King Fahd University of Petroleum & Minerals
College of Computer Sciences & Engineering
Information & Computer Science Department

CS Program

Student Guide

REVISED

June 2009

Introduction

The Department of Information and Computer Science offers a BS in computer Science either with summer training or with coop. The current program was revised and approved in 2006. The program is in full compliance with IEEE/ACM Computing Curricula guidelines and meets the Computing Accreditation Criteria (CAC).

ICS Department Mission

The mission of the ICS department is to:

a) provide high quality undergraduate and graduate educational programs in Computer Science and Software Engineering,

b) contribute significantly to the research and the discovery of new knowledge and methods in computing,

c) offer expertise, resources, and services to the community, and

d) keep its faculty members current by providing opportunities for professional development.

ICS Department Vision

The vision of the ICS department is to be a regional leader that is recognized worldwide in education, research and professional development in the areas of Computer Science and Software Engineering.

Computer Science Program Mission

The mission of the CS program is to provide high quality education in computer science that prepares students for professional careers and lifelong learning in developing/managing computational processes and systems, with emphasis on net-centric computing, information management, and intelligent systems.

Computer Science Program Objectives

1. Prepare graduates, who are entering immediately into professions upon graduation, to be capable of performing duties on an entry-level computing-related position.
2. Prepare graduates to pursue graduate studies to successfully complete an advanced degree.
3. Prepare graduates to work as individuals with minimum guidance and as leaders or members of a team.
4. Prepare graduates to follow appropriate practices within a professional, legal, and ethical framework.
5. Prepare graduates to recognize the need for and be capable of pursuing life-long learning.

Computer Science Program Learning Outcomes

The CS program enables students to acquire, by the time of graduation, the following learning outcomes:

a) An ability to apply knowledge of computing and mathematics appropriate to the discipline;

b) An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution;

c) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs;

d) An ability to function effectively on teams to accomplish a common goal;

e) An understanding of professional, ethical, legal, security and social issues and responsibilities;

f) An ability to communicate effectively with a range of audiences;

g) An ability to analyze the local and global impact of computing on individuals, organizations, and society;

h) An ability to recognize the need for and to engage in continuing professional development;

i) An ability to use current techniques, skills, and tools necessary for computing practice;

j) An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices; and

k) An ability to apply design and development principles in the construction of software systems of varying complexity.

Program

The department is offering the computer science program with two options:

Option I: B.S. in Computer Science with Summer Training

Option II: B.S. in Computer Science with Coop.

Option I: B. S. in Computer Science with Summer Training

The Program requirements are

(a) General Education Requirements (56 credits)

Basic Science	(12)	CHEM 101(4), PHYS 101(4), PHYS 102(4)
Mathematics and Statistics	(17)	MATH 101(4), MATH 102(4), MATH 201(3), MATH 260(3), STAT 319(3)
English	(9)	ENGL 101(3), ENGL 102(3), ENGL 214(3)
Physical Education	(2)	PE 101(1), PE 102(1)
Isl. & Arab. Studies	(12)	IAS 101(2), IAS 111(2), IAS 201(2), IAS 212(2), IAS 301(2), IAS 322(2)
COE	(4)	COE 202(3), COE 203(1)

(b) Core Requirements (51 credits)

ICS required	(51)	ICS 102(3), ICS 201(4), ICS 202(4), ICS 233(4), ICS 253(3), ICS 254(3), ICS 309 (2), ICS 324(4), ICS 343(4), ICS 353(3), ICS 381(3), ICS 410(3), ICS 411(3), ICS 431(4), SWE 311 (4)

(c) Electives (24 credits)

ICS Electives	(12)	4 ICS/SWE XXX (3),
Free Electives	(12)	12 credit-hours of approved free electives

(d) Summer Training (Pass/Fail grade; No credits)

Every student is required to participate in a summer training program of genuine practical experience and submit a formal written report.

(e) Total Requirements

The total required credits for the BS degree in Computer Science are 131 semester-credit-hours.

Information and Computer Science Curriculum

COMPUTER SCIENCE PROGRAM WITH SUMMER TRAINING

Course		Title	LT	LB	CR	Course		Title	LT	LB	CR
First Year (Preparatory)											
ENGL	001	Preparatory English I	15	5	8	ENGL	002	Preparatory English II	15	5	8
MATH	001	Preparatory Math I	3	1	4	MATH	002	Preparatory Math II	3	1	4
ME	003	Preparatory Engg. Tech.	0	2	1	PYP	001	Prep Physical Science	2	0	2
PYP	002	Prep Computer Science	0	2	1	PYP	003	University Study Skill	0	2	1
PE	001	Prep Physical Educ I	0	2	1	PE	002	Prep Physical Educ II	0	2	1
			18	**12**	**15**				**20**	**10**	**16**
Total credits required in Preparatory Program: 31											
Second Year (Freshman)											
MATH	101	Calculus I	4	0	4	MATH	102	Calculus II	4	0	4
PHYS	101	General Physics	3	3	4	PHYS	102	General Physics II	3	3	4
ENGL	101	An Introduction to Academic Discourse	3	0	3	ENGL	102	Introduction to Report Writing	3	0	3
CHEM	101	General Chemistry I	3	4	4	ICS	102	Intro. To Computing I	2	3	3
IAS	101	Practical Grammar	2	0	2	IAS	111	Belief & its Effects	2	0	2
						PE	101	Physical Education I	0	2	1
			15	**7**	**17**				**14**	**8**	**17**
Third Year (Sophomore)											
ICS	201	Intro. To Computing II	3	3	4	ICS	202	Data Structures	3	3	4
ICS	253	Discrete Structures I	3	0	3	ICS	233	Com. Arch. & As. Lang	3	3	4
COE	202	Digital Logic Design	3	0	3	ICS	254	Discrete Structures II	3	0	3
MATH	201	Calculus III	3	0	3	MATH	260	Lin. Alg. & Diff. Equat.	3	0	3
PE	102	Physical Education II	0	2	1	COE	203	Digital Logic Lab	0	3	1
IAS	212	Professional Ethics	2	0	2	ENGL	214	Academic & Professional Communication	3	0	3
			14	**5**	**16**				**15**	**9**	**18**
Fourth Year (Junior)											
ICS	309	Computing and Society	2	0	2	ICS	343	Fund. of Comp. Networks	3	3	4
ICS	324	Database Systems	3	3	4	ICS	381	Principles of Artificial Intell.	3	0	3
ICS	353	Des. & Analysis of Algorithms	3	0	3	ICS	xxx	(ICS Elective I)	3	0	3
SWE	311	Principles of Software Eng.	3	3	4	IAS	322	Human Rights in Islam	2	0	2
IAS	201	Objective Writing	2	0	2	XE	xxx	(Free Elective I)	3	0	3
STAT	319	Prob.& Statistics for Eng.	2	3	3						
			15	**9**	**18**				**14**	**3**	**15**
Summer Session											
ICS	399	Summer Training	0	0	0						
Fifth Year (Senior)											
ICS	410	Programming Languages	3	0	3	ICS	411	Senior Project	1	6	3
ICS	431	Operating Systems	3	3	4	ICS	xxx	(ICS Elective III)	3	0	3
ICS	xxx	(ICS Elective II)	3	0	3	ICS	xxx	(ICS Elective IV)	3	0	3
XE	xxx	(Free Elective II)	3	0	3	IAS	301	Language Comm. Skills	2	0	2
XE	xxx	(Free Elective III)	3	0	3	XE	xxx	(Free Elective IV)	3	0	3
			15	**3**	**16**				**12**	**6**	**14**

Total credits required in Degree Program: 131

Option II: B. S. in Computer Science with Coop

The Program requirements are:

(a) General Education Requirements (56 credits)

Basic Science	(12)	CHEM 101(4), PHYS 101(4), PHYS 102(4)
Mathematics and Statistics	(17)	MATH 101(4), MATH 102(4), MATH 201(3), MATH 260(3), STAT 319(3)
English	(9)	ENGL 101(3), ENGL 102(3), ENGL 214(3)
Physical Education	(2)	PE 101(1), PE 102(1)
Isl. & Arab. Studies	(12)	IAS 101(2), IAS 111(2), IAS 201(2), IAS 212(2), IAS 301(2), IAS 322(2)
COE	(4)	COE 202(3), COE 203(1)

(b) Core Requirements (48 credits)

ICS required	(48)	ICS 102(3), ICS 201(4), ICS 202(4), ICS 233(4), ICS 253(3), ICS 254(3), ICS 309 (2),ICS 324(4), ICS 343(4), ICS 353(3), ICS 381(3),ICS 410(3), ICS 431(4), SWE 311 (4)

(c) Electives (18 credits)

ICS Electives	(12)	4 ICS/SWE XXX(3)
Free Electives	(6)	6 credit-hours of approved free electives

(d) ICS 351 Cooperative Work (9 credits)

(e) Total Requirements

The total required credits for the BS degree in Computer Science with coop are 131 semester-credit-hours

COMPUTER SCIENCE PROGRAM WITH COOP

Course		Title	LT	LB	CR	Course		Title	LT	LB	CR
First Year (Preparatory)											
ENGL	001	Preparatory English I	15	5	8	ENGL	002	Preparatory English II	15	5	8
MATH	001	Preparatory Math I	3	1	4	MATH	002	Preparatory Math II	3	1	4
ME	003	Preparatory Engg. Tech.	0	2	1	PYP	001	Prep Physical Science	2	0	2
PYP	002	Prep Computer Science	0	2	1	PYP	003	University Study Skill	0	2	1
PE	001	Prep Physical Educ I	0	2	1	PE	002	Prep Physical Educ II	0	2	1
			18	**12**	**15**				**20**	**10**	**16**
Total credits required in Preparatory Program: 31											
Second Year (Freshman)											
MATH	101	Calculus I	4	0	4	MATH	102	Calculus II	4	0	4
PHYS	101	General Physics	3	3	4	PHYS	102	General Physics II	3	3	4
ENGL	101	An Introduction to Academic Discourse	3	0	3	ENGL	102	Introduction to Report Writing	3	0	3
CHEM	101	General Chemistry I	3	4	4	ICS	102	Intro. To Computing I	2	3	3
IAS	101	Practical Grammar	2	0	2	IAS	111	Belief & its Effects	2	0	2
						PE	101	Physical Education I	0	2	1
			15	**7**	**17**				**14**	**8**	**17**
Third Year (Sophomore)											
ICS	201	Intro. To Computing II	3	3	4	ICS	202	Data Structures	3	3	4
ICS	253	Discrete Structures I	3	0	3	ICS	233	Com. Arch. & As. Lang	3	3	4
COE	202	Digital Logic Design	3	0	3	ICS	254	Discrete Structures II	3	0	3
MATH	201	Calculus III	3	0	3	MATH	260	Lin. Alg. & Diff. Equat.	3	0	3
PE	102	Physical Education II	0	2	1	COE	203	Digital Logic Lab	0	3	1
IAS	212	Professional Ethics	2	0	2	ENGL	214	Academic & Professional Communication	3	0	3
			14	**5**	**16**				**15**	**9**	**18**
Fourth Year (Junior)											
ICS	309	Computing and Society	2	0	2	ICS	343	Fund. of Comp. Networks.	3	3	4
ICS	324	Database Systems	3	3	4	ICS	381	Principles of Artificial Intell.	3	0	3
ICS	353	Des. & Analysis of Algorithms	3	0	3	ICS	431	Operating Systems	3	3	4
SWE	311	Principles of Software Eng.	3	3	4	ICS	xxx	(ICS Elective I)	3	0	3
IAS	201	Objective Writing	2	0	2	ICS	xxx	(ICS Elective II)	3	0	3
STAT	319	Prob.& Statistics for Engrs	2	3	3	IAS	322	Human Rights in Islam	2	0	2
			15	**9**	**18**				**17**	**6**	**19**
Summer Session											
ICS	350	Cooperative work	0	0	0						
Fifth Year (Senior)											
ICS	351	Cooperative work (Cont.)	0	0	9	ICS	410	Programming Languages	3	0	3
						ICS	xxx	(ICS Elective III)	3	0	3
						ICS	xxx	(ICS Elective IV)	3	0	3
						IAS	301	Language Comm. Skills	2	0	2
						XE	xxx	(Free Elective I)	3	0	3
						XE	xxx	(Free Elective II)	3	0	3
			0	**0**	**9**				**17**	**0**	**17**

Total credits required in Degree Program: 131

ICS Courses Summary

A. ICS Core

1.	ICS 102	Introduction to Computing I	2	3	3
2.	ICS 201	Introduction to Computing II	3	3	4
3.	ICS 202	Data Structures	3	3	4
4.	ICS 233	Computer Architecture and Assembly Language	3	3	4
5.	ICS 253	Discrete Structures I	3	0	3
6.	ICS 254	Discrete Structures II	3	0	3
7.	ICS 309	Computing and Society	2	0	2
8.	ICS 324	Database Systems	3	3	4
9.	ICS 343	Fundamentals of Computer Networks	3	3	4
10.	ICS 350	Cooperative Work (only for Coop Option)	0	0	0
11.	ICS 351	Cooperative Work (only for Coop Option)	0	0	9
12.	ICS 352	Cooperative Work (only for Coop Option)	0	0	9
13.	ICS 353	Design and Analysis of Algorithms	3	0	3
14.	ICS 381	Principles of Artificial Intelligence	3	0	3
15.	ICS 399	Summer Training (only for Non-Coop Option)	0	0	0
16.	ICS 410	Programming Languages	3	0	3
17.	ICS 411	Senior Project (only for Non-Coop Option)	1	6	3
18.	ICS 431	Operating Systems	3	3	4
19.	SWE 311	Principles of Software Engineering	3	3	4

B. ICS Electives

1.	ICS 355	Theory of Computing	3	0	3
2.	ICS 412	Compiler Construction Techniques	3	0	3
3.	ICS 415	Computer Graphics	3	0	3
4.	ICS 424	Advanced Database Systems	3	0	3
5.	ICS 426	Data Warehousing and Data Mining	3	0	3
6.	ICS 436	Systems and Network Administration	2	3	3
7.	ICS 437	Distributed Systems	3	0	3
8.	ICS 446	Cluster Computing	3	0	3
9.	ICS 447	Computer Network Technologies	3	0	3
10.	ICS 443	Network Design and Management	3	0	3
11.	ICS 444	Computer and Network Security	3	0	3
12.	ICS 454	Principles of Cryptography	3	0	3
13.	ICS 481	Artificial Neural Networks	3	0	3
14.	ICS 482	Natural Language Processing	3	0	3
15.	ICS 483	Computer Vision	3	0	3
16.	ICS 484	Arabic Computing	3	0	3
17.	ICS 485	Machine Learning	3	0	3
18.	ICS 486	Multi-agent Systems	3	0	3
19.	ICS 488	Soft Computing	3	0	3
20.	ICS 490	Special Topic I	3	0	3
21.	ICS 491	Special Topic II	3	0	3
22.	SWE 344	Internet Protocols and Client Server Computing	3	0	3
23.	SWE 363	Web Engineering & Development	3	0	3
24.	SWE 423	Multimedia Systems	3	0	3

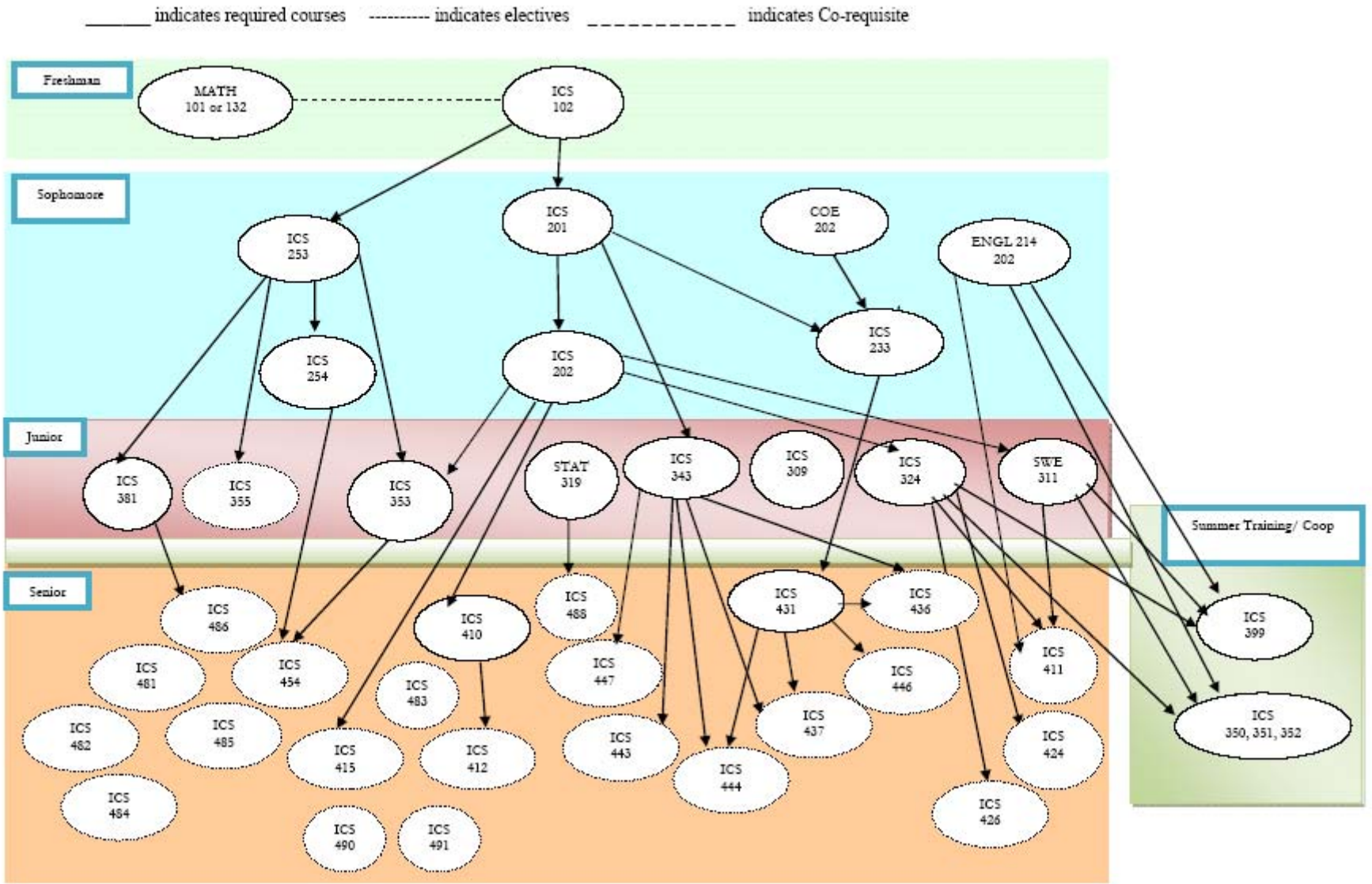
Following is a list of recommended free electives for CS programs. If the student wants to take a course outside this list, he has to get a written approval from the ICS department prior to registering the course.

#	Course #	Course Name	Credits	Pre-requisites
1.	ACCT 201	Principles of Accounting I	3	Sophomore standing, MIS 101**, MATH 132**
2.	ACCT 202	Principles of Accounting II	3	ACCT 201
3.	AE 220	Introduction to Aerospace Engineering	3	PHYS 102
4.	AE 410	Astronautics	3	PHYS 102
5.	ARE 322	Building Mechanical Systems	3	PHYS 102 or PHYS 132
6.	ARE 413	Construction Management	3	Senior Standing
7.	ARE 431	Building Economy	3	Senior Standing or Consent of Instructor
8.	CE 201	Statics	3	PHYS 101 or PHYS 131
9.	CE 341	Transportation Engineering	3	PHYS 101, Junior Standing
10.	CE 460	Remote Sensing Technology	3	PHYS 102, Junior Standing
11.	CHEM 431	Chemistry of the Environment	3	CHEM 331 or Permission from the Instructor
12.	COE 341	Data and Computer Communications	3	STAT 319
13.	COE 402	Computer System Performance Evaluation	3	STAT 319 or Consent of Instructor
14.	COE 403	Advanced Microprocessor Architecture	3	COE 305
15.	COE 410	Design of Sequential Systems	3	COE 202
16.	COE 422	Real Time Systems	3	COE 305
17.	COE 443	High Speed Networks	3	COE 342 or consent of instructor
18.	COE 446	Mobile Computing	3	Senior Standing
19.	COE 484	Introduction to Robotics	3	Senior Standing
20.	CISE 301	Numerical Methods	3	ICS 101**, MATH 201
21.	ECON 101	Principles of Economics I (MICRO)	3	
22.	ECON 202	Principles of Economics II (MACRO)	3	ECON 101
23.	GEOL 202	Applied Geosciences for Scientists and Engineers	3	None
24.	GEOP 202	Introduction to Geophysics	3	MATH 102, PHYS 102
25.	GS 221	Principles of Sociology	3	
26.	GS 321	Principles of human Behavior	3	
27.	GS 423	International Relations	3	
28.	GS 424	Planning and Social Development	3	
29.	GS 427	Human and Environment	3	
30.	IAS 411	Contemporary Islamic World	2	Junior Standing
31.	IAS 416	Al-Sirah Al-Nabawiyyah	2	Junior Standing
32.	IAS 418	Contemporary Financial Transactions in Islam	2	Junior Standing
33.	IAS 419	Inimitability of Al-Quran	2	Junior Standing
34.	ISE 303	Operations Research I	4	ISE 201,ISE 205, or STAT 319
35.	ISE 307	Engineering Economic Analysis	3	
36.	ISE 320	Quality Control and Industrial Statistics	4	ISE 205, or STAT 319
37.	ISE 405	Stochastic Systems Simulation	3	ISE 205 or STAT 319
38.	ISE 421	Operations Research II	3	ISE 303
39.	ISE 422	Facility Layout and Location	3	ISE 303
40.	ISE 429	Maintenance Planning and Control	3	Junior Standing
41.	ISE 443	Human Factors Engineering	3	Junior Standing
42.	ISE 447	Decision Making	3	ISE 205 or Equivalent
43.	ISE 463	Theory of Stochastic Systems	3	ISE 205 or STAT 319
44.	ISE 480	Reliability and Maintainability	3	SE205 or STAT 319; Junior Standing
45.	MATH 311	Advanced Calculus I	3	MATH 201
46.	MATH 430	Introduction to Complex Variables	3	MATH 201
47.	MATH 440	Differential Geometry	3	MATH 260 or MATH 280
48.	MATH 472	Numerical Analysis II	3	MATH 321, or SE 301
49.	MATH 480	Linear & Nonlinear Programming	3	MATH 280 (MATH260), ICS 102
50.	ME 424	Maintenance Engineering	3	STAT 319
51.	MGT 301	Principles of Management	3	Junior Standing
52.	MGT 311	Legal Environment	3	Sophomore Standing

#	Course #		Course Name	Credits	Pre-requisites
53.	MGT	401	Human Resources Management	3	MGT 301
54.	MGT	405	Compensation and Benefits Management	3	MGT 401
55.	MGT	410	Organization Behavior and Design	3	MGT 301
56.	MKT	301	Principles of Marketing	3	ECON 202
57.	MKT	320	Sales Management	3	MKT 301
58.	MKT	330	Advertising and Sales Promotion	3	MKT 301
59.	MKT	375	Services Marketing	3	MKT 301
60.	MKT	400	Industrial Marketing	3	MKT 301
61.	MKT	410	Consumer Behavior	3	MKT 301
62.	MKT	420	International Marketing	3	MKT 301
63.	MKT	450	Marketing Management	3	MKT 301
64.	PHYS	201	General Physics III	3	PHYS102, MATH 102
65.	PHYS	203	Electrical and Magnetic Properties of Materials	3	PHYS102
66.	PHYS	211	Optics	3	PHYS102
67.	PHYS	212	Modern Physics	4	PHYS102
68.	PHYS	215	Introduction to Astronomy	3	PHYS102
69.	PHYS	261	Energy	3	PHYS102
70.	PHYS	271	Introduction to Special Relativity	3	PHYS102
71.	PHYS	301	Classical Mechanics I	3	MATH 202, PHYS101
72.	PHYS	305	Electricity and Magnetism I	3	PHYS 102, MATH 202
73.	STAT	301	Introduction to Probability Theory	3	MATH 201
74.	STAT	302	Statistical Inferences	3	STAT 301
75.	STAT	310	Regression Analysis	3	STAT 201**(STAT 319)
76.	STAT	320	Statistical Quality Control	4	STAT 201 or STAT 319

** Students will need special waiver when registering the course.

Prerequisite Diagram



COURSE DESCRIPTIONS

ICS 101 Computer Programming (2-3-3)
Overview of computer hardware and software; Programming in FORTRAN with emphasis on modular and structured programming technique; Problem solving and algorithm development; simple engineering and scientific problems.
Co-requisite: MATH 101
Note: ICS 101 cannot be taken by ICS/SWE students.

ICS 102 Introduction to Computing I (2-3-3)
Overview of computers and computing. Introduction to a typical object-oriented programming language. Basic data types and operators. Basic object-oriented concepts. Wrapper classes. Console input/output. Logical expressions and control structures. Classes and methods. Arrays and strings.
Co-requisite: MATH 101 or MATH 132

ICS 103 Computer Programming in C (2-3-3)
Overview of computer hardware and software; Programming in C with emphasis on modular and structured programming technique; Problem solving and algorithm development; Simple engineering and scientific problems.
Co-requisite: MATH 101 or MATH 132
Note: ICS 103 cannot be taken by ICS/SWE students.

ICS 201 Introduction to Computing II (3-3-4)
Advanced object-oriented programming; inheritance; polymorphism; abstract classes and interfaces, container and collection classes, packages, object-oriented design, software modeling, event-driven programming, recursion, use of stacks, queues and lists from API, searching and sorting.
Prerequisite: ICS 102

ICS 202 Data Structures (3-3-4)
Review of object-oriented concepts; Introduction to design patterns; Basic algorithms analysis; Fundamental data structures - implementation strategies for stacks, queues and linked lists; Recursion; Implementation strategies for tree and graph algorithms; Hash tables; Applications of data structures (e.g. data compression and memory management).
Prerequisite: ICS 201

ICS 233 Computer Architecture and Assembly Language (3-3-4)
Machine organization; assembly language: addressing, stacks, argument passing, arithmetic operations, decisions, modularization; Input/Output Operations and Interrupts; Memory Hierarchy and Cache memory; Pipeline Design Techniques; Super-scalar architecture; Parallel Architectures.
Prerequisite: ICS 201& COE 202

ICS 253 Discrete Structures I (3-0-3)
Propositional Logic, Predicate Logic, Sets, Functions, Sequences and Summation, Proof Techniques, Mathematical induction, Inclusion-exclusion and Pigeonhole principles, Permutations and Combinations (with and without repetitions), The Binomial Theorem, Recurrence Relations; Graphs terminology and applications, Connectivity, Isomorphism, Euler and Hamilton Paths and Circuits, Planarity and Coloring; Trees terminology and applications.
Prerequisite: ICS 102

ICS 254 Discrete Structures II **(3-0-3)**

Number Theory: Modular Arithmetic, Integer Representation, Fermat's Little Theorem, Chinese Remainder Theorem, RSA.; Proof Techniques: Methods of Proofs, Applications from Number Theory, Recursive Definitions; Algorithm Correctness; Relations: Closures and Equivalence Relations, Partial Orderings and Lattices, Hasse Diagrams; Recurrence Relations and Generating Functions; Automata Theory: Finite State Machines, Regular Expressions, DFA, NDFA and their equivalence, Grammars and Chomsky Hierarchy, Introduction to Turing Machines.; Abstract Algebra: Groups, Homomorphisms and Lagrange's Theorem, Applications.

Prerequisite: ICS 253

ICS 309 Computer Ethics **(2-0-2)**

Impact of Computing on Society; Ethical Foundations; Governance and Regulation; Freedom of Speech; Intellectual Property; Privacy; Security; Professional Responsibility; Leadership challenge.

Prerequisite: Junior Standing

ICS 324 Database Systems **(3-3-4)**

Basic database concepts, conceptual data modeling, relational data model, relational theory and languages, database design, SQL, introduction to query processing and optimization, and introduction to concurrency and recovery.

Prerequisite: ICS 202

ICS 343 Fundamentals of Computer Networks **(3-3-4)**

Introduction to computer networks and layered architectures: connectivity, topology, circuit and packet switching, TCP/IP and ISO models; Application layer: C/S model, DNS, SMTP, FTP, WWW, socket programming and network security; Transport layer: TCP and UDP, congestion control; Network layer: internetworking, addressing and routing algorithms and protocols; Data link layer: framing, flow and error control protocols, PPP, MAC and LANs; Physical layer: principles of data communications, circuit switching, coding, multiplexing and transmission media.

Prerequisite: ICS 201

Note: This course cannot be taken for credit with COE 344.

ICS 350 Cooperative work **(0-0-0)**

Beginning of Coop in summer. Description is as given in ICS 351.

Prerequisite: ICS 324, SWE 311, ENGL 214, Major GPA ≥ 2, Completion of at least 85 hours, Department Approval

ICS 351 Cooperative work **(0-0-9)**

A continuous period of 28 weeks spent as a normal employee in industry, business, or government agencies with the purpose of familiarizing students with the real world of work and enabling them to integrate their classroom learning to a real work environment. During this period, a student is exposed to a real-life work in the field. Each student is required to participate with at least one project. Students are required to submit progress reports during the work period. Students are also required to give a presentation and submit a final report on their experience and the knowledge they gained during their cooperative.

Prerequisite: ICS 324, SWE 311, ENGL 214, Major GPA ≥ 2, Completion of at least 85 hours, Department Approval

ICS 352 Cooperative work **(0-0-9)**

A continuous period of 28 weeks spent in the industry to acquire practical experience in different fields of computer science.

Prerequisite: ICS 324, SWE 311, ENGL 214, Major GPA ≥ 2, Completion of at least 85 hours, Department Approval

ICS 353 Design and Analysis of Algorithms **(3-0-3)**

Algorithms and Problem Solving; Basic Algorithmic Analysis; Advanced algorithmic analysis; Advanced Data Structures; Algorithmic strategies & Analysis of fundamental computing algorithms; Basic computability; The complexity classes P and NP.

Prerequisites: ICS 202 and ICS 253

ICS 355 Theory of Computing **(3-0-3)**

Regular Grammars: equivalence of DFA, NDFA and regular expressions, pumping lemma, emptiness and membership. Context-Free Grammars: parsing and ambiguity, normal forms, applications, equivalence of PDA's and CFG's, pumping lemma, emptiness and membership. Turing Machine: programming techniques for Turing machines, equivalence of one-tape and multitape TM's, universal Turing-machine. Undecidability: recursively enumerable and recursive languages, undecidability, problem reduction, undecidable problems of CFG's, RE's and TM's.

Prerequisite: ICS 253

ICS 381 Principles of Artificial Intelligence **(3-0-3)**

Introduction to Artificial Intelligence (AI) history and applications; First order logic; State space representation; Blind and heuristic search; Constraint satisfaction and planning; Knowledge representation; Reasoning in uncertain situations; Machine learning; Prolog programming; Natural language processing, Expert systems and real AI applications.

Prerequisite: ICS 253

ICS 399 Summer Training **(0-0-0)**

A summer period of 8 weeks spent as a trainee in industry, business, or government agencies for the purpose of familiarizing the student with the real job world and enabling him to apply and relate his academic knowledge to a real work environment.

The student is required to participate in computer science related activities and use his time to get acquainted with the computer science related functions and resources used by his employing organization. Besides progress reports, the student is required to submit a final report and do a presentation on his experience and the knowledge he gained during his summer training program. The student receives a zero-credit Pass/Fail grade.

Prerequisites: ICS 324, SWE 311, ENGL 214, Junior Standing and Department Approval

ICS 410 Programming Languages **(3-0-3)**

Programming Paradigms: Object-oriented, imperative, functional, and logic. Application development in these paradigms. Fundamentals of Language Design: Syntax and Semantics. Language implementation: virtual machines; compilation, interpretation, and hybrid.

Prerequisite: ICS 202

ICS 411 Senior Project **(1-6-3)**

Project-oriented course in which students work in teams on an applied real-world problem of their interest, go through its software development lifecycle in order to develop a prototype software solution for the problem at hand. The senior project offers the opportunity to integrate the knowledge acquired in preceding courses, as well as promote and instill communication skills, writing skills, and lifelong self-learning.

Prerequisite: ICS 324, SWE 311, ENGL 214 and Senior Standing

ICS 412 Compiler Construction Techniques **(3-0-3)**
Compiler techniques and methodology; Organization of compilers. Lexical and syntax analysis; Parsing techniques; Object code generation and optimization, detection and recovery from errors; Contrast between compilers and interpreters.
Prerequisite: ICS 410

ICS 415 Computer Graphics **(3-0-3)**
Applications of Computer Graphics; Graphics systems and devices; Output Primitives and their Attributes; Geometric Transformations; Window to Viewport Mapping and Clipping; Curves and Surfaces; Three-Dimensional viewing; Hidden surface removal; illumination and color models, Animation.
Prerequisite: ICS 202

ICS 424 Advanced Database Systems **(3-0-3)**
Advanced data models: object-oriented model, and object-relational model, conceptual database design. Transaction processing: transactions, failure and recovery, and concurrency control techniques. Database backup and recovery. Query processing and optimization. Database security. Distributed databases: distributed data storage, distributed query processing, distributed transaction processing and concurrency control. Homogeneous and heterogeneous solutions, client-server architecture. XML and relational databases. Introduction to data warehousing, introduction to other current trends in database systems.
Prerequisite: ICS 324

ICS 426 Data Warehousing and Data Mining **(3-0-3)**
Review of relational databases and Conjunctive queries, Data Warehousing Concepts and OLAP, Data Warehouse Design and Development, Information and data Integration, OLAP Technology for Data Mining. Data Mining: Primitive, Languages and Application Developments.
Prerequisite: ICS 324

ICS 431 Operating Systems **(3-3-4)**
This course introduces the fundamentals of operating systems design and implementation. Topics include history and evolution of operating systems; Types of operating systems; Operating system structures; Process management: processes, threads, CPU scheduling, process synchronization; Memory management and virtual memory; File systems; I/O systems; Security and protection; Distributed systems; Case studies.
Prerequisite: ICS 233.

ICS 436 Systems and Network Administration **(2-3-3)**
Install and upgrade different popular operating systems. Managing File Systems. Managing User Accounts. Setting up X Windows System. Configuring Printing Services. Upgrading and installing software packages. Backing up data. Tuning kernel parameters. Configuring and managing various protocols: DNS, DHCP, Routing, Electronic Mail, and Network File System. Managing and troubleshooting computer systems and networks. Network and System Security.
Prerequisite: ICS 343 and ICS 431

ICS 437 Distributed Systems **(3-0-3)**

Introduction to Distributed Systems; Distributed Systems Architecture; Computer Networks for distributed systems; Distributed Objects and Remote Invocation; Distributed Naming; Distributed File Systems; Security; Synchronization; Distributed Coordination and Agreement; Distributed Transactions; Distributed Replication; Distributed Multimedia Systems, Distributed Shared Memory; Case Studies such as CORBA, MACH, DCOM, and GLOBE.

Prerequisite: ICS 343 and ICS 431

ICS 441 Cluster Computing **(3-0-3)**

Introduction to high performance computing: types of parallel computers, system architectures, performance measures; Message passing programming; Complexity analysis of parallel algorithms; Embarrassingly parallel computations; Partitioning and divide-and-conquer strategies; Pipelined computations; Synchronous computations; Load balancing and termination detection; Programming with shared memory; Parallel sorting algorithms; Numerical algorithms; Parallel image processing; Searching and optimization; Project/Programming-assignments.

Prerequisite: ICS 431

ICS 442 Computer Network Technologies **(3-0-3)**

Various advanced topics on LANs and internetworking technologies will be addressed. Topics include: Performance measures and evaluation techniques; Advanced network architectures and differentiated services in IP networks; High-speed access technologies; Switched, Fast and Gigabit Ethernet; VLANs; Wireless LANs; ISDN and ATM; Frame Relay; Mobile computing and mobile IP; VPN and Enterprise networks; Emerging network trends and technologies.

Prerequisite: ICS 343 and Senior Standing

ICS 443 Network Design and Management **(3-0-3)**

Overview of network design and management; Design methodologies; Network management strategies; Network configuration management; Network management protocols: SNMP, and RMON; Network management tools and systems; Network management applications; Desktop and web-based network management; Network troubleshooting.

Prerequisite: ICS 343

ICS 444 Computer and Network Security **(3-0-3)**

Introduction to computer and network security; Security services: confidentiality, integrity, availability, accountability; Hacker techniques and attack types; Public and private key encryption; Authentication; Digital signature; User identification and access control; Computer viruses, Trojans and worms; Risk management and analysis; Information security process; Internet security: security protocols such as IPSec, SSL, TLS, email and web security; Security technologies and systems: Firewalls, VPN and IDS.

Prerequisite: ICS 343, ICS 431 and Senior Standing

Note: ICS 444 is Equivalent to SWE 421. Students can take credit for only one of them.

ICS 454 Principles of Cryptography **(3-0-3)**

Classical cryptography; Secret Key Encryption; Perfect Secrecy. Cryptanalysis; Block and Stream cipher; Data Encryption Standard (DES) and Advanced Encryption Standard (AES); Public Key Encryption; Diffie-Hellman Key Exchange; RSA, ElGamal and Rabin's Cryptosystems; Authentication and Digital Signatures; One-time signatures; Randomized Encryption; Rabin and ElGamal signature schemes; Digital Signature Standard (DSS)' Cryptographically Secure Hashing; Message Authentication Codes; Network Security; Secure Socket Layer (SSL); IPsec.

Prerequisite: ICS 254 and ICS 353.

ICS 481 Artificial Neural Networks **(3-0-3)**

Introduction to neural computing: Real vs. artificial neurons; Threshold logic; Training a linear threshold unit, the perceptron rule; Multilayer feed-forward networks and the back propagation algorithm; The Hopfield net; Self-organizing maps; Radial basis functions; Adaptive resonance theory; Applications of Neural Networks (ANN).

Prerequisite: Senior Standing

ICS 482 Natural Language Processing **(3-0-3)**

This course examines a range of issues concerning computer systems that can process human languages. Among the issues to be discussed are morphological and syntactic processing, semantic interpretation, discourse processing and knowledge representation.

Prerequisite: Senior Standing

ICS 483 Computer Vision **(3-0-3)**

Image acquisition, The digital image and its properties, Image preprocessing, Segmentation (thresholding, edge- and region-based segmentation), Shape representation and object recognition, Motion analysis, Case studies (object recognition / object tracking).

Prerequisite: Senior Standing

Note: ICS 483 cannot be taken for credit with COE 487 or EE 410

ICS 484 Arabic Computing **(3-0-3)**

This course examines a range of issues concerning computer concepts related to Arabic. Among the issues to be discussed are: Arabic Language Characteristics, Arabic Character Sets, Standardization, Unicode, Arabization systems, Arabic software tools, Arabic programming languages and Introduction to Arabic Computations.

Prerequisite: Senior Standing.

ICS 485 Machine Learning **(3-0-3)**

Introduction to machine learning; Concept learning; Supervised learning - decision tree learning; Unsupervised learning - clustering. Artificial neural networks. Evaluating hypotheses; Bayesian learning; Computational learning theory; Instance based learning. Genetic algorithms; Learning sets of rules - Inductive Logic Programming; Reinforcement learning; Analytical learning.

Prerequisite: Senior Standing

ICS 486 Multi-agent Systems **(3-0-3)**

Agents, agent definitions and classification; Multi-agent systems (MAS) and their characteristics; Models of agency, architectures and languages, logics for MAS, deductive and practical reasoning agent, reactive and hybrid agents; Distributed problem solving and planning; Coordination mechanisms and strategies; Learning in MAS; Interaction, negotiation and coalition formation; Applications of agent technology (agents in electronic commerce and information retrieval).

Prerequisite: ICS 381

ICS 488 Soft Computing **(3-0-3)**

Introduction to Soft Computing, Fuzzy Sets Theory, Fuzzy Logic, Artificial Neural Networks, Probabilistic Reasoning, Genetic Algorithms, Neuro-Fuzzy Technology, Combination of Genetic Algorithms with Neural Networks, Combination of Genetic Algorithms and Fuzzy Logic, Applications of Soft Computing (three to four real life applications).

Prerequisite: STAT 319 and Senior Standing

ICS 490 Special Topics I **(3-0-3)**
State-of-the-art topics in Computer Science and Information Systems.
Prerequisite: Senior Standing.

ICS 491 Special Topics II **(3-0-3)**
State-of-the-art topics in Computer Science and Information Systems.
Prerequisite: Senior Standing

SWE 311 Principles of Software Engineering **(3-3-4)**
History and overview of software engineering. Software processes. Software project management. Software requirements and specification. Software design. Software testing and validation. Software metrics. Software quality assurance. Software evolution. Using APIs. Software tools and environments.
Prerequisite: ICS 202
Note: SWE 311 cannot be taken by SWE students.