on personal interests.

Systems Analysis and Design

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Advanced Programming

Description:

Software development processes, requirement elicitation and tracing techniques, functional and non-functional requirements, modeling languages.

Suggested Textbooks:

1. Bentley, Lonnie D., Kevin C. Dittman, and Jeffrey L. Whitten. *Systems analysis and design methods*. Irwin/McGraw Hill, 2007.
2. Rubin, Kenneth S. *Essential Scrum: A practical guide to the most popular Agile process*. Addison-Wesley, 2012.
3. M. Fowler, C. Kobryn, and K. Scott. *UML distilled: A brief guide to the standard object modeling language*. Addison-Wesley Professional, 2004.
4. Fowler, Martin. *UML distilled: a brief guide to the standard object modeling language*. Addison-Wesley Professional, 2004.
5. Bass, Len, Ingo Weber, and Liming Zhu. *DevOps: A software architect's perspective*. Addison-Wesley Professional, 2015.
6. Fowler, Martin. *Patterns of Enterprise Application Architecture: Pattern Enterpr Applica Arch*. Addison-Wesley, 2012.

Database Systems (**Database Design**)

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Data Structures

Description:

Concepts and definitions of database management (definition of data and information, database definition and necessity, data independence, various models of database systems). Architecture of a database system (three-level architecture, external level, internal level, conceptual level, database and data administrator, data relationship administrator). Different models of database systems (Hierarchical model, Relational model, network model). Relational model of database (relations, tables, base tables and non-base tables, query language). Relational model elements (domain, relation and its types). Integrity of relational model (candidate key, primary key, foreign key and its rules, Null foreign key and primary key). Relational algebra. SQL language. Functional dependencies (partial dependencies definitions, a collection of dependencies, irreducible collection of dependencies). BCNF, 3NF, 2NF, 1NF normalization, multivalued dependency (MVD), 4NF, join dependency (JD), SNF.

Suggested Textbooks:

1. Elmasri, R., Shamkant B. Navathe. *Fundamentals of Database Systems*. 7th Edition, Pearson, 2015.
2. Silberschatz, Abraham, Henry F. Korth, and Shashank Sudarshan. *Database System Concepts*. 6th Edition, McGraw-Hill, 2010.
3. C. J. Date. *An Introduction to Database Systems* 8th Edition, Pearson, 2003.
4. Connolly, Thomas M., and Carolyn E. Begg. *Database Systems*. 6th Edition, Pearson, 2014.
5. Ramakrishnan, Raghu, Johannes Gehrke, and Johannes Gehrke. *Database Management Systems*. 4th Edition, McGraw-Hill, 2014.

Design of Programming Languages

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Principles of Compiler Design

Description:
General characteristics of programming language, processors of programming language and their comparison. Specifications of data types and their implementation in high-level programs, methods of determining sequence of instruction execution and their implementation, data control, arguments of a function and its implementation, memory management methods in higher level languages, data abstraction.

Suggested Textbooks:

1. Friedman, Daniel P., Mitchell Wand, and Christopher Thomas Haynes. *Essentials of Programming Languages*. 3rd Edition, MIT Press, 2008.
2. Krishnamurthi, Shriram. *Programming Languages: Application and Interpretation*. 2nd Edition, 2017.
3. Felleisen, Matthias, et al. "A programmable programming language." *Communications of the ACM* 61.3 , 2018.

Software Engineering

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Analysis of Design of Software Systems(Systems Analysis and Design)

Description:
Introduction to the concepts of software engineering. Identification of problems related to the development of large software systems. Software project planning, requirements analysis, design, implementation, quality assurance and maintenance.

Suggested Textbooks:

1. pressman, Roger S. *Software Engineering: A Practitioner's Approach.* 8th Edition, McGraw-Hill, 2014.
2. Ammann, Paul, and Jeff Offutt. *Introduction to software testing*. Cambridge University Press, 2016.
3. Woodcock, Jim, and Jim Davies. *Using Z: Specification, Refinement, and Proof*. Prentice-Hall, 1996.

Internet Engineering

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Computer Networks

Suggested Textbooks:

Network Security

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Computer Networks

Suggested Textbooks:

1. Matt Bishop. *Computer Security*. Addison-Wesley, 2017.
2. John Erickson. *The Art of Exploitation* 2nd Edition, No Starch Press, 2008.
3. Robert C. Seacord. *Secure Coding in C and C++*. 2nd Edition, Pearson Education, 2005.
4. A. Sotirov. *Bypassing Browser Memory Protections*. 2008.
5. T. Garfinkel. *Traps and Pitfalls: Practical Problems in System Call Interposition Based Security Tools*. NDSS, 2003.
6. Adam Barth, Collin Jackson, and John C. Mitchell. *Securing Browser Frame Communication*. Usenix, 2008.
7. Adam Barth, Collin Jackson, Charles Reis, and the Google Chrome Team. *The Security Architecture of the Chromium Browser*. 2008.
8. Bortz et al. *Origin Cookies: Session Integrity for Web Applications*. 2011.
9. Enck, Ongtang, and McDaniel. *Understanding Android Security*. 2009.
10. Allan Tomlinson. *Introduction to the TPM: Smart Cards, Tokens, Security and Applications*. 2008.
11. Andrew Baumann, Marcus Peinado, and Galen Hunt. *Shielding Applications from an Untrusted Cloud with Haven*. OSDI 2014.

Principles of Secure Computing

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Operating Systems

Suggested Textbooks:

System Security

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Database Systems, Operating Systems

Suggested Textbooks:

Management of Data Security

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Principles of Secure Computing

Suggested Textbooks:

Principles of Cryptography

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Principles of Secure Computing

Suggested Textbooks:

Secure Programming

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Pre-requisites: Analysis and Design of Software Systems

Suggested Textbooks:

Laws in Security

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Pre-requisites: Network Security, System Security

Suggested Textbooks:

Software Hardware Co-Design

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Pre-requisites: Computer Architecture

Suggested Textbooks:

Principles of Real-time and Embedded Systems

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Pre-requisites: Operating Systems, Microprocessors and Assembly Language

Description
Introduction to real-time and embedded systems; scheduling; programming language and operating systems; support; formal specification, analysis, and verification; embedded programming; power-aware computing.

Suggested Textbooks:

VLSI

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Pre-requisites: Digital Electronics

Suggested Textbooks:

1. Wayne Wolf. *Modern VLSI Design, System-on-Chip Design*. 3rd Edition, Course Handouts, 2004.
2. J. M. Rabaey, A. Chandrakasan, and B. Nikolić. *Digital Integrated Circuits, A Design Perspective*. Course Handouts, 2005.
3. N. H. E. Weste and D. Harris. *CMOS VLSI Design, A Circuits and Systems Perspective*. Course Handouts, 3rd Edition, Addison-Wesley, 2005.

Architecture of Kernel Accelerators

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Pre-requisites: Advanced Programming, Computer Architecture

Suggested Textbooks:

Principles of Computational Intelligence

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Advanced Programming

Introducing intelligent systems: artificial neural networks, deep learning, evolutionary computation, fuzzy systems, swarm intelligence, and hybrid techniques.

Suggested Textbooks:

1. A. P. Engelbrecht, Computational Intelligence: An Introduction, John Wiley & Sons, 2007.
2. A. E. Eiben and J. E. Smith, Introduction to Evolutionary Computing, Springer Verlag, 2003.
3. M. Dorigo and T. Stutzle, Ant Colony Optimization, MIT Press, 2004.
4. J. Kennedy, R. C. Eberhart, and Y. Shi, Swarm Intelligence, Morgan Kaufmann Publishers, 2001.
5. L. N. de Castro, “Fundamentals of Natural Computing: An Overview”, Physics of Life Reviews, Vol. 4, No. 1, pp. 1-36, 2007.
6. L. N. de Castro, Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications, Chapman & Hall/CRC Computer and Information Sciences, 2006.

Principles of Computer Vision

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Pre-requisites: Principles of Computational Intelligence

Description:

A broad introduction to the foundations, algorithms, and applications of computer vision. Topics include filtering, feature detection, stereo vision, structure from motion, motion estimation, and recognition.

Suggested Textbooks:

Principles of Natural Language Processing

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisites: Signals and Systems, (Engineering) Probability and Statistics

Description:

N-gram language models, part-of-speech tagging, statistical parsing, word sense disambiguation, discourse segmentation, information extraction, sentiment analysis, machine translation.

Suggested Textbooks:

1. Dan Jurafsky and James H. Martin. Speech and Language Processing
2. Manning and Schuetze, Foundations of Statistical Natural Language Processing
3. Yoav Goldberg. A Primer on Neural Network Models for Natural Language Processing
4. Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning

Principles of Robotics

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Pre-requisites: Signals and Systems

Description:

Foundations of reasoning for robotics. Topics include state estimation, robot motion, perception, localization and decision-making.

Suggested Textbooks:

1. Computational Principles of Mobile Robotics. Gregory Dudek and Michael Jenkin. 2nd ed. Cambridge University Press, 2010
2. Introduction to Autonomous Mobile Robots R. Siegwart, and I. Nourbakhsh, MIT Press, 2004
3. Autonomous Robots: From Biological Inspiration to Implementation and Control G.A. Bekey, MIT Press, 2005

Human Computer Interaction

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite: Analysis of Design of Software Systems

Description:

Theories of human-computer interaction and analyzes human factors related to the design, development, and use of Information Systems.

Suggested Textbooks:

Software Testing

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Pre-requisites: Analysis of Design of Software Systems

Description:

Software testing concepts including unit tests, test oracles, automated testing, test coverage, integration testing.

Suggested Textbooks:

1. P. Ammann and J. Offutt. *Introduction to Software Testing*. Cambridge University Press, 2017.

Formal Methods in Software Engineering

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Pre-requisites: Analysis of Design of Software Systems

Description:

Concepts in formal specification and verification of systems: linear time logic, Hoare logic, concrete and symbolic model checking.

Suggested Textbooks:

Object-Oriented Design

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Pre-requisites: Advanced Programming

Suggested Textbooks:

1. J. Arlow and I. Neustadt. *UML 2 and the Unified Process*. 2nd Edition, Addison-Wesley, 2005.
2. H. Gomaa. *Software Modeling and Design: UML, Use Cases, Patterns, and Software Architectures*. Cambridge University Press, 2011.
3. G. Booch, R. A. Maksimchuk, M. W. Engel, B. J. Young, J. Conallen, and K. A. Houston. *Object-Oriented Analysis and Design with Applications*. 3rd Edition, Addison-Wesley, 2007.
4. E. Gamma, R. Helm, R. Johnson, and J. Vlissides. *Design Patterns: Elements of Reusable Object-Oriented Software*. Addison-Wesley, 1995.
5. C. Larman. *Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development*. 3rd Edition, Prentice-Hall, 2004.

Database lab

Credit Hours: 1.0
Lecture Contact Hours: 0 Lab Contact Hours: 1
Prerequisite:

Description:
It will be presented according to the syllabus of Principles of Database design course.

Suggested Textbooks:

Mobile Programming

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

GPU Programming

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

User interface design lab

Credit Hours: 1.0
Lecture Contact Hours: 0 Lab Contact Hours: 1
Prerequisite:

Suggested Textbooks:

Green Computing

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Randomized Algorithms

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Configurable Architectures

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Evolutionary Computing

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Description:

Suggested Textbooks:

Statistical Pattern Detection

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Description:

Suggested Textbooks:

Fuzzy Systems

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Description:

Suggested Textbooks:

Advanced Database Systems

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Description:

Suggested Textbooks:

Optimization Algorithms

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Web Programming

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Parallel Algorithms

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Data Mining

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Modeling of Biological Systems

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Intro to Computational Biology and Bioinformatics

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Text Mining

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Information Networks

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Advanced Engineering Mathematics

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Business Intelligence

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

E-Commerce Security

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Knowledge Management Systems

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Scientific computations and data analysis

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Suggested Textbooks:

Computer Graphics

Credit Hours: 3.0
Lecture Contact Hours: 3 Lab Contact Hours: 0
Prerequisite:

Description:
Introduction to graphical systems: raster scan, random scan, color and DVTS systems. Graphical standards: GKS, Phigs, Phigs+. Base outputs: vector, circle, oval, curve types, characters and texts. Different algorithms about base outputs: filling surfaces, scan line boundary, Nicholl-Lee-Nicholl, Cohen & Sutherland, Liang & Barsky. Optical pen, mouse, Bezier, Octree, CSG, fractal, transform, rotation, reflection, 3D view, surfaces deletion algorithms with Z-buffer method, surface shading, Guraud and Phong algorithms, introduction to Ray Tracing.

Suggested Textbooks: