German-Jordanian University

School of Electrical Engineering and Information Technology

Bachelor of Science in

Computer Engineering

Study Plan

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1. Introduction

Emerging global knowledge economies have created a demand for highly skilled Information and Communication Technology (ICT) workforce in all industries. As a result, ICT labor markets have become highly competitive. With the tremendous wealth recently generated in the Gulf States and subsequent industrial booms, such markets in the region became highly attractive to many Jordanian ICT workers. A large number of experienced ICT professionals leave the country every year. Faced with such conditions, the demand for a highly skilled ICT workforce has increased tremendously. As the result of workforce migration, the ICT workforce in Jordan comprise of graduates who are young and possess little experiences and knowledge. Therefore, the necessity to educate and develop a qualified workforce to support Jordan economy and compete on an international level is paramount.

In Jordan, current trends indicate that the skill set composition of the ICT workforce is changing. With a growing pool of 19,000 ICT related labor force and steadily inflowing 6,000 ICT graduates yearly, Jordan has a potential to become a regional leader in the ICT sector[1]. The available evidence confirms that the current quality of ICT education cannot meet the labor market requirements; neither can it cope with the evolution of ICT technologies. In spite of the growing importance of ICT workforce, very little efforts have been made to implement quality and relevance ICT education in Jordan. The need for better quality and relevance of workforce skills has been identified by the Information Technology Association - Jordan as one of the challenges facing the ICT sector and affecting its growth, development and effectiveness.

To help meet these emerging demands on ICT education and address market needs, the School of Electrical Engineering and Information Technology envisioned since its inception in 2005 a unique approach to expand on the long experience of the German model of applied science and contribute to building a premier quality and relevant, industry oriented ICT education in Jordan. The goals are high level quality in education and research, international co-operation, rich interaction and partnerships with enterprises, and focus on relevant academic programs.

The B.Sc. in Computer Engineering program at GJU provides a unique educational environment. It offers small classes, outstanding facilities, and an extremely supportive staff. It also offers peer tutoring and technical support sessions that would help students move forward on a road towards success. Our faculty includes some of the disguised professors and researchers that are specialized in various topics the computer engineering field.

The projected unrivalled quality of education in the Department of Computer Engineering at GJU not only contributes to the advancement and progress in the ICT sector in Jordan, but also began to serve as an icon within the country. The B.Sc. in Computer Engineering program has been able to train professionals and experts who began to contribute to the Jordanian economy.

[1] JIB Report (2006), Jordan Investment Board, *Information Communication Technology Sector*, URL: http://www.jordaninvestment.com/

2. Program Objectives

The mission of the Department of Computer Engineering is to offer a CE undergraduate program that augments the liberal education expected of all German Jordanian University undergraduates and imparts a basic understanding of computer engineering built on a foundation of physical science, mathematics, computing, and technology.

Graduates of the undergraduate program should possess knowledge of computer engineering fundamentals and one specialty area. They are expected to have the basic experimental, design, and communication skills to be prepared for continued study at the graduate level or entry level positions that require basic knowledge of computer engineering, science, and technology.

The educational objectives for the Department of Computer Engineering are:

1. Technical Knowledge: Provide a basic knowledge of computer engineering principles along with the required supporting knowledge of mathematics, science, computing, and engineering fundamentals. The program includes depth in one specialty area, currently including Software Systems, Embedded Systems, Computer Networks, and Operating Systems.

2. Laboratory and Design Skills: Develop the basic skills needed to perform and design experimental projects. Develop the ability to formulate problems and projects and to plan a process for solutions taking advantage of diverse technical knowledge and skills.

3. Communications Skills: Develop the ability to organize and present information, and to write and speak effective English.

4. Preparation for Further Study: Provide sufficient breadth and depth for successful subsequent graduate study, post-graduate study, or lifelong learning programs.

5. Preparation for the Profession: Provide an appreciation for the broad spectrum of issues arising in professional practice, including teamwork, leadership, safety, ethics, service, economics, and professional organizations.

3. Learning Outcomes

Students completing the program earn a Bachelor of Science in Computer Engineering. The program has been designed so that graduates will have:

- An ability to apply knowledge of mathematics, science, and engineering
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to design a system, component, or process to meet desired needs
- An ability to function on multi-disciplinary teams
- An ability to identify, formulate, and solve engineering problems
- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- The broad education necessary to understand the impact of engineering solutions in a global and societal context
- A recognition of the need for, and an ability to engage in, life-long learning
- A knowledge of contemporary issues
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- Background for admission to engineering or other professional graduate programs

4. Degree Requirements

Framework for B.Sc. Degree (Semester Credits)

The Bachelor of Science degree in Computer Engineering requires successful completion of the following course requirements**.**

Classification	Credit Hours		
	Compulsory	Elective	Total
University Requirements	**21**	**6**	**27**
School Requirements	**26**	**0**	**26**
Program Requirements:	**108**	**15**	**123**
Total =	**155**	**21**	**176**

1. University Requirements: (27 Credit Hours)

1.1. Compulsory : (21 Credit Hours)

Course No.	Course Title	Cr. Hr.	Lecture /week	Lab./ week	Prerequisite
ARB 99*	Arabic 99	0	0	3	-
ARB 100*	Arabic	3	3	0	-
ENGL 98*	English I	0	3	0	-
ENGL 99*	English II	0	0	3	ENGL 098
ENGL 101*	English III	1	0	3	ENGL 099
ENGL 102*	English IV	1	0	3	ENGL 101
ENGL 201*	English V	2	0	3	ENGL 102
ENGL 202*	English VI	2	0	3	ENGL 201
GERL 101*	German I	3	0	9	-
GERL 102	German II	3	0	9	GERL 101
MILS 100	Military Sciences	3	3	0	For Jordanian only
NE 101	National Education (in Arabic)	3	3	0	ARB 99
	National Education (in English)	3	3	0	ENGL 101
	Total	**21**			

* Student's score on placement test will decide the course level to start from

1.2.Elective: (6 Credit Hours)

Students have to choose 6 credit hours from the following courses:

Course No.	Course Title	Cr. Hr.	Lecture	Lab.	Prerequisite
PE101	Sport and Health	3	3	0	ARB 99
IC 101	Intercultural Communications	3	3	0	ENGL 101
SFTS 101	Soft Skills	3	3	0	ENGL 101
DES 101	Arts Appreciation (in Arabic)	3	3	0	ARB 99
	Arts Appreciation (in English)	3	3	0	ENGL 101
EI 101	Leadership and Emotional Intelligence	3	3	0	ENGL 101
BE 302* OR SE 301*	Business Entrepreneurship OR Social Entrepreneurship and Enterprises	3 OR 3	3	0	ENGL 101

(*) students cannot register for both SE301 and BE302

2. School Requirements: (26 Credit Hours)

Course No.	Course Title	Cr. Hr.	Lecture/ week	Lab./ week	Prerequisite
GERL 201	German III	3	6	0	GERL 102
GERL 202	German IV	3	6	0	GERL 201
MATH 099	Pre-Math	0	3		
MATH 101	Calculus I	3	3	0	MATH 099*
MATH 102	Calculus II	3	3	0	MATH 101
MATH 231	Probability and Statistics for Engineers	3	3	0	MATH 101
CS 113	Computing Fundamentals	4	3	3	
CE 352	Computer Networks	3	3	0	CS 212, CE 211
CE 211	Digital Systems	4	3	3	
	Total	**26**			

* Placement test

3. Program Requirements (123 Credit Hours)

3.1. Compulsory Courses (108 Credit Hours):

Course No.	Course Title	Cr. Hr.	Lecture /week	Lab./ week	Prerequisite
GERL 301	German V	3	6	0	GERL 202
GERL 302	German VI	3	9	0	GERL 301
CS 212	Object Oriented Programming	4	3	3	CS 113
CE 201	Computer Architecture and Organization	3	3	0	CE 211
CE 351	Operating Systems	4	3	3	CE 201
PHYS 103	Physics I	3	3	0	
PHYS 104	Physics II	3	3	0	PHYS 103
PHYS 106	Physics Lab	1	0	3	Co-requisite: PHYS 104
IE 121	Engineering Workshop	1	0	3	
MATH 203	Applied Mathematics for Engineers	3	3	0	MATH 102
MATH 205	Differential Equations	3	3	0	MATH 102
CS 201	Discrete Structures	3	3	0	
ENE 211	Electrical Circuits I	3	3	0	MATH 203
ENE 212	Electrical Circuits II	3	3	0	ENE 211
ENE 213	Electrical Circuits Lab	1	0	3	ENE 211
CS 222	Theory of Algorithms	3	3	0	CS 113, CS 201
CS 223	Data Structures	3	3	0	CS 113
ECE 241	Electronics 1	4	3	3	ENE 211
ECE 2410	Electronics 1 Lab	1	0	3	Co-requisite: ECE 241
ECE 343	Digital Electronics	3	3	0	ECE 241
ECE 3430	Digital Electronics Lab	1	0	3	Co-requisite: ECE 343
CE 331	Signals and Systems	3	3	0	MATH 203
CE 341	Microprocessor and Microcomputer Systems	4	3	3	CE 211
CS 342	Software Engineering	3	3	0	CS 212
CS 414	Systems Programming	4	3	3	CE 351
ECE 331	Electromagnetics 1	3	3	0	MATH 203, MATH 205
CE 441	Embedded System Design	3	3	0	CE 351, CE 341
CE 355	Data Communication	3	3	0	CE 331
CS 361	Database Management Systems	4	3	3	Pre requisite or Co-requisite: CS 222, CS 223

CE 3561	Computer Networks Lab	1	0	3	CE 352
CE 452	Network Protocols	3	3	0	CE 352
CE 512	Advanced Logic Design	3	3	0	CE 211 CE 351
CE 502	Parallel Architectures and Parallel Algorithms	3	3	0	CE 201, CS 222, CS 223
CE 391	Field Training	0	0	0	Department Consent
CE 493	International Internship	12	0	36	Department Consent
CE 592	Senior Project I	1	0	3	Department Consent
CE 594	Senior Project II	3	0	9	CE 592
	Total	**108**			

3.2. Elective Courses (15 Credit Hours):

Students have to choose 15 credit hours from the following courses:

Course No.	Course Title	Cr. Hr.	Lecture /week	Lab./ week	Prerequisite
CE 353	Distributed Systems	3	3	0	CE 352
CE 354	Computer Security	3	3	0	CE 352
CE 461	Image Processing	3	3	0	CE 331, MATH 231
CE 471	Software Design and Architecture	3	3	0	CS 342
CE 473	Software Requirements Analysis	3	3	0	CS 342
CE 474	Software Quality Assurance and Testing	3	3	0	CS 342
CE 501	Advanced Computer Architecture	3	3	0	CE 351
CE 521	Robotics	3	3	0	CME 343
CE 523	Machine Learning	3	3	0	
CE 551	Advanced Operating Systems	3	3	0	CE 351
CE 552	Advanced Computer Networks	3	3	0	CE 352
CE 558	Special topics in Computer Networks	3	3	0	CE352: Computer Networks
CE 559	Special topics in Operating Systems	3	3	0	CE351: Operating systems
CE 596	Special topics in Intelligent Systems	3	3	0	
CE 579	Special topics in Software Engineering	3	3	0	CS 341: Software Engineering
CS 482	Special topics in Software Engineering	3	3	0	CS 341: Software

					Engineering
CE 597	Special Topics in Computer Engineering I	1	1	0	
CE 598	Special Topics in Computer Engineering II	2	2	0	
CE 599	Special Topics in Computer Engineering	3	3	0	
ME 343	Automatic Control Systems	4	3	3	Math 203
CE 442	Microcomputer Interface and Peripheral Devices	4	3	3	CE 341
CS 213	Component-Based Computing and Web Applications Development	4	3	3	CS 212
CS 477	Mobile Computing	3	3	0	CS 212, CE351
CE 520	Cognitive robotics	3	3	0	CS 212

The table above can be extended by mutual agreement.

Students may also select a maximum of six credits of 300 level and above courses from other departments in the School of Electrical Engineering and Information Technology in order to fulfill the elective requirements.

Study Plan Guide for the Bachelor Degree in Computer Engineering

First Year			
First Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
CS 113	Computing Fundamentals	4	
ENGL 101	English III	1	ENGL 099
GERL 101	German I	3	
MATH 101	Calculus I	3	
PHYS 103	Physics I	3	
	University Elective Course	3	
ARB 100	Arabic	3	
	Total	**20**	

Second Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
CS 201	Discrete Structures	3	
CS 212	Object Oriented Programming	4	CS 113
ENGL 102	English IV	1	ENGL 101
GERL 102	German II	3	GERL 101
MATH 102	Calculus II	3	MATH 101
PHYS 104	Physics II	3	PHYS 103
PHYS 106	Physics Lab	1	Co-requisite: PHYS 104
	Total	**18**	

Second Year			
First Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
CE 211	Digital Systems	4	
CS 222	Theory of Algorithms	3	CS 113, CS 201
CS 223	Data Structures	3	CS 113
ENGL 201	English V	2	ENGL 102
GERL 201	German III	3	GERL 102
MATH 203	Applied Mathematics for Engineers	3	MATH 102
	Total	**18**	

Second Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
CE 201	Computer Architecture and Organization	3	CE 211
MATH 205	Differential Equations	3	MATH 102
ENGL 202	English VI	2	ENGL 201
ENE 211	Electrical Circuits I	3	MATH 203
GERL 202	German IV	3	GERL 201
MATH 231	Probability and Statistics for Engineers	3	MATH 101
	Total	**17**	

Third Year			
First Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
CE 331	Signals and Systems	3	MATH 203
ECE 241	Electronics 1	3	ENE 211
ECE 2410	Electronics 1 Lab	1	Co-requisite: ECE 241
CE 351	Operating Systems	4	CE 201
CE 352	Computer Networks	3	CS 212, CE 201
GERL 301	German V	3	GERL 202
NE 101	National Education	3	
	Total	**20**	

Second Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
ENE 213	Electrical Circuits Lab	1	ENE 211
CS 361	Database Management Systems	4	Pre-requisite or Co-requisite: CS 222, CS 223
CE 3561	Computer Networks Lab	1	CE 352
ENE 212	Electrical Circuits II	3	ENE 211
CE 391	Field Training	0	Department Contest
CE 341	Microprocessor and Microcomputer Systems	4	CE 211
GERL 302	German VI	3	GERL 301
ECE 343	Digital Electronics	3	ECE 241
ECE 3430	Digital Electronics Lab	1	Co-requisite: ECE 3430
	Total	**20**	

Fourth Year			
First Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
	Program Elective Course	3	
	Program Elective Course	3	
	Program Elective Course	3	
	Program Elective Course	3	
	Total	**12**	

Second Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
CE 493	International Internship 6 Months Industry intern in Germany	12	Department Contest
	Total	**12**	

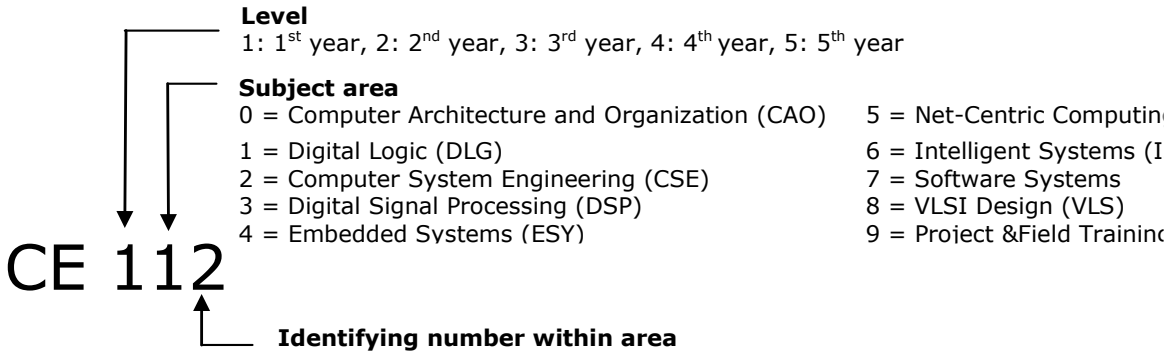
Fifth Year			
First Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
CE 452	Network Protocols	3	CE 352
	University Elective Course	3	
CE 592	Senior Project I	1	Department Contest
CE 512	Advanced Logic Design	3	CE 211 CE 351
MILS 100	Military Science	3	
CE 355	Data Communication	3	CE 331
ECE 331	Electromagnetics 1	3	MATH 203, MATH 205
	Total	**19**	

Second Term			
Course No.	**Course Title**	**Cr. hr.**	**Prerequisite**
CE 502	Parallel Architectures and Parallel Algorithms	3	CE 201, CS 222, CS 223
CS 414	Systems Programming	4	CE 351
CS 342	Software Engineering	3	CS 212
CE 594	Senior Project II	3	CE 592
CE 441	Embedded System Design	3	CE 351, CE 341
IE 121	Engineering Workshop	1	
	Program Elective Course	3	
	Total	**20**	

Generating the Course Code

The numbering system is structured as follows (from left to right):

1. Alpha digits: CE: Computer Engineering
2. Level digit: 1, 2, 3, 4, or 5 for course level year one to five
3. Subject area digits; One digit: serial number within a given are



Description of Courses Taken from the Computer Engineering Department

CE 201: Computer Architecture and Organization
Basic computer organization, central processing unit, micro-program control and control unit, arithmetic processor, memory units, bus structures, interrupt structures. Taxonomies of computer architectures; addressing methods, programs control, processing units, I-O organization, arithmetic, main-memory organization, peripherals, microprocessor families, RISC architectures and multiprocessors. Von Neumann; Baseline of processor architecture; Memory organization; Parallel computing;
Prerequisites: CE 211
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 211: Digital Systems
Fundamentals of digital electronics, Binary number system; Boolean algebra, logic operations, algebra and gates, digital circuits analysis, gate-level and block level design of digital circuits, adders, subtractors, comparators, multiplexers, decoders, analysis, design and applications of sequential circuits: flip-flops, registers, counter, and their design procedures, RAM and ROM memory elements. The course also includes 3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered in the course: basic logic gate experiments, combinational logic circuits experiments, and sequential logic circuits experiments. The experiments on all topics vary from functional troubleshooting to gate and block level design implementation.
Prerequisites: -
Credit Hours: 4, Lecture Hours: 48, Lab Hours: 48

CE 331: Signals and Systems
Concepts and mathematical tools in continuous and discrete-time signal processing and linear systems analysis with examples from digital signal processing, communications, and control. Discrete-time signal models. Continuous-discrete-continuous signal conversion. Discrete-time impulse and step response. Frequency domain representations: Fourier series and transforms. Connection between continuous and discrete time frequency representations. Discrete Fourier transform (DFT) and fast Fourier transform (FFT). Digital filter and signal processing examples. Discrete-time and hybrid linear systems. Stability and causality. Z transforms and their connection to Laplace transforms. Frequency response of discrete-time systems.
Prerequisites: MATH 203
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 341: Microprocessor and Microcomputer Systems
Introduction to theoretical concepts of 8-bit and 16-bit microprocessors including microprocessor architecture, memory organization, instruction set, input/output organization, and interrupts. Design of microcomputer systems, address maps, system bus, memory maps, peripheral I/O, memory-mapped I/O, interrupt-driven I/O, interface devices, and general-purpose programmable peripheral devices.
Prerequisites: CE 211
Credit Hours: 4, Lecture Hours: 48, Lab Hours: 48

CE 351: Operating Systems
Operating system structures, process concept, hierarchy of processes, semaphores, inter-process communication, CPU scheduling, deadlocks, memory management, virtual memory, secondary storage management, file systems, I/O systems. 3-hours lab covers hands-on-experience on a study development of a sample operating system and alternative designs of operating systems: programming language development, advanced commands, shell programming, and design principles. The focus of the sample operating system will be on the Linux Open Source to equip students with the right skills to work with open sources software.
Prerequisites: CE 201
Credit Hours: 4, Lecture Hours: 48, Lab Hours: 48

CE 352: Computer Networks
Study of computer network architectures, protocols, and interfaces. The OSI reference model and Internet architecture. Network models: LAN and WAN; Networking techniques such as multiple access, packet/cell switching, internetworking, end-to-end protocols, and congestion control; IP, UDP and TCP protocols; Internet application protocols and applications: http; DNS; Web services; email protocols: SMTP, POP3; Network security. The students are expected to implement a project in the field of computer networks and to use open source network simulators such as NS2.
Prerequisites: CS 212, CE 201
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 3561: Computer Networks Lab
Gain hands on experience on computer network protocols and interfaces, OSI reference model, and Internet protocols.
Prerequisites: CE 351
Credit Hours: 3, Lecture Hours:0, Lab Hours: 48

CE 353: Distributed Systems
Use and complexity of distributed systems; general integration problems application protocols; technical infrastructures for distributed programming; distribution strategies, i.e. load balancing, replication, fault tolerant systems Architectures and topologies; Distribution models; Reasons for distributed systems; Communication in distributed systems: Review of the OSI reference model; Communication mechanism; Middleware; Server and client programming; Client-server paradigm; Concurrent server programming; Asynchronous clients; Technologies: IP sockets; Remote invocation: RPC paradigm: C RPCs and Java RMI; Distribution strategies; Load balancing ; Fault tolerance and replication.
Prerequisites: CE 352
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 354: Computer Security
Security of networked computer systems; secure network configuration and user management; handling of attacks; Tools for secure network management; System management; System administration; System programming for security; Security: local attacks; network attacks; Firewalls; Security of web servers, ftp servers and mail servers; Virtual private networks, Cryptography, encryption and decryption techniques, primary key and digital certificate principles, Public Key Cryptography and the RSA Algorithm.
Prerequisites: CE 352
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 355: Data Communication
Fundamentals of Data Communications. Transmission Media, Data Encoding, Transmission Techniques, Protocols, Switching Networks, Broadcast Networks, Local Area Networks (LANs) and Wide Area Networks (WANs). Transmissions Technique and Cables. Troubleshooting Methods. Communication Interfaces. Network Security. Error Detection and Correction Methods. Modems Modulation Techniques for Digital Data Transmission, Data Link Protocols. High-Speed Packet Switching and Message Switching. OSI Reference Model. TCP/IP Protocols. Routing and Flow Control. Fundamentals of Frame Relay, ATM, X.25. Application Services, HTTP, Cryptography, MIME, E-mail. Telecommunication Services, ISDN, xDSL. New Technologies, IP Telephony, H323, WAP.
Prerequisites: CE 331
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 391: Field Training
Students must complete 160 hours of field training in approved industries in Jordan by the end of their third academic year.
Prerequisites: Department Contest
Credit Hours: 0, Lecture Hours: 0, Practical Hours: 160

CE 441: Embedded System Design
Embedded system concepts, hardware architecture, design and debugging, embedded processor selection, software development methodologies, real-time Linux, synchronization mechanisms, interrupt latency, application programming interface, interrupt service routine, application design considerations.
Prerequisites: CE 351, CE 341
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 461: Image Processing
This course covers image processing theory and techniques. Topics include: image models, image transformations, image enhancement, image restoration, image compression, image segmentation, and image recognition.
Prerequisites: CE 331, MATH 231
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 471: Software Design and Architecture
In-depth software design concepts; design patterns, frameworks, and architectures; middleware architectures. Design of distributed systems using middleware. Component based design. Measurement theory and appropriate use of metrics in design. Design qualities such as performance, safety, security, reusability, reliability, etc. Measuring internal qualities and complexity of software. Evaluation and evolution of designs. Basics of software evolution, reengineering, and reverse engineering methodologies.
Prerequisites: CS 342
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 473: Software Requirements Analysis
General principles and techniques for software design. BNF Domain engineering. Techniques for discovering and eliciting requirements. Languages and models for representing requirements. Analysis and validation techniques, including need, goal, and use case analysis. Requirements in

the context of system engineering. Specifying and measuring external qualities: performance, reliability, availability, safety, security, etc. Specifying and analyzing requirements for various types of systems: embedded systems, consumer systems, web-based systems, business systems, systems for scientists and other engineers. Resolving feature interactions. Requirements documentation standards. Traceability. Human factors. Requirements in the context of agile processes. Requirements management and handling requirements changes.
Prerequisites: CS 342
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 474: Software Quality Assurance and Testing
Quality assurance and verification; Need for a culture of quality. Avoidance of errors and other quality problems; Inspections and reviews; Testing, verification and validation techniques; Process assurance vs. Product assurance; Quality process standards; Product and process assurance. Problem analysis and reporting; Statistical approaches to quality control.
Prerequisites: CS 342
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 493: Field Training
A training period of six month to be spent in the industry in Germany, under a follow up of academic faculty in Jordan and in Germany. Periodic reports and a final report need to be submitted for evaluation and an oral examination is required.
Prerequisites: Department Contest
Credit Hours: 9, Lecture Hours: 0, Practical Hours: 40 Hours/week

CE 501: Advanced Computer Architecture
This course focuses on advanced system-level architecture techniques for devices such as personal computers, servers, and embedded or portable systems. It covers topics such as cache hierarchies, memory systems, storage and IO systems, virtualization, clusters, fault-tolerance, and low-power design. It also covers the interactions between the hardware and software layers in such systems. The programming assignments provide an introduction to performance analysis and optimization techniques for small-scale and large-scale systems.
Prerequisites: CE 351
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 502: Parallel Architectures and Parallel Algorithms
Parallelism in processors; multi-core processors; classification of parallel architectures; multiprocessor architectures; interconnections networks; Amdahl's law; abstract parallel machine models; templates for parallel algorithms; searching, merging, sorting; graph algorithms (traversing, spanning trees, connected components); numerical algorithms (matrix algorithms, linear equations)
Data dependencies; shared memory computing (threads, OpenMP); message passing computing; parallelization strategies (embarrassingly parallel, partitioning, pipelined, synchronous); load balance.
Prerequisites: CE 201, CS 222, CS 223
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 521: Robotics
Introduction to basics of modeling, design, planning, and control of robot systems. Topics include: robotics foundations in kinematics, dynamics, control, motion planning, trajectory generation, programming and design.
Prerequisites: CME 343

Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 520: Cognitive Robotics

This introductory course gives an overview of the cutting-edge world of Robot Operating System (ROS), an open source system for working with robots. ROS is used widely in research and is starting to be used commercially. This course will mainly focus on utilizing ROS in the field of robot perception such as the perception for manipulating objects, perception of people and other moving objects. Different open source tools beside ROS will be used such as the Open Source Computer Vision Library (Open CV), the Point Cloud Processing Library (PCL) to develop a vision and navigation frameworks for robots. In this course, students will be responsible of reading and summarizing a selection of published papers, in order to get the required skills and basics to do state-of-the-art, publishable work in mobile robotic manipulation.

Prerequisites: CS 212

Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 551: Advanced Operating Systems

The course covers advance topics: virtual memory management, synchronization and communication, file systems, protection and security, operating system extension techniques, fault tolerance, and the history and experience of systems programming.

Prerequisites: CE 351

Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 552: Advanced Computer Networks

High-speed local networks; metropolitan area networks; bridges; routers; gateways; TCP/IP; application services; IP addressing; IP forwarding, encapsulation, and fragmentation; Address Resolution (ARP& RARP); IP next generation (IPv6); Inter Control Message Protocol (ICMP). Routing Algorithms, MPLS networking technology, VPNs, Network applications and services, Multimedia over internet, Network performance, and Network design. A set of laboratory experiments will provide hands-on experience in related topics

Prerequisites: CE 352

Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 523: Machine Learning

This course provides an introduction to learning and adaptation in natural and artificial systems. The main topics of the course include: search space, training and exploitation, rule-based learning, decision tree learning, instance-based (inductive) learning, deductive learning, reinforcement learning, bayesian learning, and evolutionary computation.

Prerequisites:

Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 592: Senior project I

Theoretical investigation and practical implementation of a special project under the supervision of an academic faculty member, detailed report as well as an oral examination are required.

Prerequisites: Department Contest

Credit Hours: 1, Lecture Hours: 0, Lab Hours: 3

CE 594: Senior project II

Theoretical investigation and practical implementation of a special project under the supervision of an academic faculty member, detailed report as well as an oral examination are required.

Prerequisites: CE 592

Credit Hours: 3, Lecture Hours: 0, Lab Hours: 9

CE 558: Special Topics in Computer Networks
This course is offered to senior level students in computer engineering. It gives them exposure to special topics in computer networks. Topics may vary each time the course is offered. Details of the course will be advertised by the department at the time of offering.
Prerequisites:
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 559: Special Topics in Operating Systems
This course is offered to senior level students in computer engineering. It gives them exposure to special topics in operating systems. Topics may vary each time the course is offered. Details of the course will be advertised by the department at the time of offering.
Prerequisites:
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 579: Special Topics in Software Engineering
This course is offered to senior level students in computer engineering. It gives them exposure to special topics in software engineering. Topics may vary each time the course is offered. Details of the course will be advertised by the department at the time of offering.
Prerequisites:
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CS 482: Special Topics in Software Engineering
This course is offered to senior level students in computer engineering. It gives them exposure to special topics in software engineering. Topics may vary each time the course is offered. Details of the course will be advertised by the department at the time of offering.
Prerequisites:
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 596: Special Topics in Intelligent Systems
This course is offered to senior level students in computer engineering. It gives them exposure to special topics in artificial intelligent, machine learning and pattern recognition. Topics may vary each time the course is offered. Details of the course will be advertised by the department at the time of offering.
Prerequisites:
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 599: Special Topics in Computer Engineering
This course is offered to senior level students in computer engineering. It gives them exposure to special topics in computer engineering. Topics may vary each time the course is offered. Details of the course will be advertised by the department at the time of offering.
Prerequisites:
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 452: Network Protocols
Topics include the TCP/IP networking protocol architectures, layering, encapsulation, PDUs; sliding window algorithms, flow and error control, and the HDLC and PPP protocols; the OSI network layer organization, virtual circuits and datagrams, routing and congestion control algorithms, the X.25 and Frame Relay protocols and, internetworking, IPv4 and the evolving IPv6 internetworking protocols, and the RIP, OSPF, ES-IS, and IS-IS routing protocols, session layer

dialog control and activity management, queuing, , packet scheduling, network security protocols; IPSec and VPNs, performance analysis, testing, correctness, SNMP, Wireless network protocols, Multi-Protocol Label Switching (MPLS), multimedia and real time network protocols.
Prerequisites: CE 352

Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CE 512: Advanced Logic Design
Basic semiconductor physics, Digital Systems families, design methodologies, Digital Systems circuits, programmable logic devices, Digital Systems implementation with CPLD and FPGA, Verilog/VHDL compilation for CPLDs and FPGAs, synthesis of Altera/Xilinx CPLD and FPGA, synchronous versus asynchronous design, clock skew and path delays, PCB layout, post routing issues, embedded RAM and design criteria.
Prerequisites: CE211 and CE 351
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

Description of Courses Taken from other Departments at GJU

MILS 100: Military Sciences
History of the Jordanian Arab Army. United Nations Peace Keeping Forces. Preparation of the nation for defense and liberation. History of the Hashemite Kingdom of Jordan and its development.
Prerequisites: - None
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ARB 100: Arabic
Grammar and structure. Rectifying weakness in linguistic application; training in sound reading. Dictation; use of language in a manner free from grammatical and linguistic errors; accurate expression of intended meaning. Study and analysis of literary texts through the discussion of linguistic, grammatical and writing skills therein.
Prerequisites: None
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ENGL 098: English I (Elementary English)
Students will focus on English at an elementary level concentrating on the receptive skills of reading and listening, and the productive skills of writing and speaking. These will include such things as independent clauses, verb tenses, model verbs, adverbs, short dialogues, reading simple material and answering short questions, writing short meaningful sentences, listening to short conversations.
Prerequisites: None
Credit Hours: 0, Lecture Hours: 48, Practical Hours: 0

ENGL 099: English II (Pre-Intermediate English)
Students will focus on English at a pre-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. These will include such things as comparatives and superlatives, quantifiers, possessive adjectives and pronouns,

vocabulary building, role play activities for speaking, reading comprehension and writing short descriptive paragraphs.
Prerequisites: ENGL 098
Credit Hours: 0, Lecture Hours: 48, Practical Hours: 0

ENGL 101: English III (Intermediate English)

Students will focus on English at an intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. These will include collocations, tense review, affirmative, negative statements, synonyms and antonyms, time clauses, conditionals, active and passive forms, reported speech, phrasal verbs, reading comprehension with detailed questions, vocabulary and writing developed descriptive and opinion essays.
Prerequisites: ENGL 099
Credit Hours: 1, Lecture Hours: 48, Practical Hours: 0

ENGL 102: English IV (Upper-Intermediate English)

Students will focus on English at an upper-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. Model verb review, silent letters and proper pronunciation, jobs and careers, requests and offers, more phrasal verbs with vocabulary building, relative clauses and relative pronouns, narrative tenses for writing exercises, wishes and regrets, reading and comprehending longer passages with direct and inference questions of medium difficulty, hypothesizing, and writing fully developed descriptive, argumentative and analytical essays of 350 words.
Prerequisites: ENGL 101
Credit Hours: 1, Lecture Hours: 48, Practical Hours: 0

ENGL 201: English V (Advanced English I)

Students will focus on English at an Advanced level. Students will analyze and produce 2 – 3 page essays with an emphasis on argumentation and persuasion working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Class activities include interactive lectures, small group and class discussions, informal debates, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using basic literary terms and concepts.
Prerequisites: ENGL 102
Credit Hours: 2, Lecture Hours: 48, Practical Hours: 0

ENGL 202: English VI (Advanced English II)

Students will continue to focus on English at an Advanced level. Students will analyze and produce 4 – 5 page essays emphasizing argumentative, persuasive and discursive styles of writing, working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Students will integrate the practice of critical thinking and reading into the writing process. Class activities include interactive lectures, small group and class discussions, informal debates, mini-conferences, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using stronger and more intensive literary terms and concepts than in 201.
Prerequisites: ENGL 201
Credit Hours: 2, Lecture Hours: 48, Practical Hours: 0

GERL 101: German I
Can understand and use familiar, everyday expressions and very simple sentences, which aim at the satisfaction of specific needs. Can introduce oneself, and others, and ask others questions to themselves - e.g. where they live, which people they know or what kind of things they have - and can give answers on questions of this kind. Can communicate on a basic level if those involved with him/ her in a conversation speak slowly and clearly and are willing to help.
Prerequisites: -
Credit Hours: 3, Lecture Hours: 144, Practical Hours: 0

GERL 102: German II
Can understand sentences and frequently used expressions if those are connected with things of immediate meaning (e.g. information to the person and to the family, buying, work, closer environment). Can communicate in simple, routine situations, with the purpose of a simple and direct exchange of information about familiar and common things. Can describe with simple means their own origin and training, direct environment and things that are in connection with direct needs.
Prerequisites: GERL 101
Credit Hours: 3, Lecture Hours: 144, Practical Hours: 0

GERL 201: German III
Can understand the main points if no dialect is used and if it concerns familiar things about work, school, spare time etc. Can master most situations which one encounters on journeys in a German speaking area. Can express oneself simply and coherently about familiar topics and areas of personal interest. Can report experiences and events, describe dreams, hopes and goals and give short reasons or explanations about plans and opinions.
Prerequisites: GERL 102
Credit Hours: 3, Lecture Hours: 96, Practical Hours: 0

GERL 202: German IV
Can understand the main contents of complex texts, as well as concrete and abstract topics; even discussions between specialists in his/ her own special field. Can communicate spontaneously and fluidly a normal discussion with native speakers, without larger effort on both sides. Can express oneself clearly and in detail in a broad spectrum of topics, describe a point of view to a current question and indicate the pro and cons of different possibilities.
Prerequisites: GERL 201
Credit Hours: 3, Lecture Hours: 96, Practical Hours: 0

GERL 301: German V
Can understand and also seize implicit meanings of a broad spectrum of demanding, longer texts. Can express oneself spontaneously and fluidly, recognizing words without having to search for words frequently. Can use the language effectively and flexibly in social and vocational life or in training and study. Can express oneself clearly, structured and detailed, to complex subjects and use appropriate different means for linkage of texts.
Prerequisites: GERL 202
Credit Hours: 3, Lecture Hours: 96, Practical Hours: 0

ENE 211: Electrical circuits I
Overview: SI units, voltage and current; Ohm's and Kirchhoff"s Laws, circuits with dependent sources; simple resistive circuits: series, parallel and delta to wye; Techniques of circuit analysis: nodal and mesh analyses, source transformation, Thevenin and Norton equivalents; Amplifiers; Inductance, capacitance and mutual inductance; Natural and step responses of RL and RC circuits; Natural and step response of series and parallel RLC circuits; Sinusoidal steady state analysis.
Prerequisites: MATH 203
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ENE 212: Electrical circuits II
Calculating average and reactive power, power in parallel loads, maximum power transfer. Analysis of 3-phase circuits: calculating wattmeter readings in 3-phase circuits. Introduction to Laplace Transform: poles and zeros, initial- and final value theorems. The Laplace Transform in circuit analysis. Active filter circuits. Fourier series. The Fourier Transform. Two-port circuits.
Prerequisites: ENE 211
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ENE 213: Electrical Circuits Lab
Resistive circuits, Potentiometers, Superposition, Thevenin’s theorem and maximum power transfer, RLC current and voltage characteristics, Frequency response of RL, RC and RLC circuits, Series and parallel resonant circuits, Amplifiers.
Prerequisites: ENE 211
Credit Hours: 1, Lecture Hours:0, Lab Hours: 48

ECE 241: Electronics 1
Introduction to (semiconductor) electronic devices. Semiconductor p-n junction, the transistor. Analysis and synthesis of linear and nonlinear electronic circuits containing diodes and transistors. Elementary analog circuit analysis. Fundamentals of transistors and voltage amplification. Characterization of MOS transistors for circuit simulation. Common-source amplifiers, MOSFET source-follower buffer stage, differential amplifier stage, and MOSFET current sources. Operational amplifiers. Development of a Basic CMOS Operational amplifier.
Prerequisites: ENE 211
Credit Hours: 4, Lecture Hours: 48, Practical Hours: 48

CME 331: Electromagnetics 1
Review of Vector analysis and calculus, static electric and magnetic fields, capacitance and inductance. Maxwell's equations solutions, reflection and refraction of plane waves in dielectric and conducting media, transmission lines; transients and frequency domain solutions in loss and lossless lines, Smith chart and its applications, parallel plate and rectangular waveguides.
Prerequisites: MATH 203, MATH 205
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

ECE 343: Digital Electronics
Digital electronic topics include determining the logic voltage levels, speed and power of Bipolar Junction Transistor, BJT and Field Effect Transistor, FET logic circuits and latching circuits. Also covered will be analysis of BJT and FET ROM and RAM cells. Analog topics include input resistance, output resistance and voltage and current gain of single transistor amplifiers. Cascading and coupling of multiple transistors producing differential circuits, constant current sources and high gain amplifiers will also be discussed. The course will conclude with a discussion of feedback and stability of feedback amplifiers.
Prerequisites: ECE 241
Credit Hours: 4, Lecture Hours: 48, Practical Hours: 48

PHYS 103: Physics I (Mechanics)
Physics and measurement. Motion in one dimension. Vectors . Motion in two dimensions. Force and motion. Kinetic energy and work. Potential energy and conservation of energy. Linear momentum and collisions. Rotation. Rolling and angular momentum.
Prerequisite: None
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

PHYS 104: Physics II (Electricity and Magnetism)
Electric Fields. Gauss's Law. Electric Potential. Capacitance and Dielectrics. Current and Resistance. Direct Current Circuits. Magnetic Fields. Sources of Magnetic Field. Faraday's Law.
Prerequisite: PHYS 103
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

MATH 101: Calculus I
This course introduces the student to the calculus of single-valued functions. Topics include: limits, continuity, rates of change, rules for differentiating, differentials and local linear approximations, maxima and minima problems, L'Hôpital's rule, related rates, logarithmic and implicit differentiation, inverse trigonometric and hyperbolic functions, Rolle's theorem, the mean-value theorem, and applications of derivatives and integrals.
Prerequisite: None
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

MATH 102: Calculus II
This is a course in multivariate calculus as a continuation of Calculus I. The course focuses on power series, polar coordinates and polar functions, sequences and infinite series, vectors, functions of several variables and their limits, partial differentiation and their applications. The course views multiple integrals: double and triple, line integrals, surface integrals, Green's theorem, Gauss's divergence theorem, and Stoke's theorem.
Prerequisite: MATH 101
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

MATH 203: Applied Math for Engineers
Vector analysis in Cartesian coordinates. General Curvilinear Coordinates, Vector calculus in general curvilinear coordinates with emphasis on Spherical and Cylindrical coordinates, transformations between different coordinate systems, vector differentiation. Matrices and linear equations; Matrices and Linear Operators; Determinants, Eigenvalues and eigenvectors. Complex Numbers and Complex Variables; Representation of complex numbers, Powers and roots of complex numbers, Functions of a complex variable. Review of Infinite Series; Infinite series of constant terms, Convergence tests, Power series and radius of convergence, Taylor, and Maclaurin

series and Fourier series.
Prerequisites: MATH 102
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

MATH 205: Differential Equations
Ordinary differential equations; Sturm-Liouville theory, properties of Special Functions, Solution methods including Laplace transform, and Fourier transform. Eigenvalue problems and expansions in orthogonal functions. Partial differential equation: classification, separation of variables, solution by series and transform methods. Models in Applied Mathematics; Applications to illustrate typical problems and methods of applied mathematics in solid and fluid mechanics, fields of physics, deformation and vibration, wave phenomena, diffusion phenomena, heat conduction, chemical and nuclear reactors, and biological processes.
Prerequisites: MATH 102
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

MATH 231: Probability and Statistics for Engineers
This course familiarizes students with descriptive statistics, probability basics, random variables, special discrete random variables, and various distributions: normal, Student's t, Chi-square, and Fisher's F. It includes a discussion of inference about one mean, one proportion, difference between two means and difference between two proportions and the ratio of two variances, large and small samples, paired and independent samples. The MINITAB statistical software package will be used; there will also be an introduction to the use of SPSS.
Prerequisites: MATH 101
Credit Hours: 3, Lecture Hours: 48, Practical Hours: 0

IE 121: Engineering Workshops
General safety, materials and their classifications, measuring devices and their accuracy, basic household plumbing and electricity, fits and tolerances, theoretical background for the practical exercises including fitting, forging, carpentry, casting, welding, mechanical saws, shearers, drills, lathes, milling machines, shapers and grinders.
Prerequisite: None
Credit Hours: 1, Lecture Hours: 0, Practical Hours: 48

CS113: Computing Fundamentals
Basic computer skill; Programming concepts; algorithms: data types, arithmetic, logical, relational, Boolean, and assignment operators, simple input and output statements; programming control structures; data structures: single and multidimensional arrays; character strings; functions; pointers; file structures and representation; 3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered in the course using Gnu C compiler on a Solaris/Sun environment.
In the last 2 weeks students implement a course project that combines and covers the course topics in one application. The project is carried out during lecture and lab times as well as at home.
Prerequisites: None
Credit Hours: 4, Lecture Hours: 48, Lab Hours: 48

CS 201: Discrete Structures
Fundamental structures: Functions (surjections, injections, inverses, composition); relations (reflexivity, symmetry, transitivity, equivalence relations); sets (Venn diagrams, complements, Cartesian products, power sets); pigeonhole principle; cardinality and countability. Basic logic:

Propositional logic; logical connectives; truth tables; normal forms validity; predicate logic; limitations of predicate logic; universal and existential quantification; modus ponens and modus tollens. Proof techniques: Notions of implication, converse, inverse, contrapositive, negation, and contradiction; direct proofs; proof by counterexample; proof by contraposition; proof by contradiction; mathematical induction; strong induction; recursive mathematical definitions; well orderings Basics of counting: Counting arguments; pigeonhole principle; permutations and combinations; recurrence relations. Discrete probability: Finite probability spaces; conditional probability, independence Bayes' rule; random events; random integer variables; mathematical expectation
Prerequisites: MATH 101
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CS 212: Object-Oriented Programming
Object Oriented Programming concepts; Classes, objects and data abstraction, Constructors and destructors; Object-oriented design; encapsulation and information hiding; abstraction and modularization, coupling and cohesion, sample design patterns. inheritance; class and type hierarchies, polymorphism, Abstract classes, Interfaces; Packages; Collection classes, Generics, streams and files, exception handling; unit testing and debugging, Application Programming Interfaces, Javadoc, 3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered in the course using the Java compiler on a Solaris/Sun environment.
Prerequisites: CS 113
Credit Hours: 4, Lecture Hours: 48, Lab Hours: 48

CS 222: Theory of Algorithms
Complexity bounds and asymptotic analysis: standard complexity classes; Empirical measurements of performance; Time and space tradeoffs in algorithms; analysis of algorithms. Algorithms: recursion; recursive algorithms; divide-and-conquer strategies; backtracking; design of algorithms; sorting algorithms including heapsort, merge sort and quicksort, automata and string matching.
Prerequisites: CS 113, CS 201
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CS 223: Data Structures
Lists, stacks and queues; hash tables; binary search trees; balanced trees, B-Trees, graphs; depth- and breadth-first traversals; shortest-path algorithms; transitive closure; minimum spanning tree; topological sort. implementation strategies for data structures; strategies for choosing the right data structure; 3-hours lab session every week allows for implementing and using sample data structures and algorithms discussed during the course using Gnu C compiler.
Prerequisites: CS 113, CS 201
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

CS 342: Software Engineering
The product and the process, Software project management: Basic concepts, Software process and project metrics, Software project Planning, Risk management, Project scheduling and tracking, Quality assurance, Configuration management; Classical approaches: Waterfall and Spiral models; Object-oriented approach; Unified Modeling Language (UML); Concepts and notations of object-oriented analysis: Base concepts; Static concepts; Dynamic concepts; Object-oriented analysis: Analytical process; Analysis patterns; Static model; Dynamic model; Design notations and diagram; Design patterns. Course project that covers hands on experience on Computer Aided Software Engineering (CASE) tools such as Rational Rose and Course Team Projects.

Prerequisites: CS 212
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0

ME 343 Automatic Control Systems:

Modeling of electrical, pneumatic, hydraulic and mechanical systems, Transfer functions, block diagrams, and signal flow graph. Time domain analysis, test signals, transient response, steady state error and stability. Root locus, bode plots, PID control, phase-lead, phase lag. Software application such as Matlab and Simulink.
Prerequisites: MATH 203
Credit Hours: 4, Lecture Hours: 48, Lab Hours: 48

CS 361: Database Management Systems

DBMS Architecture, Storage Hierarchy, Indexes, Entity-relationship (E-R) modeling, The relational model, Relational Query Language (SQL), Query processing and optimization, Creation and manipulation of databases; Indices and views; Access rights management; Programming in SQL; Transaction Processing (Transactional properties, Concurrency control, Locking, and Crash recovery); Data dictionaries; Required software tools: A main-stream commercial DBMS such as MS SQL, Oracle; 3-hours lab covers hands on experience with design and implementing databases.
Prerequisite or Co-requisite: CS 222, CS 223
Credit Hours: 4, Lecture Hours: 48, Lab Hours: 48

CS 414: Systems Programming

System-level UNIX API's: Process manipulation; IO operations; Use of OS functionality; System-level programming in C; Shell programming; Unix system services: file system, process and thread management, inter-process communication: pipes, shared memory, and message queues, semaphores; Network programming, and synchronization; Microsoft Windows and UNIX TCP and UDP Communications; Connection-Oriented Client-Server Architecture; Remote procedure calls and COM overview; 3-hours lab covers hands on experience with design and implementing course subject using Linux, Solaris and Windows operating Systems.
Prerequisites: CE 351
Credit Hours: 4, Lecture Hours: 48, Lab Hours: 48

CS 213: Component-Based Computing and Web Applications Development

Component fundamentals; Interfaces; Object lifecycle services; Object brokers; Marshalling; Mobile components; Architecture of component-based systems; Component-oriented design; Event handling: detection, notification, and response; Middleware: object-oriented paradigm within middleware, Object request brokers, Transaction processing monitors, Workflow systems; Design patterns and components; Creational, structural and behavioral patterns; Component technologies such as J2EE and .NET, design, distribute, and re-use of software; Java Server Pages; Java Servlets, Enterprise Java Beans (EJB) – Session versus Entity beans, MVC-Struts design framework; 3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered in the course using Java and Gnu C/C++ compilers.
Prerequisites: CS 212
Credit Hours: 4, Lecture Hours: 48, Lab Hours: 48

CS 479: Mobile Computing

An introduction to mobile computing with a strong emphasis on application development for the Android operating system. Topics will include Introduction to Android IDE, Layout & Activity, Preference and Service Menu, Thread (message), Thread (progress, post, broadcast, & Intent filter), Notification, Dynamic layouts, TTS, and clocks SQLlite. This course will cover mobile phone programming components like UI programming, data management, localization, and programming

sensors like the accelerometer and compass, and mobile OS services. The course will focus on the Android platform and how to use cloud services in applications. Android tablets will also be given.
Prerequisites: CS 222, CS 223, CE 201.
Credit Hours: 3, Lecture Hours: 48, Lab Hours: 0