

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

Software Engineering Student Guide

(Based on the revised Software Engineering Program)

February 2009

Introduction

The Department of Information and Computer Science offers a BS in Software Engineering. The current program was revised and approved in April 2008. The program is in full compliance with IEEE/ACM Software Engineering SE2004 guidelines and meets the Engineering Accreditation Criteria (EAC).

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.

Software Engineering Program Goal

Our goal has been, and continues to be, a high quality degree program in Software Engineering that prepares students for lifelong learning as they undertake professional careers in computing. The program prepares students to work as requirements engineer, software architect, software design engineer, software quality engineer, software developer, software test engineer, or software engineering project manager.

Software Engineering Program Mission

To bring forth competent Software Engineers with a strong understanding of computer science bodies of knowledge and theories, who can apply sound engineering principles and methods to the cost-effective creation, development, operation, and maintenance of high-quality software and are prepared for lifelong learning.

Software Engineering Program Objectives

The graduates of the software engineering program shall be able to:

1. Apply proper theoretical, technical, and practical knowledge of software requirements, analysis, design, implementation, verification and validation, and documentation.
2. Resolve conflicting project objectives considering viable tradeoffs within limitations of cost, time, knowledge, existing systems, and organizations.
3. Develop appropriate design solutions to a given problem using software engineering approaches that integrate ethical, social, legal, and economic concerns
4. Work as an individual with minimum guidance and as a leader/member of a team to develop and deliver quality software artifacts with effective communication skills.
5. Engage in lifelong learning of software engineering theories and technologies

Software Engineering Program Learning Outcomes:

The software engineering program enables students, by the time of graduation, to achieve the ability to:

1. Apply their knowledge of mathematics, sciences, and computer science to the modeling, analysis, and measurement of software artifacts.
2. Work effectively as leader/member of a development team to deliver quality software artifacts.
3. Analyze, specify and document software requirements for a software system.
4. Develop alternative design solutions to a given problem and recommend the best one within limitations of cost, time, knowledge, existing systems, and organizations.
5. Implement a given software design using sound development practices.
6. Verify, validate, assess and assure the quality of software artifacts.
7. Design, select and apply the most appropriate software engineering process for a given project, plan for a software project, identify its scope and risks, and estimate its cost and time.
8. Express and understand the importance of negotiation, effective work habits, leadership, and good communication with stakeholders, in written and oral forms, in a typical software development environment.
9. Understand the impact of computing solutions in a global and societal context.
10. Recognize and be guided by the social, professional, legal, ethical issues involved in the use and development of computer & software technology.
11. Keep abreast of current developments in the discipline to continue their own professional development and life-long learning.
12. Employ appropriate methods and tools for the specification, design, implementation, and evaluation of software systems.

The Program Requirements

a. General Education Requirements (52 credits)

Basic Science	CHEM 101(4),	PHYS 101(4),	PHYS 102(4)	
Mathematics	MATH 101(4),	MATH 102(4),	MATH 201(3),	
Statistics	STAT 319(3)			
Isla. & Ara. Stu.	IAS 101(2),	IAS 111(2),	IAS 201(2),	IAS 212(2),
	IAS 301(2),	IAS 322(2)		
English	ENGL 101(3),	ENGL 102(3),	ENGL 214(3)	
SE	ISE 307(3)			
Physical Edu.	PE 101(1),	PE 102(1)		

b. Core Requirements (65 credits)

SWE	SWE 205(3),	SWE 215(3),	SWE 312(3),	SWE 316(3),
	SWE 326(3),	SWE 363(3)	SWE 387(3)	SWE 417(3),
	SWE 418(2)			
ICS	ICS 102(3),	ICS 201(4),	ICS 202(4),	ICS 233(4),
	ICS 253(3),	ICS 254(3),	ICS 324(4),	ICS 343(4)
	ICS 353(3),	ICS 431(4)		
COE	COE 202(3)			

c. Elective (15 credits)

SWE/ICS Electives	SWE/ICS xxx(3),	SWE/ICS xxx(3),	SWE/ICS xxx(3),
Free Electives	XE xxx(3),	XE xxx(3)	

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

The prerequisites for summer training:

- Student is currently enrolled in the university.
- Student has completed 65 credits or more (including current semester)
- Students has completed or currently doing ENGL 214 and SWE 363.
- Summer training is not in the last semester for the student at the university.

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

e. Total Requirements

The total required credits for the BS degree in Software Engineering are 132 semester-credit-hours.

Curriculum

BS (Software Engineering) Program

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 Credit 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 I	3	3	4	PHYS	102	General Physics II	3	3	4
ENGL	101	An Intro to Academic Discourse	3	0	3	ENGL	102	Intro 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 Consequences	2	0	2
PE	101	Physical Education I	0	2	1	PE	102	Physical Education II	0	2	1
			15	9	18				14	8	17
Third Year (Sophomore)											
SWE	205	Introduction to SW Eng.	3	0	3	ICS	202	Data Structures	3	3	4
ICS	201	Intro. To Computing II	3	3	4	SWE	215	SW Requirements Eng.	2	3	3
COE	202	Digital Logic Design	3	0	3	ICS	233	Comp. Arch.& As. Lang	3	3	4
MATH	201	Calculus III	3	0	3	ICS	254	Discrete Structures II	3	0	3
ICS	253	Discrete Structures I	3	0	3	IAS	201	Writing for Prof. Needs	2	0	2
			15	3	16				13	9	16
Fourth Year (Junior)											
SWE	312	User-Interface Design	3	0	3	SWE	326	SW Testing & QA	3	0	3
SWE	316	SW Design and Arch.	3	0	3	SWE	363	Web Eng. & Development	3	0	3
ICS	324	Database Systems	3	3	4	SWE	387	Software Project mgt.	3	0	3
STAT	319	Prob.& Stat. for Engrs	2	3	3	ICS	343	Fund. of Comp NW	3	3	4
IAS	212	Professional Ethics	2	0	2	IAS	322	Human Rights in Islam	2	0	2
						ENGL	214	Academic & Prof Comm	3	0	3
			13	6	15				17	3	18
Fifth Year (Senior)											
SWE	417	SWE Project I	1	6	3	SWE	418	SWE Project II	0	6	2
XE	xxx	(Elective I)	3	0	3	ICS	431	Operating Systems	3	3	4
ICS	353	Design and Anal of Algo.	3	0	3	SWE	xxx	(SWE/ICS Elective II)	3	0	3
ISE	307	Eng. Economics Analysis	3	0	3	SWE	xxx	(SWE/ICS Elective III)	3	0	3
SWE	xxx	(SWE/ICS Elective I)	3	0	3	IAS	301	Oral Comm. Skills	2	0	2
						XE	xxx	(Elective II)	3	0	3
			13	6	15				14	9	17
Total credits required in Degree Program: 132											

SWE Courses Summary

A. Core

A.1: SWE Courses

1.	SWE 205	Introduction to Software Engineering	3	0	3
2.	SWE 215	Software Requirement Engineering	2	3	3
3.	SWE 312	User-Interface Design	3	0	3
4.	SWE 316	Software Design and Architecture	3	0	3
5.	SWE 326	SW Testing & Quality Assurance	3	0	3
6.	SWE 363	Web Engineering & Development	3	0	3
7.	SWE 387	Software Project management	3	0	3
8.	SWE 417	Software Engineering Project I	1	6	3
9.	SWE 418	Software Engineering Project II	0	6	2
SUB TOTAL:			26 Credits		

A.1: CS Courses

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 324	Database Systems	3	3	4
8.	ICS 343	Fundamentals of Computer Networks	3	3	4
9.	ICS 353	Design and Analysis of Algorithms	3	0	3
10.	ICS 431	Operating Systems	3	3	4
SUB TOTAL:			36 Credits		

A.2: COE Courses

1.	COE 202	Digital Logic Design	3	0	3
SUB TOTAL:			3 Credits		

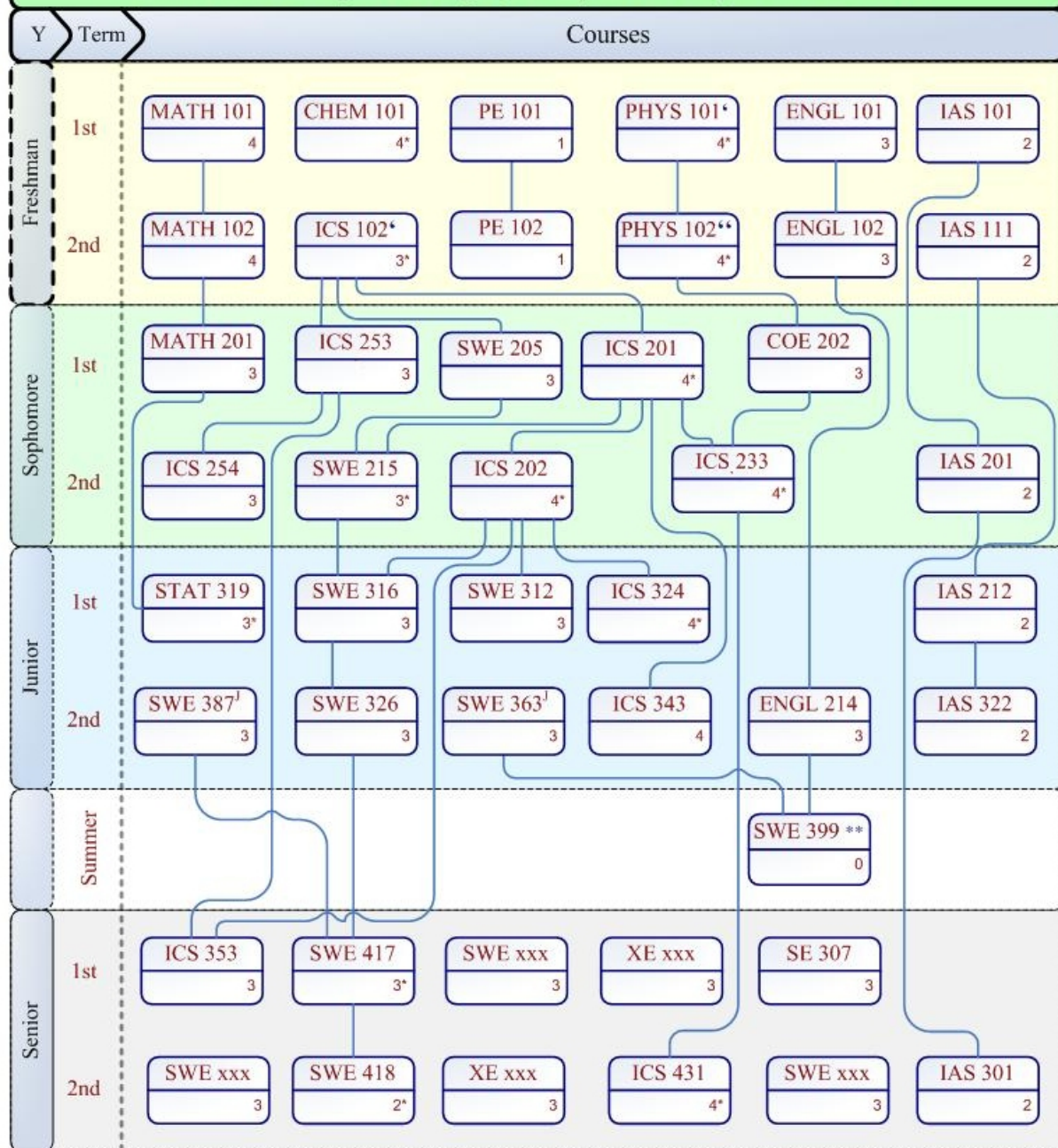
B. Electives

ICS 300 - ICS 499 and SWE 300 - SWE 499 courses

SUB TOTAL (3 SWE/ICS Electives): 9 Credits



Software Engineering (SWE) Pre-Requisites Chart



** Pre-requisites for Summer Training (SWE 399): ENGL 214 and SWE 363 and Department Approval

❖ Key:

• Co-requisite: Math 101

* Requires Lab work

“ Co-requisite: Math 102

J Junior Standing

Designed By: Azam!

Approved Free Electives for the Software Engineering Program

#	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.	ACCT 301	Intermediate Accounting I	3	ACCT 202
4.	ACCT 401	Cost Accounting	3	ACCT 202
5.	AE 220	Introduction to Aerospace Engineering	3	PHYS 102
6.	AE 410	Astronautics	3	PHYS 102
7.	ARE 444	Knowledge-Based Systems in Buildings	3	ICS 102, ARE 221; or Consent from Instructor
8.	CE 341	Transportation Engineering	3	PHYS 101, Junior Standing
9.	CHEM 431	Chemistry of the Environment	3	CHEM 331 or Permission from the Instructor
10.	CISE 301	Numerical Methods	3	ICS 101**, MATH 201
11.	CISE 438	Instrumentation for Process Control	3	CISE 312
12.	ISE 303	Operations Research I	3	ISE 201, ISE 205, or STAT 319
13.	ISE 320	Quality Control and Industrial Statistics	4	ISE 205, or STAT 319
14.	ISE 405	Stochastic Systems Simulation	3	ISE 205 or STAT 319
15.	ISE 421	Operations Research II	3	ISE 303
16.	ISE 443	Human Factors Engineering	3	Junior Standing
17.	ISE 447	Decision Making	3	ISE 205 or Equivalent
18.	ISE 463	Theory of Stochastic Systems	3	ISE 205 or STAT 319
19.	ISE 480	Reliability and Maintainability	3	ISE205 or STAT 319; Junior Standing
20.	COE 305	Microprocessor System Design	4	COE 205 (ICS 232 equivalent)
21.	COE 308	Computer Architecture	3	COE 205
22.	COE 342	Data and Computer Communications	3	STAT 319
23.	COE 402	Computer System Performance Evaluation	3	STAT 319 or Consent of Instructor
24.	COE 403	Advanced Microprocessor Architecture	3	COE 305
25.	COE 405	Design and Modeling of Digital Systems	3	COE 308 or consent of instructor
26.	COE 420	Parallel Computing	3	COE 308
27.	COE 421	Fault-Tolerant Computing	3	COE 308
28.	COE 443	High Speed Networks	3	COE 342 or consent of instructor
29.	COE 484	Introduction to Robotics	3	Senior Standing
30.	COE 488	Data Acquisition Interfacing	3	COE 305
31.	ECON 101	Principles of Economics I (MICRO)	3	
32.	ECON 202	Principles of Economics II (MACRO)	3	ECON 101
33.	ECON 301	Intermediate Microeconomic Theory	3	ECON 202
34.	ECON 305	Money and Banking	3	ECON 202
35.	ECON 306	Economy of Saudi Arabia	3	ECON 202
36.	ECON 410	International Economics	3	ECON 202
37.	EE 446	Programmable Logic Controllers	3	Senior Standing

#	Course #	Course Name	Credits	Pre-requisites
38.	GEOL 202	Applied Geosciences for Scientists and Engineers	3	None
39.	GEOP 202	Introduction to Geophysics	3	MATH 102, PHYS 102
40.	GS 221	Principles of Sociology	3	
41.	GS 321	Principles of human Behavior	3	
42.	GS 423	International Relations	3	
43.	GS 424	Planning and Social Development	3	
44.	GS 427	Human and Environment	3	
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 ISE 301
49.	MATH 480	Linear & Nonlinear Programming	3	MATH 280 (MATH260), ICS 102
50.	MATH 495	Industrial Mathematics.	3	MATH 301, MATH 321; or Instructor's Consent
51.	ME 203	Thermodynamics I	3	MATH 102, PHYS 102
52.	ME 204	Thermodynamics II	3	ME 203
53.	ME 215	Material Science for ME	3	CHEM 101, MATH 102, PHYS 102
54.	ME 424	Maintenance Engineering	3	STAT 319
55.	MGT 301	Principles of Management	3	Junior Standing
56.	MGT 311	Legal Environment	3	Sophomore Standing
57.	MGT 401	Human Resources Management	3	MGT 301
58.	MIS 345	Information Technology in Society	3	MIS 215**, Junior Standing
59.	MKT 301	Principles of Marketing	3	ECON 202
60.	PHYS 201	General Physics III	3	PHYS102, MATH 102
61.	PHYS 203	Electrical and Magnetic Properties of Materials	3	PHYS102
62.	PHYS 211	Optics	3	PHYS102
63.	PHYS 212	Modern Physics	4	PHYS102
64.	PHYS 215	Introduction to Astronomy	3	PHYS102
65.	PHYS 261	Energy	3	PHYS102
66.	PHYS 271	Introduction to Special Relativity	3	PHYS102
67.	PHYS 301	Classical Mechanics I	3	MATH 202, PHYS101
68.	STAT 301	Introduction to Probability Theory	3	MATH 201
69.	STAT 302	Statistical Inferences	3	STAT 301
70.	STAT 310	Regression Analysis	3	STAT 201**(STAT 319)
71.	STAT 320	Statistical Quality Control	4	STAT 201 or STAT 319

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

Course Equivalency

The following table outlines the correspondence between courses in the current program and the new program.

Current Program		New Program	
Software Engineering Core Courses			
		SWE 205 Introduction to Software Engineering	(3-0-3)
SWE 214 Introduction to Software Engineering	(3-3-4)	SWE 215 Software Requirements Engineering	(2-3-3)
SWE 312 User Interface Design	(3-0-3)	SWE 312 User Interface Design	(3-0-3)
SWE 316 Software Design and Architecture	(3-0-3)	SWE 316 Software Design and Architecture	(3-0-3)
		SWE 387 Software Project Management	(3-0-3)
SWE 415 Software Testing and Quality Assurance	(3-0-3)	SWE 326 Software Testing and Quality Assurance	(3-0-3)
SWE 417 Software Engineering Project I	(2-3-3)	SWE 417 Software Engineering Project I	(1-6-3)
SWE 418 Software Engineering Project II	(1-6-3)	SWE 418 Software Engineering Project II	(0-6-2)
SWE 444 Internet and Web Application Development	(3-0-3)	SWE 363 Web Engineering & Development	(3-0-3)
SWE 490 Special Topics I	(3-0-3)	SWE 490 Special Topics I	(3-0-3)
SWE 491 Special Topics II	(3-0-3)	SWE 491 Special Topics II	(3-0-3)
Electives			
SWE 344 Internet Protocols and Client Server Computing	(2-3-3)	SWE 344 Internet Protocols and Client Server Computing	(2-3-3)
SWE 421 Principles of Information Security	(3-0-3)	ICS 444 Computer and Network Security	(3-0-3)
SWE 321 Formal Methods and Models in Software Engineering	(3-0-3)	SWE 321 Formal Methods and Models in Software Engineering	(3-0-3)
SWE 423 Multimedia Systems	(3-0-3)	ICS 425 Multimedia Systems	(3-0-3)
		SWE 416 Software Architecture	(3-0-3)
		SWE 436 Design patterns	(3-0-3)
		SWE 469 Software metrics	(3-0-3)
		SWE 487 Software processes & Process improvements	(3-0-3)
SWE 322 Principles of Concurrent Software Systems	(3-0-3)		
SWE 422 Real-Time Software Systems	(3-0-3)		
SWE 446 Selected Topics on Emerging Internet Technologies	(3-0-3)		
Other Core Courses			
ICS 102 Introduction to Computing	(2-3-3)	ICS 102 Introduction to Computing I	(2-3-3)
ICS 201 Introduction to Computer Science	(3-3-4)	ICS 201 Introduction to Computing II	(3-3-4)
ICS 202 Data Structures	(3-3-4)	ICS 202 Data Structures	(3-3-4)
ICS 324 Database Systems	(3-3-4)	ICS 324 Database Systems	(3-3-4)
ICS 353 Design and Analysis of Algorithms	(3-0-3)	ICS 353 Design and Analysis of Algorithms	(3-0-3)
ICS 431 Operating Systems	(3-3-4)	ICS 431 Operating Systems	(3-3-4)
		ICS 343 Fundamentals of Computer Networks	(3-3-4)
ICS 410: "Programming Languages"	(3-0-3)		
ICS 232 Computer Organization & Assembly Programming	(3-3-4)	ICS 233 Computer Architecture and Assembly Language	(3-3-4)
ICS 252 Discrete Structures			
	(3-0-3)	ICS 253 Discrete Structures I	(3-0-3)
	(3-0-3)	ICS 254 Discrete Structures II	(3-0-3)
ECON 403: Engineering Economics	(3-0-3)	SE 307: Engineering Economics Analysis	(3-0-3)
MATH 260 Linear Algebra & Differential Equation	(3-0-3)		

Course Prerequisite Changes

The following table outlines the pre-requisite changes of the courses in the new program.

Course Number	Old Prerequisite(s)	New Prerequisite(s)
SWE 205	NEW COURSE	ICS 102
SWE 215	NEW COURSE	SWE 205 & ICS 201
SWE 312	ICS 202, SWE 214	ICS 202
SWE 316	SWE 214, ICS 324	ICS 202 & SWE 215
SWE 326	NEW COURSE	SWE 312 and SWE 316
SWE 363	NEW COURSE	Junior Standing
SWE 387	NEW COURSE	Junior Standing
SWE 399	NEW COURSE	ENGL 214 and SWE 363 and Department Approval
SWE 416	NEW COURSE	SWE 316
SWE 417	Co requisite SWE 415	SWE 326 & SWE 387
SWE 436	NEW COURSE	SWE 316
SWE 469	NEW COURSE	SWE 316 & STAT 319
SWE 487	NEW COURSE	SWE 387

Implementation Plan

In the following description, two terms, current program and new program, have been used. The term current program refers to the BS Software Engineering program that is offered by the ICS Department before the new revised program is implemented and the term new program refers to the revised BS Software Engineering program when approved and offered by the ICS Department. Guidelines to move the students from current program to the new program are:

1. Students who have not taken SWE 214 should start registering SWE courses by registering SWE 205.
2. SWE 205 should be waived for students who have already taken SWE 214 and they have to take a free or a major elective to replace SWE 205.
3. Students who have taken ICS 252 should also take ICS 254.
4. Students who have taken MATH 260, then it will be considered as free or a major elective.
5. Students who have taken SWE 344, then it will be considered as a free or a major elective.
6. ICS 251 and ICS 252 are equivalent to ICS 253 & ICS 254.
7. If the student has taken ICS 410, then it will be considered as a free or major elective.
8. Requiring SWE 387 to be a Prerequisite for SWE 417 should be delayed one semester from the beginning of the implementation of the proposed program. The 081 offering of SWE 417 will take that into consideration.

Note: Students who are taking SWE 417 in 072 or in 081 will follow the current program (old program).

However, there might be some circumstances that may arise that need special handling due to the differences between the two programs.

Catalog Description of Courses

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 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: COE 202, ICS 201

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 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 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 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.

SWE 205 Introduction to Software Engineering**(3-0-3)**

Introduction to software engineering and software processes. Construction techniques and principals. Concepts of Programming Languages: Syntax and semantics. Analysis and Design Modes. Ethical and professional responsibilities.

Prerequisites: ICS 102

SWE 215 Software Requirements Engineering**(2-3-3)**

Requirements engineering process. Methods, tools and techniques for eliciting, organizing and documenting software requirements. Analysis and validation techniques, including need, goal, and use case analysis. Requirements documentation standards. Traceability. Requirements management. Handling requirements changes. Students participate in a group project on software requirements.

Prerequisites: ICS 201 and SWE 205

SWE 312 User Interface Design**(3-0-3)**

Study of both theoretical and practical issues in human-computer interfaces. User interface design process. Usability engineering. Development, programming, and evaluating interface designs. Design of windows, and menus. Commands and natural languages I/O. Visual prototyping. User manuals, online help and tutorials. Students participate in a group project on software user interface design.

Prerequisites: ICS 202

SWE 316 Software Design and Architecture**(3-0-3)**

Study of design concepts and notations. Architecture, middleware architectures, design patterns, frameworks and components. Designing for qualities such as performance, security, reusability, reliability. Metrics and measurement. Basics of software evolution, reengineering, and reverse engineering. Students participate in a group project on software design.

Prerequisites: ICS 202 and SWE 215

SWE 321 Formal Methods and Models in Software Engineering**(3-0-3)**

Mathematical foundations for formal methods. Formal languages and techniques for specification and design, including specifying syntax using grammars and finite state machines. Analysis and verification of specifications and designs. Use of assertions and proofs. Automated program and design transformation.

Prerequisites: ICS 202 and ICS 253

SWE 326 Software Testing and Quality Assurance**(3-0-0)**

Concept of software quality, and software quality metrics. Software quality assurance planning & implementation. Quality process standards. Validation & verification. Reviews, walkthroughs, & inspections. Mechanisms for validating software systems. Techniques for generating and validating test data. Students participate in a group project on software validation and verification.

Prerequisites: SWE 312 and SWE 316

SWE 344 Internet Protocols and Client-Server Programming**(2-3-3)**

Principles of inter-network architecture and communication protocols. Open systems and interoperability. Case studies of particular protocols from network layer and above. Socket programming. Remoting. Selected examples of networked client-server applications such as e-mail, news, file-transfer, HTTP. Client-Server Programming Project(s). Using APIs. Software tools and environments.

Prerequisites: ICS 202

SWE 363 Web Engineering and Development**(3-0-3)**

Web Engineering fundamentals: requirements, analysis modeling, design modeling, testing. Internet basics for web applications. Technologies and tools for developing web applications: markup languages, styling, data description and transformation, client and server side programming. Web services. Advances in web engineering.

Prerequisites: Junior Standing

SWE 387 Software Project Management**(3-0-3)**

Introduction project management concepts, tools, and techniques: integration management and project planning, scope management, scheduling, budget control, human resource management, communication management, risk analysis and management, project quality management, and procurement management.

Prerequisites: Junior Standing

SWE 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: SWE 363, ENGL 214, and Department Approval

SWE 416 Software Architecture**(3-0-3)**

Study the concepts, principles, methods, and best practices in software architecture. Different architectural styles, patterns and product lines are presented and compared. Methods to analyze, evaluate and document software architectures are also discussed. Students participate in a group project on software architecture design.

Prerequisites: SWE 316

SWE 417 Software Engineering Project I**(1-6-3)**

This is the first part of a two-semester senior-year capstone project. Student teams employ knowledge gained from courses throughout the program such as development of requirements, design, implementation, and quality assurance to develop a software solution to a real-world problem from conception to completion. In this part students develop project plan, software requirement specification and software design document.

Prerequisites: SWE 326 and SWE 387

SWE 418 Software Engineering Project II**(0-6-2)**

This is the second part of a two-semester, senior-year capstone project. Student teams employ knowledge gained from courses throughout the program such as development of requirements, design, implementation, and quality assurance to develop a software solution to a real-world problem from conception to completion. In this part, students implement the design they produced in SWE 417, test their code, and evaluate their final product.

Prerequisites: SWE 417

SWE 436 Object-Oriented Design Patterns**(3-0-3)**

A depth study of object-oriented design patterns. How design patterns solve design problems? How to select a design pattern? How to use a design pattern? Detailed study of creational patterns, structural patterns, and behavioral patterns. Case studies.

Prerequisites: SWE 316

SWE 469 Software Metrics**(3-0-3)**

Overview of software metrics, basics of measurement theory, goal-based framework for software measurement, empirical investigation in software engineering. Measuring internal product attributes, measuring external product attributes, measuring cost and effort, measuring software reliability, software test metrics, and object-oriented metrics.

Prerequisites: SWE 316 and STAT 319

SWE 487 Software Processes and Process Improvements.**(3-0-3)**

Software process models. Software process analysis. Life cycle process models and standards. Process implementation at various levels like organization, project, team, or individual. Measurement and analysis of software process. Process improvements.

Prerequisite: SWE 326

SWE 490 Special Topics I**(3-0-3)**

In-depth study of a selected special topic relevant to software engineering

Prerequisites: Senior Standing

SWE 491 Special Topics II**(3-0-3)**

In-depth study of a selected special topic relevant to software engineering

Prerequisites: Senior Standing