Revised Curriculum of BS Computer Science for Main Campus, Sub Campuses, and Affiliated Colleges

Department of Computer Science & Information Technology

University of Sargodha

(Applicable from Fall 2019)

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- BSCS program shall be offered under Term System observing University of Sargodha's Affiliation Rules & Regulation.
- There shall be two terms in a calendar academic year.
- The affiliated college(s)/institutions shall follow the prescribed curriculum and course matrix. Necessary modification/changes shall be communicated to the affiliated Colleges/Institutions, if any.
- For specialization elective courses, the affiliated institution(s)/college(s) shall follow "Regular Track". However, the administration of any affiliated institution must get prior permission from the competent authority to offer any specialization tracks from the approved curriculum. For this purpose, the institution's administration needs to show/demonstrate the availability of appropriate human resource along with necessary educational provisions before the start of the term in which specialization track shall be offered. The recommendations of the Convener BOS shall be solicited to allow the Institution to offer the requested specialization track already approved by the BOS.

Underlying Principles of Computer Science Degree Programs

Curriculum plays an important role within education as it outlines the planned and structured learning experiences that an academic program provides. For an effective academic program the curriculum must meet the needs of the stakeholders and face the emerging challenges. The Department of CS & IT (UOS) realizes the rapidly changing needs of today's knowledge intensive technology driven complex work places and the changing patterns of 21st century universities' education which have removed the identity of place, the identity of time, the identity of the scholarly community, and the identity of the student community. To meet these challenges, the Department has revised the existing curriculum. The revised curriculum is based on following underlying principles:

i. The curriculum should be a broad based and provides students with the flexibility to work across many disciplines & professions.
ii. The curriculum should prepare graduates to succeed in a rapidly changing field.
iii. The curriculum should provide guidance for the expected level of mastery of topics by graduates.
iv. Should provide realistic, adoptable recommendations that provide guidance and flexibility, allowing curricular designs that are innovative and track recent developments in the field.
v. The curriculum contents should be relevant and compatible with a variety of institutions.
vi. The size of the essential knowledge must be managed.
vii. The curriculum should identify the fundamental skills and knowledge that all graduates should possess.
viii. The curriculum should provide the greatest flexibility in organizing topics into courses and curricula.

The revised curriculum has developed using top-down curriculum development approach. It has adopted a balanced and multidisciplinary approach and presents a blend of study areas which spread across the boundaries of fundamental knowledge of traditional disciplines to advanced knowledge of the emerging disciplines. Body of knowledge (BOK) of CS program covers knowledge areas which are required for the program's accreditation from the Accreditation Council and knowledge area which are required for professional certification and professional development.

It is universally accepted that each profession needs both a specific skill set and an appropriate mindset. Developing an appropriate mindset of the prospective computing graduates requires a body of knowledge which enriches students' experiences, thoughts, beliefs, assumptions, and attitudes about the special characteristics of that specific domain. Therefore, the course contents and related practical experiences are designed to meet the professional requirements of the respective domain. For this the revised curriculum mainly focuses on following six (6) key areas:

i. Knowledge: Theoretical learning of concepts and principles regarding a particular subject(s).

ii. Skills: Capability of using learnt knowledge and applying it according to the context
iii. Competencies: The ability to do things satisfactory- not necessarily outstandingly or even well, but rather to a minimum level of acceptable performance.
iv. Expertise: Level of proficiency and innovative ways of applying learnt knowledge. (Competitive edge)
v. Dispositions: Habits of mind or tendencies to respond to certain situations in certain ways. The role of dispositions in computing education is very important. For example, having the disposition to be a programmer is much better that just having programming skills.
vi. Values: Moral, ethical and professional practices.

To strengthen the curriculum further, specialization tracks have also been integrated within the curriculum's BOK. These specialization tracks are designed according to what the industry is looking for in an employee and the learning interests of students. Furthermore, life skills including desired dispositions, soft skills, public speaking, critical thinking & reasoning, 21st Century literacies, personal attributes, entrepreneurship, attitude towards lifelong learning, professional practices and other social skills have not considered discrete items, rather threaded into the entire fabric of the curriculum.

Curriculum
for
BS Computer Science Program

BSCS Program's Rationale

Computer Science is the systematic study of the feasibility, structure, expression, and mechanization of the methodical processes (or algorithms) that underlie the acquisition, representation, processing, storage, communication of, and access to information, whether such information is encoded in bits and bytes in a computer memory or transcribed in genes and protein structures in a human cell.

Computer Science spans a wide range, from its theoretical and algorithmic foundations to cutting-edge developments in robotics, computer vision, intelligent systems, bioinformatics, image processing, computational biology, computational lenses, and other exciting areas. Computer scientists develop new programming approaches for software development, devise new ways to use computers and develop effective ways to solve computing problems. While other disciplines produce graduates with more immediately relevant job-related skills, computer science offers a comprehensive foundation for research and innovation.

Recent developments in computer hardware, software and communication technologies have offered new exciting opportunities and challenges for creation of innovative learning environments for Computer Science and its curricula design. The challenge of getting all newly emerging technologies incorporated into the curriculum is becoming pivotal for the effectiveness of curricula. There is a need for curricula structures that are really able to meet the challenges of 21st century knowledge driven complex work places. The key rationale behind the BS Computer Science program is to prepare a curriculum that provide integration of all components and the foundations that allow accessing all of the new knowledge and technology to fulfill the vision of future.

Program's Aims & Objectives

BSCS Program is committed to create, expand, disseminate and teach the computer science body of knowledge through academics, applications and research which positively impact society locally, nationally, and internationally.

BSCS program aims to develop students' critical professional thinking and intuition. The program's curriculum provides a balanced mixture of learning experiences to make the graduates capable of sound professional decisions. As a result, the successful graduates will be able to assume responsible positions in business, government, and education at the research, development, and planning levels. The program also provides an excellent foundation for further formal learning and training. The program is also expected to provide environments to put into practice, the principles and techniques learnt during the course of implementation of the program's curriculum. Some of the key objectives of the program are listed below:

- The program should provide a broad understanding of the field through introducing concepts, theory, techniques, and through intensive education/training in focused areas of Computer Science.

- The program should encourage students to develop and use abstract models in addition to apply respective technology in practical situations.
- The program should promote students' special communication skills both orally and in writing. They must be able to produce well-organized reports/presentations/projects, which clearly delineate objectives, methods of solution, results, and conclusions for a complex task.
- The program should provide formal foundations for higher learning and education.
- The program should be dynamic and flexible enough to maintain its body of knowledge in line with the latest scientific and technological developments in the field.
- The program should provide professional orientation to prepare students for industry.

Program's Outcome

The program will produce Computer Scientists of great character, competence, vision and drive equipped with up-to-date knowledge, marketable skills, valuable competencies, unique expertise, globally compatible dispositions and culturally and professionally acceptable values to take on appropriate professional roles in computer science domain or proceed to further or higher education or training.

Program's Structure

The structure of a BS Computer Science program meets the needs of students with formal computing experience and relevant skills. The students are expected to learn theoretical and practical understanding of the entire field of Computer Science. The program structure is dynamic and provides basis for various options including Breadth-Based, Depth-Based, and Integrated Breadth & Depth-Based specializations. Student may choose a particular option, which is the most appropriate to their planned future career. Followings are the program's details:

Specialization Tracks

Students can opt one of the following specialization tracks:

1. Regular Track
2. Computer Science
3. Web Engineering
4. Database Management Systems
5. Software Engineering
6. Computer Network

Degree Requirement

Minimum credit hours shall be 132 for BS Computer Science program including elective courses& a capstone project.

Duration

The program shall comprise Eight (8) Semesters/Terms spread over Four (4) calendar years with two Semesters/Terms a year as per rules of the University.

Eligibility Criteria

The minimum requirements for admission in a Bachelor degree program in Computer Science, is **at least 50% marks in Intermediate (HSSC) examination**

with Mathematics or equivalent qualification with Mathematics certified by IBCC.

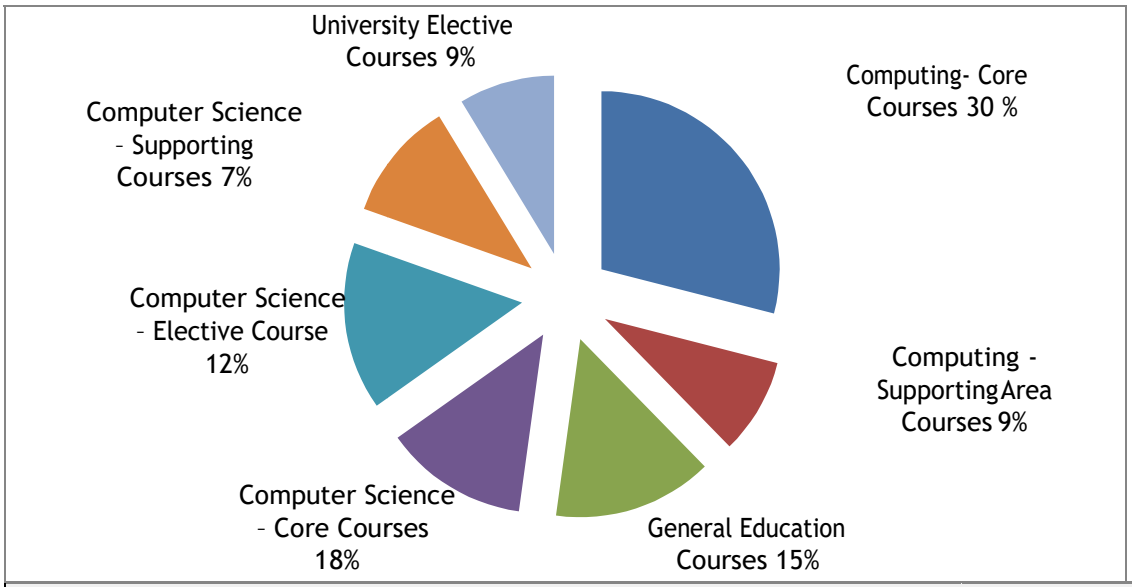
Assessment& Evaluation

University's semester and examination rules & regulations shall be followed for assessment & evaluation.

Distribution of Courses

Followings are the distribution of total credit hours:

Distribution of Courses		
Major Areas	**Credit Hours**	%
Computing- Core Courses	39	30%
Mathematics & Science Foundation	12	9%
General Education Courses	19	15%
Computer Science – Core Courses	24	18%
Computer Science – Elective Course	15	12%
Computer Science – Supporting Courses	09	7%
University Elective Courses	12	9%
Total	**130**	**100%**



Computing Core Courses – 39 Credit Hours				
#	**Code**	**Pre-Req**	**Course Title**	**Cr. Hrs.**
1	CMPC-101	-	Programming Fundamentals	4 (3+1)
2	CMPC-102	CMPC-101	Object Oriented Programming	4 (3+1)
3	CMPC-104	-	Discrete Structures	3 (3+0)
4	CMPC-201	CMPC-102	Data Structure and Algorithms	4 (3+1)

5	CMPC-302	-	Information Security	3 (3+0)
6	CMPC-301	-	Operating Systems	4 (3+1)
7	CMPC-202	-	Database Systems	4 (3+1)
8	CMPC-204	-	Software Engineering	3 (3+0)
9	CMPC-205	-	Computer Networks	4 (3+1)
10	CMPC-401	-	Capstone Project	6 (0+6)

Mathematics & Science Foundation Courses - 12 Credit Hours				
#	**Code**	**Pre-Req**	**Course Title**	**Cr. Hrs.**
11	MATH-101	-	Calculus and Analytical Geometry	3 (3+0)
12	MATH-102	-	Probability and Statistics	3 (3+0)
13	MATH-202	-	Linear Algebra	3 (3+0)
14	PHYS-101	-	Applied Physics	3 (3+0)

General Education Courses – 19 Credit Hours				
#	**Code**	**Pre-Req**	**Course Title**	**Cr. Hrs.**
15	ENGL-101	-	Functional English (English-I)	3 (3+0)
16	ENGL-102	ENGL-101	Communication Skills (English-II)	3 (3+0)
17	ENGL-201	ENGL- 101	Technical and Report Writing (English-III)	3 (3+0)
18	ISLS-101	-	Islamic Studies	2 (2+0)
19	PKST-201	-	Pakistan Studies	2 (2+0)
20	ICTC-101	-	Introduction to Information & Communication Technologies	3(2+1)
21	CSSC-402	-	Professional Practices	3 (3+0)

Computer Science – Core Courses - 24 Credit Hours				
#	**Code**	**Pre-Req**	**Course Title**	**Cr. Hrs.**
22	CSCC-102		Digital Logic and Design	4 (3+1)
23	CSCC-201	CSCC-102	Computer Organization and Assembly Language	4 (3+1)
24	CSCC-301		Theory of Automata	3 (3+0)
25	CSCC-202	CMPC-201	Design and Analysis of Algorithms	3 (3+0)
26	CSCC-302	CMPC-201	Artificial Intelligence	4 (3+1)
27	CSCC-304		Parallel & Distributed Computing	3 (3+0)
28	CSCC-306	CSCC-301	Compiler Construction	3 (3+0)

Computer Science Supporting Courses - 9 Credit Hours (Any three of the below)				
#	**Code**	**Pre-Req**	**Course Title**	**Cr. Hrs.**
29	MATH-301	MATH-101	Multivariable Calculus	3 (3+0)
30	CSSC-301	-	Differential Equations	3 (3+0)

31	CSSC-303	-	Numerical Computing	3 (3+0)
32	CSSC-307	CMPC-204	Object-Oriented Analysis and Design	3 (3+0)
33	CSSC-305	CSCC-102	Computer Architecture	3 (3+0)
34	CSSC-306		Internet Architecture and Protocols	3 (3+0)

GE/University Elective Courses - Credit Hours (Any four of the below)				
#	**Code**	**Pre-Req**	**Course Title**	**Cr. Hrs.**
35	BUSB-201	-	Principles of Management	3(3+0)
36	BUSB-204	-	Human Resource Management	3(3+0)
37	BUSB-202	-	Organizational Behavior	3(3+0)
38	ECON-402	-	Business Economics	3(3+0)
39	BUSB-401	-	Entrepreneurship	3(3+0)
40	BUSB-402		Financial Accounting	3(3+0)

Computer Science Elective Courses - 15 Credit Hours

Regular Track Elective Courses - 15 Credit Hours (Any 5 Courses) for Main Campus, Mianwali, Bhakkar Campus				
42	CSEC-301	-	Web systems Technologies	3(3+0)
43	CSEC-302	-	Multimedia Systems and Design	3(3+0)
44	CSEC-303	-	Big Data Analytics	3(3+0)
45	CSEC-304	-	Digital Image Processing	3(3+0)
46	CSEC-305	-	E-Commerce Applications Development	3(3+0)
47	CSEC-306	-	Enterprise Resource Planning Systems	3(3+0)
48	CSEC-312	-	Mobile Application Development	3(3+0)
49	CSEC-308	-	Enterprise Application Development	3(3+0)
50	CSEC-309	-	Cloud Computing	3(3+0)
51	CSEC-310	-	Systems Programming	3(3+0)
52	CSEC-311	-	Management Information Systems	3(3+0)
53	CSEC-401	-	Game Application Development	3(3+0)
54	CSEC-402	-	Computer Graphics	3(3+0)

55	CSEC-403	-	Semantic Web Techniques	3(3+0)
56	CSEC-404	-	Virtual Reality	3(3+0)
57	CSEC-405	-	Mobile Computing	3(3+0)
58	CSEC-406	-	Data Warehousing	3(3+0)
59	CSEC-407	-	Data Mining	3(3+0)
60	CSEC-408	-	Business Intelligence and Analytics	3(3+0)
61	CSEC-409	-	Database Administration & Management	3(3+0)
62	CSEC-410	-	Advance Database Management	3(3+0)
63	CSEC-411	-	Business Process Management	3(3+0)
64	CSEC-412	-	Knowledge Management	3(3+0)
65	CSEC-413	-	Graph Theory and Algorithms	3(3+0)

Course Coding Scheme

Course Level	
Level	**Course Type**
1	Foundation, Core Level 1 Courses
2	Foundation, Core Level 1 Courses
3	Core Level 2 + Specialization Level 1
4	Specialization Level 2
Discipline Code	
CMPC	Computing Core
CSCC	Computer Science Core
CSSC	Computer Science Supporting
CSEC	Computer Science Elective
PKST	Pakistan Studies
ISLS	Islamic Studies
MATH	Mathematics
ENGL	English
BUSB	Management
PHYS	Physics
ICTC	Information & Communication Technologies

Scheme of Studies for BS Computer Science Program for (Affiliated Colleges and PPP- Sub Campuses)

(130 Credit Hours)

Semester - I

Code	Course Title	Credit Hours	Pre-requisite
ICTC-101	Introduction to ICT	2-1	
CMPC-101	Programming Fundamentals	3-1	
ENGL-101	Functional English	3-0	
MATH-101	Cal3culus & Analytical Geometry	3-0	
PHYS-101	Applied Physics	3-0	
ISLS-101	Islamic Studies	2-0	
	Total	16-2	

Semester - II

Code	Course Title	Credit Hours	Pre-requisite
CSCC-102	Digital Logic and Design	3-1	
CMPC-102	Object Oriented Programming	3-1	Programming Fundamentals
MATH-102	Probability & Statistics	3-0	
CMPC-104	Discrete Structure	3-0	
ENGL-102	Communication Skills	3-0	Functional English
	Total	15-2	

Semester - III

Code	Course Title	Credit Hours	Pre-requisite
CSCC-201	Comp Organization & Assembly Language	3-1	
CMPC-201	Data Structures & Algorithms	3-1	Object Oriented Programming
ENGL-201	Technical & Report Writing	3-0	Communication Skills
PKST-201	Pakistan Studies	2-0	
CMPC-205	Computer Networks	3-1	
BUSB-201	Principles of Management	3-0	
	Total	17-3	

Semester - IV

Code	Course Title	Credit Hours	Pre-requisite
CSCC-202	Design & Analysis of Algorithms	3-0	Data Structures & Algorithms
CMPC-202	Database Systems	3-1	
MATH-202	Linear Algebra	3-0	
CMPC-204	Software Engineering	3-0	
BUSB-204	Human Resource Management	3-0	
	Total	15-1	

Semester - V

Code	Course Title	Credit Hours	Pre-requisite
CSCC-301	Theory of Automata	3-0	
CMPC-301	Operating Systems	3-1	Data Structures and Algorithms

CSEC-301	Web systems Technologies	3-0
CSSC-301	Multimedia Systems and Design	3-0
MATH-301	Multivariable Calculus	3-0
CSSC-307	Object-Oriented Analysis and Design	3-0
	Total	18-1

Semester - VI

Code	Course Title	Credit Hours	Pre-requisite
CSCC-302	Artificial Intelligence	3-1	Discrete Structures
CSCC-306	Compiler Construction	3-0	Theory of Automata
CSCC-304	Parallel & Distributed Computing	3-0	
CMPC-302	Information Security	3-0	
CSEC-312	Mobile Application Development	3-0	
	Total	15-1	

Semester - VII

Code	Course Title	Credit Hours	Pre-requisite
CMPC-401	Capstone I	0-3	
CSEC-407	Data Mining	3-0	
BUSB-401	Entrepreneurship	3-0	
CSEC-409	Database Administration & Management	3-0	
	Total	9-3	

Semester - VIII

Code	Course Title	Credit Hours	Pre-requisite
CMPC-402	Capstone II	0-3	
CSSC-402	Professional Practice	3-0	
CSEC-406	Data Warehousing	3-0	
BUSB-402	Financial Accounting	3-0	
	Total	9-3	

Contents of Computing Core Courses

CMPC-101 Programming Fundamentals			
Credit Hours:	3+1	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Problem solving skills	C	1
2. Coding skills	C	2
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective		

domain

Course Content:

1. Introduction, Introduction to Computer Programming: Machine Languages, Assembly Languages and High-Level Languages. History of C, C Standard Library, Typical C Program Development Environment, Memory Concepts, white spaces, comments. [Ch. 1]
2. Principles of Structured and Modular Programming: Algorithms, Pseudo code, flowchart representation. Basic Data Types (variables, constants). [Ch. 2]
3. Unary (increment/decrement) and Binary (arithmetic, relational, arithmetic assignment) operators. Arithmetic (Expression) in C. C Programming Basics: Programming Practices, Summary. [Ch. 1, 2, 3]
4. Decision Statements: if statement, if-else statement, Multi if-else-if statement. Decision Statements: Nested if-else statements, Switch Statement. [Ch. 3]
5. Decision Statements: Conditional operator, Logical Operators, Programming Practices, and Summary. Program Control: Repetition Essentials, Counter-Controlled Repetition. for loop. [Ch. 3]
6. Loops: while loop, do while loop [Ch. 4]
7. Nested loop structures. Other Control Statements, break and continue Statements, Logical Operators, Confusing Equality (==) and Assignment (=) Operators. Programming Practices, Summary. [Ch. 4]
8. Arrays: Defining Arrays, Array Examples (finding max, min value from the array). Searching techniques (linear search, Binary search). Sorting Arrays: selection sort, bubble sort. Case Study: Computing Mean, Median and Mode Using Arrays. [Ch. 6]
9. Strings: String Library Functions Characters and Strings: Fundamentals of Strings and Characters. Strings: Character-Handling Library, Programming Practices, Summary. [Ch. 8]
10. Functions: Function declaration, definition, Passing Arguments to functions, Returning values from functions. Functions: Arguments pass by reference and pass by copy. [Ch. 8]
11. Functions: Passing arrays and strings to functions. Functions: Inline functions, Default arguments, Local and global variables, Summary. [Ch. 8]
12. Pointers: Pointers and their purpose. Pointer expressions. Pointers: Pointers and arrays, Pointers in functions. [Ch. 8]
13. Pointers: Static and dynamic memory allocation, Memory Management using Pointers. Problems with pointers, program practice, Summary.[Ch. 8]
14. Structures: Purpose, Defining structures, Initializing Structures, Accessing Structure Members. Example (complex number or Time). Structures: Passing Structures to functions, Structures using pointers,
15. File Processing: Data Hierarchy, Files and Streams, Creating a Sequential-Access File, Reading Data from a Sequential-Access File. File Processing: Random-Access Files, Creating a Random-Access File, Writing Data Randomly to a Random-Access File, Reading Data from a Random-Access File. [Ch.10]
2. Revise + Lab Exam discussion, Class discussion

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. C How to Program by Paul Deitel and Harvey Deitel, Prentice Hall; 7th Edition (March 4, 2012)
2. Programming in C by Stephen G. Kochan, Addison-Wesley Professional; 4 edition (September 25, 2013). ISBN-10: 0321776410

CMPC-102 Object Oriented Programming			
Credit Hours:	3+1	**Prerequisites:**	Programming Fundamentals

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understand principles of object oriented paradigm.	C	2
2. Identify the objects & their relationships to build object oriented solution	C	3
3. Model a solution for a given problem using object oriented principles	C	3
4. Examine an object oriented solution.	C	4
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Introduction to Classes, Objects and Strings: Defining a Class with a Member Function, Defining a Member Function with a Parameter, Data Members, set Member Functions and get Member Functions, Initializing Objects with Constructors, Placing a Class in a Separate File for Reusability, Separating Interface from Implementation, Validating Data with set Functions [Ch. 3]
2. Class Templates array and vector; Catching Exceptions: Introduction, Arrays, Declaring arrays, Examples Using arrays, Range-Based for Statement, Sorting and Searching arrays, Multidimensional arrays. [Ch. 7]
3. Classes - Throwing Exceptions: Class Scope and Accessing Class Members, Access Functions and Utility Functions, Constructors with Default Arguments, Destructors, When Constructors and Destructors Are Called, Default Memberwise Assignment, const Objects and const Member Functions, Composition: Objects as Members of Classes, friend Functions and friend Classes, Using the this Pointer, static Class Members. [Ch. 9] Operator Overloading; Class string: Introduction, Using the Overloaded Operators of Standard Library Class string, Fundamentals of Operator Overloading, Overloading Binary Operators, Overloading the Binary Stream Insertion and Stream Extraction Operators, Overloading Unary Operators, Overloading the Unary Prefix and Postfix ++ and – Operators, Dynamic Memory Management, Operators as Member vs. Non-Member Functions, Converting Between Types, explicit Constructors and Conversion Operators, Overloading the Function Call Operator ()[Ch. 10].
4. Inheritance: Introduction, Base Classes and Derived Classes, Relationship between Base

and Derived Classes, Constructors and Destructors in Derived Classes, public, protected and private Inheritance, Software Engineering with Inheritance. [Ch. 11]]

5. Polymorphism: Introduction, Relationships Among Objects in an Inheritance Hierarchy, Type Fields and switch Statements, Abstract Classes and Pure virtual Functions, Polymorphism, Virtual Functions and Dynamic Binding —Under the Hood‖. [Ch. 12]
6. Stream Input/Output: Introduction, Streams, Stream Output, Stream Input, Unformatted I/O Using read, write and gcount, Introduction to Stream Manipulators, Stream Format States and Stream Manipulators, Stream Error States, Tying an Output Stream to an Input Prentice Hall File Processing: Introduction, Files and Streams, Creating a Sequential File, Reading Data from a Sequential File, Updating Sequential Files, Random-Access Files, Creating a Random-Access File, Writing Data Randomly to a Random-Access File, Reading from a Random-Access File Sequentially [Ch. 14]
7. Standard Library Containers and Iterators: Introduction to Containers, Introduction to Iterators, Introduction to Algorithms, Sequence Containers, Associative Containers, Container Adapters, Class bitset. [Ch. 15]
8. Exception Handling: Introduction, Rethrowing an Exception, Stack Unwinding, When to Use Exception Handling, Constructors, Destructors and Exception Handling, Exceptions and Inheritance, Processing new Failures, Class unique_ptr and Dynamic Memory Allocation, Standard Library Exception Hierarchy. [Ch. 17]

Teaching Methodology:

Lectures, Written Assignments, Practical labs, Semester Project, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Text Book & Reference Materials:

1. C++ How to Program, 10th Edition, Deitel & Deitel.
2. Object Oriented Programming in C++, 3rd Edition by Robert Lafore
3. Starting Out with C++ from Control Structures to Objects, 9th Edition, Tony Gaddis
4. Java: How to Program, 9th Edition by Paul Deitel
5. Beginning Java 2, 7th Edition by Ivor Horton
6. An Introduction to Object Oriented Programming with Java, 5th Edition by C. Thomas Wu

CMPC-104 Discrete Structures			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
The course provides a solid theoretical foundation of discrete structures as they apply to computer science problems and structures. The students will learn how to use mathematical notation and solve problems using mathematical tools.	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Logic: Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Methods of Proof. [TB: Ch. 1]
2. Sets & Functions, Sequences and Summations. [TB: Ch. 2]
3. Algorithms: the Growth of Functions, Complexity of Algorithms, the Integers and Division, Matrices. [TB: Ch. 3]
4. Number Theory and Cryptography. [TB: Ch. 4]
5. Advanced Counting Techniques: Recurrence Relations, Solving Recurrence Relations, Divide-and-Conquer Algorithms and Recurrence Relations, Generating Functions, Inclusion-Exclusion & its Application. [TB: Ch. 8]
6. Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Partial Orderings. [TB: Ch. 9]
7. Graph: Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Coloring. [TB: Ch. 10]
8. Trees: Applications of Trees, Tree Traversal, Spanning Trees, Minimum Spanning Trees. [TB: Ch. 11]

Teaching Methodology:

Lectures, Class Exercises

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Final Exam

Reference Materials:

- K. H. Rosen, Discrete Mathematics and Its Applications, McGraw-Hill Science/Engineering/Math, 7th Ed. 2011. ISBN-10: 0073383090
- R. Johnsonbaugh, Discrete Mathematics, Pearson; 7th Ed., 2008. ISBN-10: 0131593188
- S. B. Maurer and A. Ralston, Discrete Algorithmic Mathematics, A K Peters/CRC Press; 3rd Ed., 2004. ISBN-10: 1568811667
- B. Kolman, R. Busby and S. C. Ross, Discrete Mathematical Structures, Pearson, 6th Ed. 2008. ISBN-10: 0132297515

CMPC-201 Data Structures and Algorithms			
Credit Hours:	3+1	**Prerequisites:**	Object Oriented Programming

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Acquire the basic knowledge of data structures & algorithms and understand the concepts of various data structures and use them in different applications.	C	1,2
2. Solve, analyze and evaluate the problems using different data structures and algorithms.	C	3
3. Demonstrate& apply independently the various forms of data structures and algorithms	P	3,4
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Introduction to Course, Basic Object Orientation concepts, Properties of Algorithm, Introduction to Algorithm's Performance Analysis and Measurement (Big Oh Notation)
2. ADT, Basic Operations, Reading, Writing, Insertion, Deletion, Merging, Binary

Search.
3. Introduction to Sorting types and Techniques, Logical and Algorithmic Implementation of Bubble, Selection Sort, Insertion, Quick Sort, Merge Sort.
4. The Stack ADT, Expressions, Postfix Notation, Infix to postfix, postfix evaluation, Applications of stack
5. Introduction to Recursion, Examples of Recursion, Writing Recursive Programs
6. The Queue ADT and Its Applications, Variation of Queue ADT i.e. Circular and Double Ended Queue
7. Priority Queues, Introduction to Pointers, Linear single Link
8. Linked Stacks and Queues, Linear Doubly Linked list
9. Circular Lists: Implementation of queues and stacks, Doubly Link List
10. Introduction to Trees, Tree Terminology, Logical construction and Representation of Trees, Introduction to Binary Tree ADT, Mathematical properties, Linked Implementation of Binary Trees (Insertion, Traversing, Searching and deletion in Binary Trees)
11. Binary Search Tree, Implementation and Applications of BSTs
12. Heaps and Heaps as Priority Queues, Introduction to Balanced and AVL Trees, Heap Sort.
13. Hashing, Overflow Handling, Open Addressing, Chaining
14. Introduction to graph and related terminology, Adjacency Matrix representation of graph and Adjacency list
15. Elementary Graph Operations, DFS, BFS, Spanning Trees
16. Shortest path algorithms: Dijkstra Algorithm, Minimum Cost Spanning Trees.

Teaching Methodology:

Lectures, Written Assignments, Practical labs, Semester Project, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Data Structures and Algorithms in C++ by Michael T. Goodrich, Roberto Tamassia, and David Mount (2nd Edition) : ISBN-13: 978-0470383278
2. Data Structures and Algorithms in C++ 4th Edition by Adam Drozdek : ISBN-13: 978-1133608424
3. Data Structures and Algorithm Analysis in Java (3rd Edition) 3rd Edition by Mark A. Weiss : ISBN-13: 978-0132576277
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, “Introduction to Algorithms”, 2nd Ed, MIT Press, 2001, ISBN 0-07-013151-1
5. Data Structures and Abstractions with Java (5th Edition) (What's New in Computer Science) 5th Edition by Frank M. Carrano (Author), Timothy M. Henry (Author) : ISBN-13: 978-0134831695
6. Data Structures & Algorithm Analysis in C++ 4th Edition by Mark A. Weiss : ISBN-13: 978-0132847377

CMPC-301 Operating Systems			
Credit Hours:	3+1	**Prerequisites:**	Data Structures and Algorithms

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT**

		Level*
1. Understand the characteristics of different structures of the Operating Systems and identify the core functions of the Operating Systems.	C	2
2. Analyze and evaluate the algorithms of the core functions of the Operating Systems and explain the major performance issues with regard to the core functions.	C	4,5
3. Demonstrate the knowledge in applying system software and tools available in modern operating systems.	C	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Introduction: Over view of: Operating Systems, Operating-System Structure, Operating-System Operations, Process management, Memory Management, Storage Management, Protection and Security, Protection and Security, Distributed Systems, Special-Purpose Systems, Computing Environments. [TB: Ch1]
2. Operating-System Structures: Operating-System Services, Operating-System Structure, User Operating-System Interface, Virtual Machines, System Calls, Operating-System Generation, Types of System Calls, System Boot, System Programs. [TB:Ch2].
3. Processes: Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication, Communication in Client- Server Systems. Threads: Multithreading Models, Thread Libraries, Threading Issues. [TB: Ch. 3, 4]
4. CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Thread Scheduling, Algorithm Evaluation. [TB: Ch. 5]
2. Process Synchronization: Background, Monitors, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization. [TB: Ch. 6]
3. Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock. [TB: Ch. 7]
4. Main Memory: Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Example: The Intel Pentium. [TB: Ch.8]
5. Virtual Memory: Allocating Kernel Memory, Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing. [TB: Ch. 9]
6. File-System Implementation: File-System Structure, Log-Structured File Systems, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance, Recovery. [TB: Ch. 11]
7. Security: The Security Problem, Computer-Security, Program Threats, Classifications, System and Network Threats, Cryptography as a Security Tool, User Authentication, Implementing Security Defenses, Firewalling to Protect Systems and Networks. [TB: Ch. 15]

Teaching Methodology:

Lectures, Written Assignments, Practical labs, Semester Project, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Text Book & Reference Materials:

1. Operating Systems Concepts, 9th edition by Abraham Silberschatz [Text Book]
2. Modern Operating Systems, 4th edition by Andrew S. Tanenbaum
3. Operating Systems, Internals and Design Principles, 9th edition by William Stallings

CSCC-102 Digital Logic and Design			
Credit Hours:	3+1	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Introduces students with digital circuit of large complexity and how such circuits could be built in a methodological way, starting from Boolean logic and applying a set of rigorous techniques	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Number Systems, Operations, and Codes: Decimal Numbers, Binary Numbers, Decimalto-Binary Conversion, Binary Arithmetic, I's and 2's Complements of Binary, Numbers,
   Signed Numbers, Arithmetic Operations with Signed Numbers, Hexadecimal Numbers, Octal Numbers, Binary Coded Decimal (BCD), Digital Codes, Error Detection and Correction Codes. [Ch. 2]
2. Logic Gates: The Inverter, The AND Gate, The OR Gate, The NAND Gate, The NOR Gate, The Exclusive-OR and Exclusive-NOR Gates. [Ch. 3]
3. Boolean Algebra and logic Simplification: Boolean Operations and Expressions, Laws and Rules of Boolean Algebra, DeMorgan's Theorem, Boolean Analysis of Logic Circuits, Simplification Using Boolean Algebra, Standard Forms of Boolean Expressions, Boolean Expressions and Truth Tables, The Kamaugh Map, Karnaugh Map SOP Minimization, Karnaugh Map POS Minimization, Five-Variable Karnaugh Maps. [Ch. 4]
4. Combinational logic Analysis: Basic Combinational Logic Circuits, Implementing Combinational Logic, The Universal Property of NAND and NOR Gates, Combinational Logic Using NAND and NOR Gates. [Ch. 5]
5. Functions of Combinational logic: Basic Adders, Parallel Binary Adders, Ripple Carry versus Look-Ahead Carry Adders, Comparators, Decoders, Encoders. Code Conveners: Multiplexers (Data Selectors), Demultiplexers, Parity Generators/Checkers.[Ch. 6]
6. latches, Flip-Flops, and Timers: Latches, Edge-Triggered Flip-Flops, Flip-Flop Operating Characteristics, Flip-Flop Applications. [Ch. 7]
7. Counters: Asynchronous Counter Operation, Synchronous Counter Operation, Up/Down Synchronous Counters, Design of Synchronous Counters. [Ch. 8]
8. Shift Registers: Basic Shift Register Functions, Serial In/Serial Out Shift Registers, Serial In/Parallel Out Shift Registers, Parallel In/Serial Out Shift Registers, Parallel In/Parallel Out Shift Registers, Bidirectional Shift Registers, Shift Register Counters. [Ch. 9]
9. Memory and Storage: Basics of Semiconductor Memory, Random-Access Memories

(RAMs), Read-Only Memories (ROMs), Programmable ROMs (PROMs and EPROMs), Flash Memories. [Ch. 10] 10. Programmable Logic: FPGA [Ch. 11]
Teaching Methodology:
Lectures, Written Assignments, Semester Project, Presentations
Course Assessment:
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
Reference Materials:
1. Digital Fundamentals by Thomas L. Floyd, Prentice Hall; 9th edition (2007) 2. Digital Fundamentals: A Systems Approach by Thomas L. Floyd, Prentice Hall; 1 edition (July 13, 2012) 3. Digital Design, by M. Morris Mano, Michael D. Ciletti, 4th Edition, Prentice Hall (2007). ISBN-10: 0131989243

CMPC-202 Database Systems			
Credit Hours:	3+1	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Explain fundamental database concepts.	C	2
2. Design conceptual, logical and physical database schemas using different data models.	C	3
3. Identify functional dependencies and resolve database anomalies by normalizing database tables.	C	3
4. Use Structured Query Language (SQL) for database definition and manipulation in any DBMS	C	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
1. Databases Overview: Basic Concepts and Definitions, Traditional File Processing & Database Approach [TB1: Ch 1] 2. Data Models, Advantages of Database Approach, Costs and Risks of Database Approach, Components of the Database Environment, The Database Development Process [TB1: Ch 1] 3. E-R Model, Modelling Rules of the Organisation, Modelling Entities and Attributes, Modelling Relationships [TB1: Ch 2] 4. Enhanced E-R Model, Representing Supertypes and Subtypes, Specifying Constraints in Supertype/Subtype Relationships [TB1: Ch 3] 5. Relational Data Model, Integrity Constraints, Transforming EER Diagrams into Relations [TB1: Ch 4] 6. Introduction to Normalization, First Normal Form, Second Normal Form, Third Normal Form, Functional Dependencies and Keys [TB1: Ch 4] 7. The Physical Database Design Process, Designing Fields: Choosing Data Types, Coding Techniques, Handling Missing Data [TB1: Ch 5]

8. Denormalizing and Partitioning Data, File Organizations (Heap, Sequential, Indexed, Hashed), Creating a Unique/Nonunique Key Index, When to Use Indexes [TB1: Ch 5]
9. Introduction to SQL, The SQL Environment, Defining a Database in SQL [TB1: Ch 6]
10. Basic SQL Commands for Processing Single Tables [TB1: Ch 6]
11. SQL Commands for Processing Multiple Tables using Joins and Subqueries [TB1: Ch 7]
12. Client/Server Architectures, Databases in a Two-Tier Architecture, Three-Tier Architectures [TB1: Ch 8]
13. Web Application Components, Databases in Three-Tier Applications [TB1: Ch 8]
14. The Roles of Data and Database Administrators, Database Backup and Recovery, Types of Database Failure, Disaster Recovery [TB1: Ch 12]
15. Controlling Concurrent Access, Serializability, Locking Mechanisms, Data Dictionaries and Repositories [TB1: Ch 12]

Teaching Methodology:

Lectures, Written Assignments, Practical labs, Semester Project, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Modern Database Management by Jeffrey A. Hoffer, V. Ramesh, and Heikki Topi. Pearson; 12th Edition (2015). ISBN-10: 1292101857
2. Fundamentals of Database Systems by R. Elmasri and S. Navathe. Pearson; 7th Edition (2015). ISBN-10: 0133970779
3. Database System Concepts by Abraham Silberschatz, Henry F. Korth and S. Sudarshan. McGraw-Hill Education; 6th Edition (2010). ISBN-10: 0073523321
4. Oracle 12c: SQL by Joan E. Casteel. Cengage Learning; 3rd Edition (2015). ISBN-10: 1305251032

CMPC-204 Software Engineering			
Credit Hours:	3(3,0)	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Explains how various software development models and software development life cycles are applied.	C	4
2. Presents the fundamentals concepts of project management.	C	3
3. Important Requirements modeling, fact-finding techniques		
4. Have knowledge of software configuration management.	C C	3 4

* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain

Course Content:

1. The Nature of Software, Unique Nature of WebApps, Software Engineering, The Software Process, Software Engineering Practice, Software Myths. [TB1: Ch. 1]
2. Generic Process Models: Framework Activity, Task Set, Process Patterns, Process Improvement, CMM, Prescriptive Process Models: Waterfall Model, Incremental Process Model, Evolutionary Process Model. [TB1: Ch. 2]

3. Specialized Process Models: Component Based Development, The Formal Methods Models, Agile Development. [TB1: Ch. 2-3]
5. Introduction to Systems Analysis and Design, Business Information Systems, Information System Components, Types of Information Systems, Evaluating Software, Make or Buy Decision. [TB1: Ch. 1]
6. Introduction to SDLC, SDLC Phases, System Planning, Preliminary Investigation, SWOT Analysis. [TB1: Ch. 2]
2. The Importance of Strategic Planning, Information Systems Projects, Evaluation of Systems Requests, Preliminary Investigation, Systems Analysis, Requirements Modeling, Fact-Finding Techniques. [TB1: Ch. 2-3]
3. Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Requirements Model. [TB1: Ch. 5]
4. Requirements Modelling Strategies, Difference between Structured Analysis and Object Oriented Analysis; Difference between FDD Diagrams & UML Diagrams. [TB2:Ch. 3]
5. Data & Process Modelling, Diagrams: Data Flow, Context, Conventions, Detailed Level DFD‘s Diagram 0, Levelling, Balancing, Logical Versus Physical Models. [TB2: Ch. 4]
6. Design Within the Context of Software Engineering, The Design Process, Design Concepts, Design Models: Data Design Elements. [TB1: Ch. 8]
7. Architecture Design Elements, Interface Design Elements, Component-Level Design Elements, Deployments Design Elements. [TB: Ch. 8]
8. System Architecture, Architectural Styles, User Interface Design: The Golden Rules, User Interface Analysis and Design, WebApps Interface Design. [TB1: Ch. 9-11]
9. Software Quality Assurance: Background Issues, Elements of Software Quality Assurance, Software Testing Strategies, Strategic Issues, Test Strategies for Conventional Software. [TB1: Ch.16-17]
10. Validation Testing, System Testing, Internal and External View of Testing: White Box Testing and Black Box Testing Techniques. [TB1: Ch. 17-18)]
11. Introduction to Project Management, Project Scheduling: Gantt Chart, Risk Management: Proactive versus Reactive Risk Strategies, Software Risks, Maintenance and Reengineering: Software Maintenance, Software Reengineering. [TB1: Ch. 28-29]

Teaching Methodology:

Lecturing, Written Assignments, Report Writing

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam

Reference Materials:

1. Software Engineering: A Practitioner's Approach by Roger S. Pressman, McGraw-Hill Science/Engineering/Math; 7th Edition (2009). ISBN-10: 0073375977
2. Software Engineering 8E by Ian Sommerville, Addison Wesley; 8th Edition (2006). ISBN-10: 0321313798
3. Systems Analysis and Design by Gary B. Shelly, Thomas J. Cashman and Harry J. Rosenblatt, Course Technology; 7th Edition (2007). ISBN-10: 1423912225
4. Systems Analysis and Design by Gary B. Shelly, Thomas J. Cashman and Harry J. Rosenblatt, Course Technology; 7th Edition (2007). ISBN-10: 1423912225

CMPC-205 Computer Networks			
Credit Hours:	3+1	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Describe the key terminologies and technologies of computer networks	C	2
2. Explain the services and functions provided by each layer in the Internet protocol stack.	C	2
3. Identify various internetworking devices and protocols, and their functions in a network.	C	4
4. Analyze working and performance of key technologies, algorithms and protocols.	C	4
5. Build Computer Network on various Topologies	P	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Introduction to networks and protocols architecture [TB1: Ch. 1].
2. Basic concepts of networking, network topologies and the Internet [TB1: Ch. 1].
3. Layered architecture and the OSI model [TB1: Ch. 2].
4. Physical layer functionality, data link layer functionality and the TCP/IP protocol architecture [TB1: Ch. 2].
5. Multiple access techniques, WAN Technologies and protocols , circuit switching and packet switching.[TB1: Ch. 9]
6. Wireless networks, Cellular Network Generations and LTE-Advanced [TB1: Ch. 10]
7. LAN technologies, LAN protocol architecture and virtual LANs [TB1: Ch. 11]
8. MAC addressing. [TB1: Ch. 11]
9. Networking devices , bridges, hubs and switches [TB1: Ch. 11]
10. Network layer protocols, Principles of Internetworking, IPv4 and IPv6. [TB1: Ch. 14]
11. IP addressing, Internet Protocol Operation, virtual private networks and IP Security and Subnetting, CIDR. [TB1: Ch. 14].
12. Transport layer protocols, ports and sockets and connection-oriented transport protocol mechanisms [TB1: Ch. 15]
13. Routing protocols OSPF ,EIGRP,RIP and routing in packet-switching networks [TB1: Ch. 19]
14. Connection establishment, flow and congestion control, effects of congestion, TCP congestion control and datagram congestion control protocol [TB1: Ch. 20]
15. Application layer protocols, electronic mail (SMTP and MIME), Web Access: HTTP and DNS [TB1: Ch. 24]
16. Latest trends in computer networks , real-time traffic and voice over IP [TB1: Ch. 25]

Labs:

1- Introduction to Networking equipment.
2- Networking Basics commands.
3- TCP/IP Networks configuration.
4- Cabling Construction.

5- Building Peer-to-Peer Network.
6- Tools: Packet tracer, Wireshark.

Teaching Methodology:

Lectures, Written Assignments, Practical labs, Semester Project, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Data and Computer Communications, 10th Edition by William Stallings
2. Computer Networking: A Top-Down Approach Featuring the Internet, 6th edition by James F. Kurose and Keith W. Ross
3. Computer Networks, 5th Edition by Andrew S. Tanenbaum
4. Data Communication and Computer Networks, 5th Edition by Behrouz A. Forouzan

CMPC-306 Human Computer Interaction			
Credit Hours:	3(3,0)	**Prerequisites:**	Software Engineering

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
At the end of the course the students will be able to: 1. Explain context of HCI and different measures for evaluation. 2. Apply the principles of good design for people from the 3. Perspective of age and disabilities. 4. Analyze techniques for user centered design for a medium sized software.	 C C C C	 2 3 4 5
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. The human: Input–output channels, Human memory, Thinking, Emotion, Individual differences, Psychology and the design of interactive systems. [Ch. 1]
2. The computer: Text entry devices, Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Paper: printing and scanning, Memory, Processing and networks. [Ch. 2]
3. The interaction: Models of interaction, Frameworks and HCI, Ergonomics, Interaction styles, Elements of the WIMP interface, Interactivity, The context of the interaction, Experience, engagement and fun. [Ch. 3]

4. Interaction design basics: What is design? The process of design, User focus, Scenarios, Navigation design, Screen design and layout, Iteration and prototyping. [Ch. 5]
5. HCI in the software process: The software life cycle, Usability engineering, Iterative design and prototyping, Design rationale. [Ch. 6]
6. Design rules: Principles to support usability, Standards, Guidelines, Golden rules and heuristics, HCI patterns. [Ch. 7]
7. Implementation support: Elements of windowing systems, Programming the application,
8. Using toolkits, User interface management systems.[Ch. 8]
9. Evaluation techniques: What is evaluation? Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, choosing an evaluation method. [Ch. 9]
10. Universal design: Universal design principles, Multi-modal interaction, Designing for diversity.[Ch. 10]
11. User support: Requirements of user support, Approaches to user support, Adaptive help systems, designing user support systems. [Ch. 11]
12. Task analysis: Differences between task analysis and other techniques, Task decomposition, Knowledge-based analysis, Entity–relationship-based techniques, Sources of information and data collection, Uses of task analysis [Ch. 15]
13. Dialog notations and design: What is dialog? Dialog design notations, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and design. [Ch. 16]
14. Models of the system: Standard formalisms, Interaction models, Continuous behavior.
15. Modeling rich interaction: Introduction, Status–event analysis, Rich contexts, Low intention and sensor-based interaction. [Ch. 18]
16. Groupware: Groupware systems, Computer-mediated communication, Meeting and decision support systems, Shared applications and artifacts, Frameworks for groupware, implementing synchronous groupware. [Ch. 19]
17. Ubiquitous computing and augmented realities: Ubiquitous computing applications research, Virtual and augmented reality, Information and data visualization. [Ch. 20]
18. Hypertext, multimedia and the World Wide Web: Understanding hypertext, Finding things, Web technology and issues, Static web content, Dynamic web content. [Ch. 21]

Teaching Methodology:

Lectures, Class Discussions

Course Assessment:

Midterm Exam, Home Assignments, Quizzes, Final Exam

Reference Materials:

1. Human-Computer Interaction by Alan Dix, Janet E. Finlay, Gregory D. Abowd, Russell Beale, Prentice Hall; 4th Edition (October 2012).
2. Designing the User Interface: Strategies for Effective Human-Computer Interaction, Ben Shneiderman and Catherine Plaisant, 6th Ed, Pearson Inc, 2016.
3. Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design, Benyon, D. 3rd Ed., Pearson. 2013
4. About Face: The Essentials of Interaction Design, Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, 4th Ed, Wiley, 2014

CMPC-401 Capstone I			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Project Proposal
2. Introduction Software Requirement Specification
3. Software Function Specification
4. Design Documentation

Teaching Methodology:

Lectures, Semester Project, Assignments, Presentations, Interactive sessions

Course Assessment:

Sessional Marks(Assignments, Quizzes, Project, Presentations), Mid Exam, Final Exam

Reference Materials:

CMPC-402 Capstone II			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Database Design
2. Interface Design
3. Initial Prototype
4. Implementation
5. Testing

Teaching Methodology:
Lectures, Semester Project, Assignments, Presentations, Interactive sessions
Course Assessment:
Sessional Marks(Assignments, Quizzes, Project, Presentations), Mid Exam, Final Exam
Reference Materials:

Mathematics & Science Foundation Courses

MATH-101 Calculus and Analytical Geometry			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. To provide foundation and basic ground for calculus and analytical geometry background.	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Real Numbers and the Real Line, Coordinates, Lines, and Increments, Functions, Shifting Graphs, Trigonometric Functions. [TB: Preliminaries]
2. Limits and Continuity: Rates of Change and Limits, Rules for Finding Limits, Target Values and Formal Definitions of Limits, Extensions of the Limit Concept, Continuity, Tangent Lines. [TB: Ch. 1]
3. Derivatives: The Derivative of a Function, Differentiation Rules, Rates of Change, Derivatives of Trigonometric Functions, The Chain Rule, Implicit Differentiation and Rational Exponents. [TB: Ch. 2]
4. Applications of Derivatives: Extreme Values of Functions, The Mean Value Theorem, The First Derivative Test for Local Extreme Values, Graphing with y‘ and y‘‘. [TB: Ch. 3]
5. Integration: Indefinite Integrals, Integration by Substitution—Running the Chain Rule Backward, Estimating with Finite Sums, Riemann Sums and Definite Integrals,

Properties, Area, and the Mean Value Theorem. Substitution in Definite Integrals. Numerical Integration. [TB: Ch. 4]

6. Applications of Integrals: Areas between Curves, Finding Volumes by Slicing, Volume of Solids of Revolution—Disks and Washers. Cylindrical Shells. Lengths of Plan Curves, Areas of Surfaces of Revolution, Moments and Centers of Mass. [TB: Ch. 5]
7. Transcendental Functions: Inverse Functions and Their Derivatives, Natural Logarithms, The Exponential Function, ax and logax, Growth and Decay, L'Hôpital's Rule, Relative Rates of Growth, Inverse Trigonometric Functions, Derivatives of Inverse Trigonometric Functions; Integrals. Hyperbolic Functions. [TB: Ch. 6]
8. Conic Sections, Parameterized Curves, and Polar Coordinates: Conic Sections and Quadratic Equations. Classifying Conic Sections by Eccentricity. Quadratic Equations and Rotations. Parameterizations of Plan Curves. Calculus with Parameterized Curves. Polar Coordinates. Graphing in Polar Coordinates. Polar Equations for Conic Sections. Integration in Polar Coordinates. [TB: Ch. 7, 9]
9. Vectors and Analytic Geometry in Space, Vectors in the Plane Dot Products, Vector Valued Function Cartesian (Rectangular) Coordinates and Vectors in Space. Dot Products. Cross Products. Lines and Planes in Space. Cylinders and Quadric Surfaces. Cylindrical and Spherical Coordinates. [TB: Ch. 9, 10]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Calculus and Analytic Geometry by George B. Thomas and Ross L. Finney, Addison Wesley; 10th Edition (1995) ISBN-10: 0201531747
2. Calculus and Analytical Geometry by Swokowski, Olinick and Pence, 6th Edition, (1994), Brooks/Cole Publishers.
3. Calculus by Howard Anton, Irl C. Bivens, Stephen Davis, Wiley; 10th Edition (2012), ISBN-10: 0470647728
4. Calculus with Analytic Geometry: Student Solution Manual by Howard Anton, Wiley; 5th Edition (1995). ISBN-10: 047110589

MATH-102 Probability and Statistics			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understanding cloud computing and related techniques	C	1
2. Understand the basic principles of implementing issues, ecosystem and case studies	C	2
3. Familiarity with cloud services and their techniques through labs and the Semester project.	C	2

* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain

Course Content:

1. Introduction to Statistics and Data Analysis: Statistical Inference, Samples, Populations, Role of Probability, Sampling Procedures; Collection of Data, Measures of Location: The Sample Mean and Median, Measures of Variability [TB1: Ch. 1]
2. Discrete and Continuous Data, Statistical Modeling, Scientific Inspection, and Graphical, General Types of Statistical Studies: Designed Experiment, Observational Study, and Retrospective Study. [TB1: Ch. 1]
3. Probability: Sample Space, Events, Counting Sample Points, Probability of an Event, Additive Rules, Conditional Probability, Independence, and the Product Rule, Bayes' Rule. [TB: Ch. 2]
4. Random Variables and Probability Distributions: Concept of a Random Variable, Discrete Probability Distributions, Continuous Probability Distributions, Joint Probability Distributions. [TB1: Ch. 3]
5. Mathematical Expectation: Mean of a Random Variable, Variance and Covariance of Random Variables, Means and Variances of Linear Combinations of Random Variables, Chebyshev's Theorem. [TB1: Ch. 4]
6. 5. Discrete Probability Distributions: Binomial and Multinomial Distributions, Hypergeometric Distribution, Negative Binomial and Geometric Distributions, Poisson Distribution and the Poisson Process. [TB1: Ch. 5]
7. Continuous Probability Distributions: Continuous Uniform Distribution, Normal Distribution, Areas under the Normal Curve, Applications of the Normal Distribution, Normal Approximation to the Binomial, Gamma and Exponential Distributions, Chi Squared Distribution, Beta Distribution. [TB1: Ch. 6]
8. Fundamental Sampling Distributions and Data Descriptions: Random Sampling, Sampling Distributions, Sampling Distribution of Means and the Central Limit Theorem. Sampling Distribution of S2, t-Distribution, F-Quantile and Probability Plots. [TB1: Ch. 8]
9. One- and Two-Sample Estimation Problems: Introduction, Statistical Inference, Classical Methods of Single Sample: Estimating the Mean, Standard Error of a Point, Prediction Intervals, Tolerance Limits, Estimating the Difference between Two Means. [TB1: Ch. 9]
10. Single Sample: Estimating a Proportion, Estimating the Difference between Two Proportions, Single Sample: Estimating the Variance, Estimating the Ratio of Two Variances. [TB1: Ch. 9]
11. One- and Two-Sample Tests of Hypotheses: Statistical Hypotheses: General Concepts, Testing a Statistical Hypothesis, The Use of P-Values for Decision Making in Testing Hypotheses. [TB1: Ch. 10]
12. Single Sample: Tests Concerning a Single Mean, Two Samples: Tests on Two Means, Choice of Sample Size for Testing Means, Graphical Methods for Comparing Means, One Sample: Test on a Single Proportion, Two Samples: Tests on Two Proportions. [TB1: Ch. 10]
13. One- and Two-Sample Tests Concerning Variances, Goodness-of-Fit Test, Test for Independence (Categorical Data), Test for Homogeneity [TB1: Ch. 10]
14. Simple Linear Regression and Correlation: Introduction to Linear Regression, The Simple Linear Regression Model, Least Squares and the Fitted Model, Properties of the Least Squares Estimators. [TB1: Ch. 11]
15. Multiple Linear Regression and Certain: Nonlinear Regression Models, Introduction, Estimating the Coefficients, Linear Regression Model Using Matrices, Properties of the Least Squares Estimators. [TB1: Ch. 12]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Probability and Statistics for Engineers and Scientists by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying E. Ye, Pearson; 9th Edition (January 6, 2011). ISBN-10: 0321629116
2. Probability and Statistics for Engineers and Scientists by Anthony J. Hayter, Duxbury Press; 3rd Edition (February 3, 2006), ISBN-10: 0495107573
3. Schaum's Outline of Probability and Statistics, by John Schiller, R. Alu Srinivasan and Murray Spiegel, McGraw-Hill; 3rd Edition (2008). ISBN-10: 0071544259
4. Probability: A Very Short Introduction by John Haigh, Oxford University Press (2012). ISBN-10: 0199588481

MATH-202 Linear Algebra			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Develops students‘ fundamental skills of solving ordinary differential equations, and developing differential equations for real-world problems	C	1

* BT= Bloom’s Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain

Course Content:

1. Introduction to Vectors: Vectors and Linear Combinations, Lengths and Dot Products, Matrices. [TB1: Ch. 1]
2. Solving Linear Equations: Vectors and Linear Equations, the Idea of Elimination, Elimination Using Matrices, Rules for Matrix Operations, Inverse Matrices. [TB1: Ch. 2]
3. Elimination = Factorization; A = LU, Transposes and Permutations
4. Vector Spaces and Subspaces: Spaces of Vectors, The Null space of A: Solving Ax = 0,
5. The Rank and the Row Reduced Form, the Complete Solution to Ax = B, Independence,
   Basis and Dimension, Dimensions of the Four Subspaces. [TB1: Ch. 3]
6. Orthogonally: Orthogonally of the Four Subspaces, Projections, Least Squares Approximations, Orthogonal Bases and Gram-Schmidt. [TB1: Ch. 4]
7. Determinants: The Properties of Determinants, Permutations and Cofactors, Cramer's Rule, Inverses, and Volumes. [TB1: Ch. 5]
8. Eigenvalues and Eigenvectors: Introduction to Eigenvalues, Diagonalizing a Matrix, Applications to Differential Equations, Symmetric Matrices, Positive Definite Matrices,
   Similar Matrices, Singular Value Decomposition (SVD). [TB1: Ch. 6]Page 36 of 121 Revised Curriculum BSCS: Applicable from Fall 2013 | Dept. CS & IT; UOS
9. Applications: Matrices in Engineering, Graphs and Networks, Markov Matrices, Population, and Economics; Linear Programming, Fourier series: Linear Algebra for Functions, Linear Algebra for Statistics and Probability, Computer Graphics.

Numerical Linear Algebra: Gaussian Elimination in Practice, Norms and Condition
10. Numbers, Iterative Methods for Linear Algebra. [TB1: Ch. 9]
11. Complex Vectors and Matrices: Complex Numbers, Hermitian and Unitary Matrices, Matrix Factorizations. [TB1: Ch. 10

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Introduction to Linear Algebra by Gilbert Strang, Wellesley Cambridge Press; 4th Edition (February 10, 2009). ISBN-10: 0980232716Advanced Engineering Mathematics by Erwin Kreyszig, Wiley; 10th Edition (August 16, 2011).ISBN-10: 0470458364
2. Elementary Linear Algebra with Applications by Bernard Kolman, David Hill, 9th Edition, Prentice Hall PTR, 2007. ISBN-10: 0132296543
3. Strang's Linear Algebra And Its Applications by Gilbert Strang, Strang, Brett Coonley, Andy Bulman-Fleming, Andrew Bulman-Fleming, 4th Edition, Brooks/Cole, 2005
4. Elementary Linear Algebra: Applications Version by Howard Anton, Chris Rorres, 9th Edition, Wiley, 2005.

Contents of Computing Supporting Area Elective Courses

MATH-301 Multivariable Calculus			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Develop the skills to have ground knowledge of multivariate calculus and appreciation for their further computer science courses.	C	1

* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain

Course Content:

1. Multivariable Functions and Partial Derivatives: Functions of Several Variables. Limits and Continuity. Partial Derivatives. Differentiability, Linearization, and Differentials. The Chain Rule. Partial Derivatives with Constrained Variables. Directional Derivatives, Gradient Vectors, and Tangent Planes. Extreme Values and Saddle Points. Lagrange Multipliers. Taylor's Formula. [TB1: Ch. 11]
2. Multiple Integrals: Double Integrals. Areas, Moments, and Centers of Mass. Double Integrals in Polar Form. Triple Integrals in Rectangular Coordinates. Masses and Moments in Three Dimensions. Triple Integrals in Cylindrical and Spherical Coordinates. Substitutions in Multiple Integrals. [TB1: Ch. 12]
3. Laplace Transforms: Laplace Transform. Inverse Transform. Linearity. First Shifting Theorem (s-Shifting). Transforms of Derivatives and Integrals. ODEs. Unit Step

Function (Heaviside Function). Second Shifting Theorem (t-Shifting). Short Impulses. Dirac's Delta Function. Partial Fractions. Convolution. Integral Equations. Differentiation and Integration of Transform. Systems of ODEs. Laplace Transform: General Formulas. Table of Laplace Transforms. [TB2: Ch. 6]

4. Fourier Analysis: Fourier Series, Arbitrary Period. Even and Odd Function. Half-Rang Expansions. Forced Oscillations. Approximation by Trigonometric Polynomials. SturmLiouville Problems. Orthogonal Functions. Orthogonal Series. Generalized Fourier Series. Fourier Integral. Fourier Cosine and Sine Transforms. Fourier Transform. [TB2: Ch. 11]
5. Power Series, Taylor Series: Sequences, Series, Convergence Tests. Power Series. Functions Given by Power Series. Taylor and Maclaurin Series. [TB2: Ch. 15]\
6. Laurent Series. Residue Integration: Laurent Series. Singularities and Zeros. Infinity. Residue Integration Method. Residue Integration of Real Integrals. [TB2: Ch. 16]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Calculus & Analytic Geometry by Thomas, Wiley; 10th Edition (August 16, 2011). ISBN-10: 0470458364
   Advanced Engineering Mathematics by Erwin Kreyszig, Wiley; 10th Edition (August 16,
   2011). ISBN-10: 0470458364
2. Multivariable Calculus by James Stewart, Brooks Cole; 7th Edition (January 1, 2011). ISBN-10: 0538497874
3. Multivariable Calculus by James Stewart 6th Edition, 2007, Cengage Learning
4. publishers.
5. Calculus and Analytical Geometry by Swokowski, Olinick and Pence, 6th Edition, 1994, Thomson Learning EMEA, Ltd.
6. Elementary Multivariable Calculus by Bernard Kolman William F. Trench, 1971, Academic Press.
7. Multivariable Calculus by Howard Anton, Albert Herr 5th Edition, 1995, John Wiley

CSSC-301 Differential Equations			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Develops students‘ fundamental skills of solving ordinary differential equations, and developing differential equations for real-world problems	C	1
* BT= Bloom’s Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Introduction to Differential Equations: Definitions and Terminology. Initial-Value Problems. Differential Equations as Mathematical Models. [TB: Ch. 1]
2. First-Order Differential Equations: Solution Curves without a Solution. Separable Variables. Linear Equations. Exact Equations and Integrating Factors. Solutions by Substitutions. A Numerical Method. [TB: Ch. 2]
3. Modelling With First-Order Differential Equations: Linear Models. Nonlinear Models. Modelling with Systems of First-Order Differential Equations. [TB: Ch. 3]
4. Higher-Order Differential Equations: Preliminary Theory- Linear Equations. Reduction of Order. Homogeneous Linear Equations with Constant Coefficients. Undetermined Coefficients- Superposition Approach. Undetermined Coefficients- Annihilator Approach. Variation of Parameters. Cauchy-Euler Equation. Solving Systems of Linear Differential Equations by Elimination. Nonlinear Differential Equations. [TB: Ch. 4]
5. Modeling with Higher-Order Differential Equations: Linear Models: Initial-Value Problems. Linear Models: Boundary-Value Problems. Nonlinear Models. [TB: Ch. 5]
6. Series Solutions of Linear Equations: Solutions about Ordinary Points. Solutions about Singular Points. Special Functions. [TB: Ch. 6]
7. Systems of Linear First-Order Differential Equations: Preliminary Theory. Homogeneous Linear Systems. Non-homogeneous Linear Systems. Matrix Exponential. [TB: Ch. 7].
8. Numerical Solutions of Ordinary Differential Equations: Euler Methods. Runge-Kutta Methods. Multistep Methods. Higher-Order Equations and Systems. Second-Order Boundary-Value Problems. [TB: Ch. 7].

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. A First Course in Differential Equations by Dennis G. Zill, Brooks Cole; 10th Edition (March 15, 2012).ISBN-10: 1111827052Multivariable Calculus by James Stewart, Brooks Cole; 7th Edition (January 1, 2011). ISBN-10: 0538497874
2. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley; 10th Edition (August 16, 2011).ISBN-10: 0470458364
3. Differential Equations with Boundary-Value Problems by Dennis G. Zill, Michael R. Cullen, Brooks Cole; 8th Edition (March 15, 2012). ISBN-10: 1111827060 Elementary Differential Equations with Applications by C. H .Edwards, David E. Penney, Pearson; 3rd Edition (October 20, 2008). ISBN-10: 013605425

CSSC-303 Numerical Computing			
Credit Hours:	3	**Prerequisites:**	Calculus & Analytical Geometry

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
On completion of this course, students will be able to demonstrate programming proficiency using Mat Lab for all methods. The course	A	3

must serve the purpose of scientific software development for science and engineering problems.		

* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain

Course Content:

1. Introduction to numerical algorithms and errors [TB: Ch. 1]
2. Round off Errors: Floating point systems, Round off error accumulation, The IEEE standard [TB: Ch. 2]
3. Nonlinear Equations in One Variable: Solving nonlinear equations, Bisection method, Fixed point iteration, Newton's method [TB: Ch. 3]
4. Review of Linear Algebra: Basic concepts like Vectors and matrix norms, Special classes of matrices, Singular values [TB: Ch. 4]
5. Direct Methods for solving Linear Systems: Gaussian elimination and backward substitution, LU decomposition, The Cholesky decomposition, Sparse matrices [TB: Ch. 5]
6. Linear Least Squares Problems: Least squares and the normal equations, Orthogonal transformations and QR, Householder transformations and Gram–Schmidt orthogonalization [TB: Ch. 7]
7. Eigen values and Singular Values: The power method and variants, Singular value decomposition, General methods for computing eigen values and singular values [TB: Ch. 8]
8. Polynomial Interpolation: Lagrange interpolation, Divided differences and Newton's form, Chebyshev interpolation [TB: Ch. 10]
9. Fourier Transform: The Fourier transform, Discrete Fourier transform and trigonometric interpolation, Fast Fourier transform [TB: Ch. 13]
10. Numerical Integration: Basic quadrature algorithms, Composite numerical integration [TB: Ch. 15]
11. Differential Equations: Initial value ordinary differential equations, Euler's method, Runge–Kutta methods [TB: Ch. 16]

Teaching Methodology:

Lectures, Class Assignments

Course Assessment:

Midterm Exam, Home Assignments, Quizzes, Final Exam

Reference Materials:

1. [TB] Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, SIAM, 2011. ISBN-10: 0898719976, ISBN-13: 978-0898719970
2. Richard L. Burden and J. Douglas Faires, Numerical Analysis, 10th Ed., Cengage Learning, 2011. ISBN-10: 1305253663
3. Anne Greenbaum & Timothy P. Chartier, Numerical Methods: Design, Analysis, and Computer Implementation of Algorithms, Princeton University Press, 2012. ISBN-10: 0691151229 [For MatLab implementation]
4. Anthony and Philip Rabinowitz, A First Course in Numerical Analysis, 2nd Ed., Dover Publications, 2001. ISBN-10: 048641454X
5. Germund Dahlquist and Åke Björck, Numerical Methods in Scientific Computing, Society for Industrial and Applied Mathematics, 2008. ISBN-10: 0898716446

CSSC-307 Object Oriented Analysis and Design			
Credit Hours:	3(3,0)	**Prerequisites:**	Object Oriented Programming

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Explains object models and designs from system requirements.	C	2
2. Presents the use the modeling concepts provided by UML.		
3. identify use cases and expand into full behavioral designs.	C	2
4. Expand the analysis into a design ready for implementation and construct designs that are reliable.	C C	2 2
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Principles of Object Technology: Introduction to Object Technology, Principles of Modeling, and Principles of Object Orientation [TB: Ch. 1.1-5]
2. Introduction to UML, Unification, UML Diagrams, Unified Process & Rational Unified Process, RUP Disciplines, Case Study Analysis and Basics, Case Study, About Inception, Feasibility and Risk Analysis [TB: Ch. 1.6, 2.1-6, 3.1-2,4.1-3]
3. Understanding Requirements, Requirements Types, Use Case Modeling: Use Case Writing Styles, EBP Guidelines [TB: Ch. 5.1, 6.1-8]
4. System Use Case Diagram, Use Case Table, Activity Diagram, Supplementary Specifications, Vision Document, Glossary, Rational Rose Overview, Use Case & Activity Diagram Modeling in Rational Rose [TB: Ch. 6.9, 6.12-17, 7.2-4 & 7]
5. Elaboration Phase of RUP; Configuration Management; System Sequence Diagram, Domain Model : Identifying Business Classes, Associations, Attributes [TB: Ch.8.25,9.2-4,10.1-4,11.1-7,12.1-4]
6. Implementation of System Sequence & Domain Model: Use Case Operational Contracts, Business Sequence, Analysis Sequence & Collaboration Diagrams [TB: Ch. 11.10, 12.9, 13.1-2, 13.9, 15.1-7]
7. Use Case Dependencies. Analysis Use Case Diagram, Implementation of Sequence, Collaboration, Analysis Use Case Diagram [TB: Ch. 25.1-5, 15.6-7]
8. State Chart Diagrams and Implementation [TB: Ch. 29.1-5, 29.8, Ch. 1-13, 25, 29]
9. Design Patterns: GRASP: Information Expert, Creator, Cohesion & Coupling, Controller [Ch. 16.1-10]
10. Use Case Realization Using GRASP Patterns, Design Model: Determining Visibility [TB: Ch. 17.1-9, 18.1-3]
11. Modeling Generalization, Creating Design Class Diagram, Mapping Data Model to Domain Model [TB: Ch. 26.1-7, 27.1-10, 19.1-6, 34.5-9]
12. Implementation of Design Class Diagram, Coding patterns, Mapping Design to Code [TB: Ch. 19.6, 20.1-11]
13. More Patterns for Assigning Responsibilities, Polymorphism, Pure Fabrication, Indirection, Protected Variation. GoF Design Patterns: Adapter, Factory [TB: Ch. 22.1-4, 23.1-2]
14. Gof: Singleton, Strategy, Composition, Façade and Discuss Remaining Patterns [TB: Ch. 23.4-8]

Teaching Methodology:

Lecturing, Written Assignments.
Course Assessment:
Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam
Reference Materials:
1. Applying UML and patterns: An introduction to Object-Oriented Analysis and Design and Iterative Development by Craig Larman, Prentice Hall; 3rdEdition (October 30, 2004). ISBN-10: 0131489062 Estimating Software Costs: Bringing Realism to Estimating by Capers Jones, McGraw-Hill Osborne Media; 2nd Edition (April 19, 2007).ISBN-10: 0071483004 2. The Unified Modeling Language User Guide by G. Booch, J. Rambaugh and I. Jakobson, Addison-Wesley Professional; 2ndEdition (2005). ISBN-10: 0321267974. 3. The Unified Modeling Language User Guide by G. Booch, J. Rambaugh and I. Jakobson, and Grady Booch, Addison-Wesley Professional; 2ndEdition (2004). ISBN-10: 032171895X 4. The Unified Modeling Language User Guide by Grady Booch, James Rumbaugh and Ivar Jacobson, Addison-Wesley Professional; (2005). ISBN-10: 0321267974. 5. Visual Modeling with Rational Rose 2000 and UML by Terry Quatrani, Addison Wesley, (2000). ISBN: 0201699613. 6. The Rational Unified Process Made Easy: A Practitioner's Guide to the RUP: A Practitioner's Guide to the RUP by Per Kroll, Philippe Kruchten and Grady Booch, Addison-Wesley Professional (2003). ISBN-10: 0321166094.

Contents of General Education Courses

ENGL-101 Functional English			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Fundamentals and principles of management.	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
Syllabus will be approved by the BOS, Department of English
Teaching Methodology:
Lectures, Written Assignments, Semester Project, Presentations
Course Assessment:
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
Reference Materials:

ENGL-102 Communication Skills			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1.	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
Syllabus will be approved by the BOS, Department of English
Teaching Methodology:
Lectures, Written Assignments, Semester Project, Presentations
Course Assessment:
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
Reference Materials:

ISLS-101 Islamic Studies			
Credit Hours:	2	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Fundamentals and principles of Islamic Philosophy.	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
Syllabus will be approved by the BOS, Department of Islamiat
Teaching Methodology:
Lectures, Written Assignments, Semester Project, Presentations
Course Assessment:
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
Reference Materials:

PKST-201 Pakistan Studies			
Credit Hours:	2	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Fundamentals and principles of Islamic Philosophy.	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
Syllabus will be approved by the BOS, Department of History
Teaching Methodology:
Lectures, Written Assignments, Semester Project, Presentations
Course Assessment:
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
Reference Materials:

ENGL-201 Technical & Report Writing			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1.	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
Syllabus will be approved by the BOS, Department of English
Teaching Methodology:
Lectures, Written Assignments, Semester Project, Presentations
Course Assessment:
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
Reference Materials:

ICTC-101 Introduction to Information & Communication Technologies			
Credit Hours:	2+1	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Demonstrate an awareness of the main processes in an ICT system (sending, receiving, storing, retrieving, manipulating, conveying)	C	1
2. Demonstrate an awareness of some of the hardware, software and communication components used in ICT systems	C	2
3. Use a system map or a block diagram to identify the components of an ICT system	C	2
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Introduction to Computers: Data and Information, Information Processing Cycle, the Components of a Computer, Advantages and Disadvantages of Using Computers. Networks and the Internet. [TB1, Ch.1]
2. Computer Software, Categories of Computers, Elements of an Information System, Examples of Computer Usage, Computer Applications in Society [TB1, Ch. 1].
3. The Internet and World Wide Web: Key Concepts of the Internet, Evolution of the Internet, the World Wide Web, E-Commerce, Other Internet Services, Netiquette [TB1, Ch. 2].
4. Application Software: Business Software, Graphics and Multimedia Software, Software for Home, Personal, and Educational Use, Web Applications, Application Software for Communications. [TB1, Ch. 3]
5. The System Unit: Processor, Data Representation, Memory, Expansion Slots and Adapter Cards, Ports and Connectors, Buses, Bays, Power Supply. [TB1, Ch. 4]
6. Input Devices: What Is Input? What Are Input Devices? The Keyboard, Pointing Devices, Mouse, Other Pointing Devices, Touch Screens And Touch-Sensitive Pads, Pen Input, Other Input For Smart Phones, Game Controllers, Digital Cameras, Voice Input, Video Input, Scanners And Reading Devices, Biometric Input, Terminals, Putting It All Together, Input Devices For Physically Challenged Users. [TB1, Ch. 5]
7. Output Devices: What is Output? Display Devices, Printers, Speakers, Headphones, and Earbuds, Other Output Devices. [TB1, Ch. 6]
8. Storage: Hard Disks, Flash Memory Storage, Cloud Storage, Optical Discs, Other Types of Storage. [TB1, Ch. 7]
9. System Software: Operating Systems, Operating System Functions, Types Of Operating Systems. [TB1, Ch. 8]
10. Stand-Alone Operating Systems, Server Operating Systems, Embedded Operating Systems, Utility Programs [TB1, Ch. 8]
11. Communications: Uses of Computer Communications, Networks, Network

Communications Standards, Communications Software, Communications over the Telephone Network, Communications Devices, Home Networks, Communications Channel, Physical Transmission Media, Wireless Transmission Media. [TB1, Ch. 9]

12. Databases: Data, and Information, The Hierarchy of Data, Maintaining Data, File Processing Versus Databases. [TB1, Ch. 10]
13. Database Management Systems, Relational, Object Oriented, and Multidimensional Databases, Web Databases, Database Administration. [TB1, Ch. 10]
14. Computer Security and Safety, Ethics, and Privacy: Computer Security Risks, Internet And Network Attacks, Unauthorized Access And Use. [TB1, Ch. 11]
15. Hardware Theft And Vandalism, Software Theft, Information Theft, System Failure, Backing Up, Wireless Security, Health Concerns Of Computer Use, Ethics And Society. [TB1, Ch. 11]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Discovering Computers by Gary B. Shelly & Misty E. Vermaat, Course Technology; 1st Edition (January 25, 2011).
2. Computing Essentials 2012 by Timothy J. O'Leary and Linda I. O'Leary, McGraw Hill Higher Education; 22nd Revised Edition (February 1, 2011).
3. Computers: Understanding Technology by Fuller, Floyd; Larson, Brian, Fourth Edition, ISBN: 978-0-76383-927-7 (OR Latest Edition.)
4. The Concepts of Information Technology by Imran Saeed, Afsan Raza, Tariq Mahmood and Zafar Hussain, 6th Edition, IT Series Publications

Contents of University Elective Courses

BUSB-402 Financial Accounting			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1.	C	1

* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain

Course Content:

Syllabus will be approved by the BOS, Department Business Administration

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
Reference Materials:

BUSB-201 Principles of Management			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Fundamentals and principles of management.	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Introduction to Managers and Management: What as Management and What Do Managers Do? Defining Management, Management Functions, Management Roles, Management Skills, History of Management.[TB2: Ch. 1]
2. Organizational Culture and Environment: The Manager: Omnipotent or Symbolic? The Organization's Culture, The Environment - Defining Environment, The Specific Environment, The General Environment, Influence on Management Practice. [TB1: Ch. 3]
3. Decision Making The Essence of Manager's Job: The Decision Making Process, The Rational Decision Maker, Decision Making Styles, Analyzing Decision Alternatives – Certainty, Risk, Uncertainty. [TB1: Ch. 6]
4. Planning: The Foundations of Planning, The Definition of Planning, Purposes of Planning, Types of Plans, Contingency Factors on Planning, Objectives: The Foundation for Planning, Multiplicity of Objectives, Real Versus Stated Objectives, Traditional Objective Setting, Management by Objectives. [TB2: Ch. 3]
5. Organization Structure and Design: Defining Organization Structure and Design, Building, The Vertical Dimension of Organizations, Building the Horizontal Dimension of Organizations, The Contingency Approach to Organization Design, Application of Organization Design.
6. Motivation: Motivating Employees, What is Motivation? Contemporary Approaches to Motivation, Contemporary Issues in Motivation, From Theory to Practice: Suggestions for Motivating Employees. [TB2: Ch. 10]
7. Leadership: Managers Verses Leaders, Trait Theories, Behavioral Theories, Contingency Theories, Emerging Approaches to Leadership, Contemporary Issues in Leadership. [TB2: Ch. 11]
8. Communication: Communication and Interpersonal Skills, Understanding Communication, Communication Styles of Men And Women, Feedback Skills, Delegation Skills', Conflict Management Skills, Negotiation Skills [TB2: Ch. 12]
9. Controlling - Foundations of Control: What is Control? The Importance of Control, The Control Process, Types of Control, Qualities of Effective Control, The Dysfunctional Side of Control, Ethical Issues in Control; Controlling Tools and Techniques: Information Controls, Financial Controls, Operations Controls, Behavioral Controls. [TB2: Ch. 13]

10. The Personnel Function: Terminology, Who Does Personnel Work? Staff Role of The Personnel Department Personnel (Human Resource) Functions. [TB3: Ch. 1 & 2]
11. Job Design and Analysis: Job Design, Job Information and Personnel Management, Analyzing Jobs-Obtaining Job Information, Functional Job Analysis, Administration of The Job Analysis Program. [TB3: Ch. 6 & 7]
12. Human Resource Planning: Reasons for Human Resource Planning, The Planning Process. [TB3: Ch. 5]
13. Recruitment and Selections/Testing and Interview: Labor Market Considerations, Recruitment and Selection Policy Issues, The Employment Process, Sources of People, The Selection Process, The Selection Procedure, Testing: Interview. [TB3: Ch. 6 & 7]
14. Miscellaneous: Union and Management, Compensation Administration, Health And Safety [TB2: Ch. 15, 17 & 18

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Management by Robbins, S.P. & Coulter, Mary, Prentice Hall; 10th Edition (November 3, 2008). ISBN-10: 0132090716
2. Fundamentals of Management by Robbins, S.P. &DeCenzo, David A, Prentice Hall; 7th Edition (January 13, 2010). ISBN-13: 978-0132090711
3. Human Resource Management by David A. DeCenzo and Stephen P. Robbins. Wiley; 7th Edition (October 10, 2001). ISBN-10: 0471397857

PSYC-302 Introduction to Psychology			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Fundamentals and principles of Islamic Philosophy.	C	1

* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain

Course Content:

Syllabus will be approved by the BOS, Department of Psychology

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

CSCC-201 Computer Organization and Assembly Language			
Credit Hours:	3	**Prerequisites:**	

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understanding the basics of computer organization with emphasis on the lower level abstraction of a computer system	C	1
2. Understand the digital logic, instruction set	C	2
3. Familiarity with assembly language programming.	C	2
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Introduction to Microprocessor Architecture: Microprocessor Bus Structure - Addressing, Data and Control, Registers and Flags. Addressing Modes.
2. Introduction to Assembly Language, 80x86 families; program layout. [TB: Ch. 1.1, 1.2; 2,3]
3. Data Definitions, Basic Instructions. [TB: Ch. 3, 4]
4. Unsigned Arithmetic; Logic and Bit Operations. [TB: Ch. 6, 7]
5. Modules; Separate Assembly; Argument Passing [TB: Ch. 5,8]
6. Libraries; Combining Assembly and C Code [TB: Ch. 13]
7. String Instructions; Arrays [TB: Ch. 9]
9. Macros; Structures [TB: Ch. 10]
10. Floating Point Instructions [TB: Ch. 12]
11. Bit MS-DOS. [TB: Ch. 14]
12. BIOS Disk Accessing [Ref]
13. BIOS Keyboard/Video/Graphics [Ref]
14. Interrupts; TSR Programs [Terminate And Stay Resident] [Ref]
15. Accessing I/O Ports; 8253 Timer [Ref]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Textbook(s):

Assembly Language for x86 Processors by Kip R. Irvine, Prentice Hall; 6thEdition (March 7, 2010). ISBN-10: 013602212X

Reference Materials:

1. The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware,and Applications by Walter A. Triebel & Avtar Singh, Prentice Hall; 4thEdition (September 8,

2002). ISBN-10: 0130930814.
2. Lab Manual to Accompany - The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, and Applications by Walter A. Triebel & Avtar Singh, Pearson; 4thEdition (2003). ASIN: B000Q652KQ
3. Principles of Computer Organization and Assembly Language by Patrick Juola, Prentice Hall; 1stEdition (January 11, 2011). ASIN: B009TGBI1Q
4. The Art of Assembly Language by Randall Hyde, No Starch Press; 2ndEdition (March 22, 2010). ISBN-10: 1593272073

CSSC-305 Computer Architecture			
Credit Hours:	3	**Prerequisites:**	

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understand structure and behavior of the various functional modules of the computer	C	2
2. How these structure and behavior interact to provide the processing needs of the user.	C	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Introduction to a Simple Computer: CPU Basics and Organization, The Bus, Clock, The Input/Output Subsystem, Memory Organization and Addressing, Interrupts, MARIE, Instruction Processing, Hardware vs Micro-programmed Control, Real-World Examples of Computer . [TB2: Ch. 4]
2. Architectures: Intel & MIPs Architecture [TB1: Ch. 6]
3. Instruction Set Architecture: Instruction Format, Instruction Types, Addressing, Instruction Pipelining, ISAs – Intel, MIPS, Java Virtual Machine [TB2: Ch. 5]
4. Micro-architecture: Single-Cycle Processor, Multicycle Processor, Pipeline Processors, DDL Representation, Exceptions. [TB1: 7]
5. Advanced Micro-architecture: Deep Pipelines, Branch Prediction, Superscalar Processor, Out-of-Order Processor, Register Renaming, Single Instruction Multiple Data, Multithreading, Homogeneous Multiprocessing, Heterogeneous Multiprocessor. [TB1: 7]
6. Memory: Types of Memory, The Memory Hierarchy, Cache Memory, Virtual Memory, Memory Management [TB1: 8]
7. Input/Output and Storage System: I/O and Performance, Amdahl's Law, I/O architectures, Data Transmission Modes, Magnetic Disk Technology, Optical Disk Technology, Magnatic Tape, RAID, Future of Data Storage. [TB2: Ch. 7]
8. Alternative Architectures: RISC Machines, Flynn's Taxonomy, Parallel and Multiprocessor Architecture, Alternative Parallel Processing Approaches, Quantum Computing. [TB2: Ch. 9]
9. Embedded Systems: Embedded Hardware & Embedded Software. [TB2: Ch. 10]

Teaching Methodology:

Lecturing, Written Assignments, Project, Report Writing

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Digital Design and Computer Architecture & Organization by David Harris and Sarah Harris, Morgan Kaufmann; 2ndEdition (August 7, 2012). ISBN-10: 0123944244
2. Essentials of Computer Organization and Architecture by Linda Null and Julia Lobur, Jones & Bartlett Learning; 3rdEdition (December 17, 2010)
3. Computer Architecture & Organization: A Quantitative Approach (Fifth Edition) by John L. Hennessy and David A. Patterson, Morgan Kaufmann; 5thEdition (September 30,2011). ISBN-10: 012383872X
4. Digital Design and Computer Architecture & Organization by D. M. Harris and S. L. Harris and Morgan Kaufmann, Morgan Kaufmann; 1stEdition (March 16, 2007). ISBN-10: 0123704979

CSCC-301 Theory of Automata			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Fundamental concepts of automata theory and formal languages to form basic models of computation which provide foundation of many branches of computer science, e.g. compilers, software engineering, concurrent systems	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Introduction to Automata: The Methods and the Madness, Introduction to Formal Proof, Inductive Proofs, the Central Concepts of Automata Theory. [TB: Ch.1]
2. Finite Automata: Introduction of Finite Automata, Deterministic Finite Automata, Nondeterministic Finite Automata, Finite Automata with Epsilon Transitions. [TB: Ch.2]
3. Regular Expressions and Languages, Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions. [TB: Ch.3]
4. Properties of Regular Languages, Proving Languages Not to Be Regular, Closure Properties of Regular Languages, Decision Properties of Regular Languages, Equivalence and Minimization of Automata. [TB: Ch.4]
5. Context-Free Grammars and Languages: Context-Free Grammars, Parse Trees, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages
6. Pushdown Automata: Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDAs and CFGs, Deterministic Pushdown Automata. [TB: Ch.6]
7. Properties of Context-Free Languages: Normal Forms for Context-Free Grammars,

The Pumping Lemma for Context-Free Languages, Closure Properties of Context-Free Languages, Decision Properties of CFLs. [TB: Ch.7]

8. Introduction to Turing Machines: Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines, Extensions to the Basic Turing Machine, Restricted Turing Machines, Turing Machines and Computers. [TB: Ch.8]
9. Un-decidability: A Language That Is Not Recursively Enumerable, Un-decidable Problem That Is RE, Un-decidable Problems About Turing Machines, Posts Correspondence Problem, Other Un-decidable Problems. [TB: Ch.9]
10. Intractable Problems: The Classes P and NP, an NP-Complete Problem, A Restricted Satisfiability Problem. [TB: Ch.10]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Introduction to Automata Theory, Languages, and Computation by J. Hopcroft, R. Motwani, and J. Ullman, 3rdEdition, 2006, Addison-Wesley.
2. An Introduction to Formal Language and Automata by Peter Linz, Jones & Bartlett Pub; 4 thEdition (2006). ISBN-10: 0763737984
3. Automata and Formal Languages: An Introduction by Dean Kelley, Prentice Hall (1995). ISBN-10: 0134977777

CSCC-202 Design and Analysis of Algorithms			
Credit Hours:	3	**Prerequisites:**	Discrete Structure

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Student will be enable to design algorithms for problems	C	1
2. Understanding the core logic of problem solving	C	2
3. Time and Space Complexity of Algorithm	C	2

* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain

Course Content:

1. Role of Algorithms in Computing, Analysing Algorithms, Designing Algorithms, Growth of Functions, Asymptotic Notation, Standard Notations and Common Functions. [TB: Ch1,2,3]
2. Divide-and-Conquer, Strassen's Algorithm for Matrix Multiplication, Recursion. [TB: Ch. 4]
3. Recurrences: Substitution Method for Solving Recurrences, Recursion-Tree Method for Solving Recurrences, Master Method for Solving Recurrences. [TB: Ch. 4]
4. Sorting and Order Statistics: Heapsort Algorithm, Priority Ques, Quicksort Algorithm, Analysis of Quicksort. [TB: Ch. 6, 7]
5. Sorting in Linear Time: Lower Bounds for Sorting, Counting Sort, Radix Sort, Bucket Sort. [TB: Ch. 8]
6. Medians and Order Statistics, Binary Search Trees, Querying a Binary Search Tree, Insertion and Deletion. [TB: Ch. 9, 12]
7. Red-Black Trees: Properties of Red-Black Trees, Rotations, Insertion, Deletion; Minimum Spanning Trees: Introduction, Growing a Minimum Spanning Tree. [TB: Ch. 12]
8. Dynamic Programming: Elements of Dynamic Programming, Longest Common Subsequence, Optimal Binary Search Trees [TB: Ch. 15]
9. Greedy Algorithms: Elements of The Greedy Strategy, Huffman Codes, Matroids and Greedy Methods, Task-Scheduling Problem. [TB: Ch. 16]
10. Elementary Graph Algorithms, Representations of Graphs, Breadth-First Search, Depth-First Search, Topological Sort. [TB: Ch. 22]
11. Single-Source Shortest Paths: The Bellman-Ford Algorithm, Single-Source Shortest Paths in Directed Acyclic Graphs, Dijkstra's Algorithm. [TB: Ch. 24]
12. All-Pairs Shortest Paths: Floyd-Warshall Algorithm, Johnson's Algorithm for Sparse Graphs. [TB: Ch. 25]
13. Maximum Flow: Flow Networks, Ford-Fulkerson Method, Push-Relabel Algorithms, Relabel-to-Front Algorithm. [TB: Ch. 26]
14. String Matching: Naive String-Matching Algorithm, Rabin-Karp Algorithm, String Matching with Finite Automata, Knuth-Morris-Pratt Algorithm. [TB: Ch. 32]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, The MIT Press; 3rdEdition (2009). ISBN-10: 0262033844
2. Introduction to the Design and Analysis of Algorithms by Anany Levitin, Addison Wesley; 2ndEdition (2006). ISBN-10: 0321358287
3. Algorithms in C++ by Robert Sedgewick (1999). ASIN: B006UR4BJS
4. Algorithms in Java by Robert Sedgewick, Addison-Wesley Professional; 3rdEdition(2002). ISBN-10: 0201361205

CSCC-302 Artificial Intelligence			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Knowledge of current progresses related to AI	C	1
2. Introduction of many advances subjects taught at MS and PhD level	C	2
3. Introduction of game theory	C	2
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Introduction: What is AI, Foundations of AI, History of AI. Intelligent Agents: Agents and Environments, The Nature of Environments, The Structure of Agents [TB: Ch. 1, 2]
2. Problem Solving by Searching: Problem Solving Agents, Searching for Solutions, Uninformed Search Strategies.
3. Breadth-First Search, Depth-First Search, Depth-limited Search, Iterative Deepening, Depth-first Search, Comparison of Uninformed Search Strategies. [TB: Ch. 3]
4. Informed Search and Exploration: Informed (Heuristic) Search Strategies: Greedy Best-first Search, A* Search, Heuristic Functions, Local Search Algorithms and Optimization Problems. [TB: Ch. 4]
5. Constraint Satisfaction Problems: Backtracking Search for CSPs, Local Search for CSPs. Adversarial Search: Games, Minimax Algorithm, Alpha-Beta Pruning. [TB: Ch. 5, 6]
6. Reasoning and Knowledge Representation: Introductions to Reasoning and Knowledge Representation, Propositional Logic, First Order Logic: Syntax and Semantics of First-Order Logic, Knowledge Engineering in First-Order Logic, [TB: Ch. 7, 8]
7. Inference in First-Order Logic: Inference rules for quantifiers, A first-order inference rule, Unification, Forward Chaining, Backward Chaining, A backward chaining algorithm, Logic programming, The resolution inference rule [TB: Ch. 9]
8. Introduction to Prolog Programming
9. Reasoning Systems for Categories, Semantic Nets and Description logics, Reasoning with Default Information: Open and closed worlds, Negation as failure and stable model semantic. Truth Maintenance Systems [TB: Ch. 10]
10. Reasoning with Uncertainty & Probabilistic Reasoning : Acting Under Uncertainty, Bayes' Rule and Its Use, [TB: Ch 13]
11. Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks. [TB: Ch. 14]
12. Learning from Observations: Forms of Learning , Inductive Learning,, Learning Decision Trees [TB: Ch. 18]
13. Knowledge in Learning, Explanation-Based Learning, Inductive Logic Programming. [TB: 19]
14. Statistical Learning, Neural Networks [TB: Ch. 20]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Artificial Intelligence: A Modern Approach, by Russell and Norvig, Prentice Hall. 2ndEdition. ISBN-10: 0137903952
2. Artificial Intelligence: A Systems Approach by M. Tim Jones, Jones and Bartlett Publishers, Inc; 1stEdition (December 26, 2008). ISBN-10: 0763773379
3. Artificial Intelligence in the 21st Century by Stephen Lucci , Danny Kopec, Mercury Learning and Information (May 18, 2012). ISBN-10: 1936420236

CSCC-306 Compiler Construction			
Credit Hours:	3	**Prerequisites:**	Theory of Automata

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understand the basic techniques used in compiler construction such as lexical analysis, top-down, bottom-up parsing, context-sensitive analysis, and intermediate code generation	C	2
2. - Understand the basic data structures used in compiler construction such as abstract syntax trees, symbol tables, three-address code, and stack machines	C	2
3. Design and implement a compiler using a software engineering approach	C	2
4. Use generators (e.g. Lex and Yacc)	C	2
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Overview of Compilation: Principles of Compilation, Compiler Structure, High-Level View of Translation, Desirable Properties of a Compiler. [TB: Ch.1]
2. Scanners: Recognizing Words, Regular Expressions, Implementing Scanners. [TB: Ch.2]
3. Parsers: Expressing Syntax, Top-Down Parsing, Bottom-Up Parsing. [TB: Ch.3]
4. Context-Sensitive Analysis: Type Systems, Attribute-Grammar Framework, Ad Hoc Syntax-Directed Translation. [TB: Ch.4]
5. Intermediate Representations: Graphical IRs, Linear IRs, Mapping Values to Names, Symbol Tables. [TB: Ch.5]
6. The Procedure Abstraction: Procedure Calls, Name Spaces, Communicating Values Between Procedures, Standardized Linkages. [TB: Ch.6]
7. Code Shape: Assigning Storage Locations, Arithmetic Operators, Boolean and Relational Operators, Storing and Accessing Arrays, Character Strings, Structure References, Control-Flow Constructs, Procedure Calls. [TB: Ch.7]
8. Code Optimization: Scope of Optimization, Local Optimization, Regional Optimization, Global Optimization, Interprocedural Optimization. [TB: Ch.8]
9. Data-Flow Analysis: Iterative Data-Flow Analysis, Static Single-Assignment Form, Inter-procedural Analysis. [TB: Ch.9]
10. Scalar Optimizations: Taxonomy for Transformations, Example Optimizations. [TB:

Ch.10]

11. Instruction Selection: Code Generation, Extending the Simple Tree-Walk Scheme, Instruction Selection via Tree-Pattern Matching, Instruction Selection via Peephole Optimization. [TB: Ch.11]
12. Instruction Scheduling: The Instruction-Scheduling Problem, Local List Scheduling, Regional Scheduling. [TB: Ch.12]
13. Register Allocation: Background Issues, Local Register Allocation and Assignment, Moving Beyond Single Blocks, Global Register Allocation and Assignment.
15. Implementation of a prototype compiler (Class Assignment for the Semester)

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Engineering a Compiler, Second Edition by Keith Cooper and Linda Torczon, Morgan Kaufmann; 2ndEdition (February 21, 2011). ISBN-10: 012088478X
2. Compilers: Principles, Techniques, and Tools, A. V. Aho, R. Sethi and J. D. Ullman, Addison-Wesley, 2nd ed., 2006
3. Modern Compiler Design, D. Grune, H. E. Bal, C. J. H. Jacobs, K. G. Langendoen, John Wiley, 2003.
4. Modern Compiler Implementation in C, A. W. Appel, M. Ginsburg, Cambridge University Press, 2004.

CSEC-407 Data Mining			
Credit Hours:	3	**Prerequisites:**	Database Systems

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understanding the structure of modern data mining models	C	1
2. Understand the basic principles of implementing data mining models	C	2
3. Familiarity with key algorithms for efficiency and efficacy	C	2
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Data-Mining Concepts: Introduction, Data-Mining Process, Large Data Sets, Data Warehouses for Data Mining, Business Aspects Data Mining. [TB1: Ch. 1]
2. Preparing the Data: Raw Data- Representation, Characteristics, Transformation; Missing Data, Time-Dependent Data, Outlier Analysis. [TB1: Ch. 2]
3. Data Reduction: Dimensions of Large Data Sets, Feature Reduction, Relief Algorithm, Entropy Measure for Ranking Features, PCA, Value Reduction, Feature Discretization: Chi Merge Technique, Case Reduction. [TB1: Ch. 3]
4. Learning From Data: Learning Machine, SLT, Types of Learning Methods, Common

Learning Tasks, SVMs, kNN: Nearest Neighbor Classifier, Model Selection versus Generalization, Model Estimation. [TB1: Ch. 4]

5. Statistical Methods: Statistical Inference, Assessing Differences in Data Sets, Bayesian Inference, Predictive Regression, ANOVA, Logistic Regression, Log-Linear Models, LDA. [TB1: Ch. 5]
6. Decision Trees and Decision Rules: Decision Trees, Generating & Pruning Decision Tree, CART Algorithm & Gini Index, Limitations of Decision Trees and Decision Rules. TB1: Ch. 6]
7. Artificial Neural Networks: Model of an Artificial Neuron, Architectures of ANNs, Learning Process, Learning Tasks Using ANNs, Multilayer Perceptron's, Competitive Networks and Competitive Learning, SOMs. [TB1: Ch.7]
8. Ensemble Learning: Ensemble-Learning Methodologies, Combination Schemes for Multiple Learners, Bagging and Boosting, Ada Boost. [TB: Ch. 8]
9. Cluster Analysis: Clustering, Similarity Measures, Agglomerative Hierarchical Clustering, Partitional Clustering, Incremental Clustering, DBSCAN Algorithm. BIRCH Algorithm, Agglomerative Hierarchal and Partition Clustering Algorithms, Clustering Validation. [TB: Ch. 9]
10. Association Rules: Market-Basket Analysis, Algorithm Apriori, From Frequent Item-sets to Association Rules, Improving the Efficiency of the Apriori Algorithm, FP Growth Method, Associative-Classification Method, Multidimensional Association–Rules Mining. [TB: Ch. 10]
11. Web Mining and Text Mining: Web Mining, Web Content, Structure, and Usage Mining, HITS and LOGSOM Algorithms, Mining Path–Traversal Patterns, PageRank Algorithm, Text Mining, Latent Semantic Analysis. [TB: Ch. 11]
12. Genetic Algorithms: Fundamentals of GAs, Optimization Using GAs, Schemata, TSP, Machine Learning Using GAs, GAs for Clustering. [TB: Ch. 13]
2. Fuzzy Sets and Fuzzy Logic: Fuzzy Sets, Fuzzy-Set Operations, Extension Principle and Fuzzy Relations, Fuzzy Logic and Fuzzy Inference Systems, Multifactorial Evaluation, Extracting Fuzzy Models from Data, Data Mining and Fuzzy Sets
3. Visualization Methods: Perception and Visualization, Scientific Visualization and In-formation Visualization, Parallel Coordinates, Radial Visualization, Visualization Using Self-Organizing Maps, Visualization Systems for Data Mining
4. Data Mining Tools: Weka, CBA and Yale, etc.

Teaching Methodology:

Lectures, Semester Project, Assignments, Presentations, Interactive sessions

Course Assessment:

Sessional Marks(Assignments, Quizzes, Project, Presentations), Mid Exam, Final Exam

Reference Materials:

1. Data Mining: Concepts, Models, Methods, and Algorithms by Mehmed Kantardzic, Wiley-IEEE Press; 2nd Edition (August 16, 2011). ISBN-10: 0470890452
2. Data Mining: Concepts and Techniques, Third Edition (The Morgan Kaufmann Series in Data Management Systems) by Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufmann; 3rd Edition (2011). ISBN-10: 0123814790
3. Principles of Data Mining (Adaptive Computation and Machine Learning) by David J. Hand, Heikki Mannila and Padhraic Smyth, A Bradford Book (August 1, 2001). ISBN-10: 026208290X
4. Data Mining and Data Warehousing: Practical Machine Learning Tools Techniques by Ram Kumar Singh and Amit Asthana, LAP LAMBERT Academic Publishing (2012). ISBN-10: 3659118419

5. Information-Statistical Data Mining: Warehouse Integration with Examples of Oracle Basics (The Springer International Series in Engineering and Computer Science) by Bon K. Sy and Arjun K., Springer; 1st Edition (2003). ISBN-10: 1402076509
6. Building the Data Warehouse by William H. Inmon, Wiley; 4th Edition (2005). ISBN-10: 0764599445

CSEC-302 Multimedia Systems and Design			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. To learn complete process of multimedia system specifications, formats, design, testing, and prototyping.	C	1
2. Comprehensive understanding of multimedia tools, technologies, and techniques.	C	2
3. Learn and apply the design patterns and good practices in the designing of the multimedia applications	C	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. What is Multimedia? Text [TB1. Ch. 1, 2]
2. Multimedia Authoring and Tools: Multimedia Authoring, Multimedia Production, Multimedia Presentation, Automatic Authoring; Editing and Authoring Tools- Adobe Premiere, Macromedia Director, Macromedia Flash, Dreamweaver; VRML. [TB2: Ch.2]
3. Handling Images. [TB1. Ch. 3]
4. Handling Sound. [TB1. Ch. 4]
5. Handling Animation. [TB1. Ch. 5]
6. Handling Video. [TB1. Ch. 6]
7. Making Multimedia. [TB1. Ch. 7]
8. Multimedia Skills. [TB1. Ch. 8]
9. Planning and Costing. [TB. Ch. 9]
10. Designing and Producing [TB1. Ch. 10]
11. Content and Talent. [TB1. Ch. 11]
12. The Internet and Multimedia [TB1. Ch. 12]
13. Designing for the World Wide Web; [TB1. Ch. 13]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Multimedia Making It Work Eighth Edition by Tay Vaughan, McGraw-Hill Osborne Media; 8 Edition (October 29, 2010). ISBN-10: 0071748466 [Text Book (TB 1)]
2. Fundamentals of Multimedia by Z. M. Li and M. S. Drew, Prentice Hall (2004), ISBN: 0-13-127256-X [Text Book (TB 2)]
3. Digital Multimedia by N. Chapman and J. Chapman. 2nd Edition, Wiley 2004, ISBN: 0-470 5890-7 [Reference Material (RM1)]
4. The Technology of Video and Audio Streaming by David Austerberry, Focal Press; 2nd Edition (2004). ISBN-10: 0240805801 [Reference Material (RM2)]
5. Multimedia Security: Watermarking, Steganography, and Forensics by Frank Y. Shih, CRC Press; 1st Edition (2012), ISBN-10: 1439873313 [Reference Material (RM3)]
6. Multimedia Computing by Daniel Cunliffe and Geoff Elliott, Lexden Publishing Ltd. (2005). ISBN-10: 1904995055 [Reference Material (RM3)]
7. Multimedia Foundations: Core Concepts for Digital Design by Vic Costello, Ed Youngblood and Susan Youngblood, Focal Press; 1st Edition (2012). ISBN-10:0240813944 [Reference Material (RM4)]

CSEC-302 Web System and Technology			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Have essential skills for website management	C	1
2. Demonstrate understanding of the basic Internet technology concepts	C	2
3. Develop a prototype of interactive World Wide Web applications	C	3, 5
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Overview of WWW, Web Pages, Web Sites, Web Applications, TCP/IP, TCP/IP Application, Services, Web Servers, WAMP Configuration.
2. Introduction to HTTP, HTML & HTML5 Tags, and Dynamic Web Content.[Ch. 1]
3. CSSC and CSSC3 [Ch. 18,19]
4. Client Side Programming: Programing in JavaScript: Basics, Expressions and Control Flow, Functions, Objects, and Arrays, Accessing CSSC from JavaScript [Ch. 13, 14, 15, 20]
5. Form Handling [Ch. 11]
6. Server Side Programing: Programing in PHP, [Ch. 3, 4,5,6]
7. Introduction MySQL, MySQL Functions, Accessing MySQL via phpMyAdmin,
8. Cookies, Sessions, and Authentication [Ch. 12]
9. Introduction to Ajax, jQuery, Browsers and the DOM [W3 Schools Tutorial]
10. Designing a Social Networking Site [Ch. 21]

Teaching Methodology:
Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations
Course Assessment:
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
Reference Materials:

1. Learning PHP, MySQL, JavaScript, and CSSC, A Step-by-Step Guide to Creating Dynamic Websites by Robin Nixon, O'Reilly Media; Second Edition (September 3, 2012). ISBN-10: 1449319262
2. Web Technologies: A Computer Science Perspective by Jeffrey C. Jackson, Prentice Hall; 1st Edition (August 27, 2006). ISBN-10: 0131856030
3. Web Technologies by Uttam Kumar Roy, Oxford University Press, USA (June 13, 2011). ISBN-10: 0198066228
4. Web Application Architecture: Principles, protocols and practices by Leon Shklar and Richard Rosen, Wiley; 2nd Edition (May 5, 2009). ISBN-10: 047051860X

CSEC-417 Optimization Techniques			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
The course provides students an exposure to solving non-linear optimization problems by various techniques, with due emphasis on their mathematical rigor in terms of their derivation / justification.	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Preliminaries: Review of the theory of maxima, minima (two variables); positive definite matrices, convexity of regions and functions; quadratic function and Hessian matrix; uniqueness of minimum. [TB2: Chapt. 9, Chapt. 11 : Sec.11.1 – 11.5]
2. Classical methods for functions of one variable and *n* variables, Newton's method [TB1: Chap. 1].
3. Search methods for functions of one variable: Single search techniques: Bracketing method; Quadratic and cubic interpolation; Fibonacci search; Golden-section. [TB1: Chap. 2]
4. Search methods for functions of *n* variables: method of Hooke and Jeeves, Nelder and

Mead's Method. [TB1: Chap. 3]

5. Gradient methods: Davidon-Fletcher-Powell (DFP); Fletcher- Reeves, conjugate-gradient and direct- search methods, Newton's method, method of Steepest descent [TB1: Chap. 4].
6. Review of Lagrange multipliers technique with equality constraints; inequality constraints and slack variables; Kuhn-Tucker conditions [TB1: Chap. 5]
7. Search methods: modified Hooke and Jeeves, the Complex method [TB1: Chap. 6].
8. Penalty-function approach to constrained optimization; equality and inequality constraints, SUMT method of Fiacccco and McCormick. [TB1: Chap. 7]

Teaching Methodology:
Lectures, Class Exercises
Course Assessment:
Midterm Exam, Home Assignments, Quizzes, Final Exam
Reference Materials:

1. Bunday, B. D., Basic Optimization Methods, Edward Arnold Ltd., 1984.
2. Chiang,Alpha.C., Fundamental Methods of Mathematical Economics, McGraw-Hill Education; 4th ed., 2004.

CSEC-308 Enterprise Application Development			
Credit Hours:	3	**Prerequisites:**	Web Systems and Technologies

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understanding the structure of modern computer system	C	1
2. Understand the basic principles of implementing computer graphics primitive	C	2
3. Familiarity with key algorithms for modelling and rendering graphic data	C	2
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Object-Oriented Programming Review, Software Architectures Overview: Desktop, File/Server, 2-Tier Client/Server, Multi-Tier Client/Server.
2. Application and Page Framework, Page Directives, Page Life Cycle, Build Providers Compilation and its techniques, compilation implantations, Application level events.
3. Asp. Net Server Control and Client Side Scripts, JQuery, JQuery selectors, validation with JQuery.
4. Applying Style to Server Control, HTML Server Control Manipulating Pages and Server Control with JavaScript, Client-Side call-back.
5. Web Server Control: label, literal, textbox, button, link button, image button and their

server side events, Web Server Control: dropdown, list box, checkbox, checkbox list, radio button, radio button list, and their dynamic binding, Web Server Control: Image, Calendar, table, panel bullet list, hidden field, file upload controls and their server side calling.

6. Validation Server Control, Client side validation vs server side validation, Validation control's implantation. Validate a form using validation controls.
7. Master Pages, Coding Master Pages, Coding Content Pages, Nesting Master Pages.
8. HTML and CSSC Design with Asp.Net, Bootstrap and responsive design, Theme and Skins: Creating Own Theme, Multiple Skin Theme, Programmatically Working with Themes.
9. Entity framework and its approaches, LINQ, ADO.Net, Create Database and model and insert/update record using entity framework.
10. Data Binding & Data Management using store procedures, Data Grid view Server Control, List View Server Control.
11. SQL Queries, JOINS, built in function, Session and Cookies, User Authentication.
12. Basic of XML, XML Reader and XML Writer, Xml Document and Xpath Document.
13. ASP.Net AJAX Control, ASP .Net AJAX Application Control, Server Side Control, Update Panel Control.
14. Building and Consuming Services, XML Services, Protocol for Web Services.

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Professional ASP.NET 4 in C# and VB by Bill Evjen, Scott Hanselman and Devin Rader, Wrox; 1st Edition (March 9, 2010). ISBN-10: 0470502207.
2. Beginning ASP.NET 4.5.1: in C# and VB (Wrox Programmer to Programmer) 1st Edition) by Imar Spaanjaars (March 24, 2014. ISBN-13: 978-1118846773
3. Beginning ASP.NET 4.5 in C# by Matthew MacDonald, Apress; 1st Edition (August 29, 2012). ISBN-10: 1430242515.

CSEC-418 Introduction To Computational Linguistics			
Credit Hours:	3	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Fundamental concepts of automata theory and formal languages to form basic models of computation which provide foundation of many branches of computer science, e.g. compilers, software engineering, concurrent systems	C	1
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:

1. Introduction, Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithms, Language, Thought, and Understanding, The State of the Art and The Near-Term Future, Some Brief History [TB1-Ch1]
2. 2 Regular Expressions and Automata, Regular Expressions, Finite-State Automata, Regular Languages and FSAs [TB1-Ch2-Optional]
3. Morphology and Finite-State Transducers, Survey of (Mostly) English Morphology, Finite-State Morphological Parsing, Combining FST Lexicon and Rules, Lexicon-free FSTs: The Porter Stemmer, Human Morphological Processing [TB1-Ch3]
4. Computational Phonology and Text-to-Speech, Speech Sounds and Phonetic Transcription, The Phoneme and Phonological Rules, Phonological Rules and Transducers, Advanced Issues in Computational Phonology, Machine Learning of Phonological Rules, Mapping Text to Phones for TTS, Prosody in TTS, Human Processing of Phonology and Morphology [TB1-Ch4-Optional]
5. Probabilistic Models of Pronunciation and Spelling, Dealing with Spelling Errors, Spelling Error Patterns, Detecting Non-Word Errors, Probabilistic Models, Applying the Bayesian method to spelling, Minimum Edit Distance, English Pronunciation Variation, The Bayesian method for pronunciation, Weighted Automata, Pronunciation in Humans [TB1-Ch5]
6. N-grams, Counting Words in Corpora, Simple (Unsmoothed) N-grams, Smoothing, Backoff, Deleted Interpolation, N-grams for Spelling and Pronunciation, Entropy [TB1-Ch6]
7. HMMs and Speech Recognition, Speech Recognition Architecture, Overview of Hidden Markov Models, The Viterbi Algorithm, Advanced Methods for Decoding, Acoustic Processing of Speech, Computing Acoustic Probabilities, Training a Speech Recognizer, Waveform Generation for Speech Synthesis, Human Speech Recognition [TB1-Ch7]
8. Word Classes and Part-of-Speech Tagging, English Word Classes, Tagsets for English, Part of Speech Tagging, Rule-based Part-of-speech Tagging, Stochastic Part-of-speech Tagging, Transformation-Based Tagging, Other Issues [TB1-Ch8]
9. Context-Free Grammars for English, Constituency, Context-Free Rules and Trees, Sentence level construction, The noun phrase, coordination, agreement, The verb phrase and sub categorization, auxiliaries, spoken language syntax, grammar equivalence & normal form, finite state & context free grammars, grammars & human processing [TB1-Ch9]
10. Parsing with context free grammars, parsing as search, a basic top-down parser, problems with the basic top-down parser, the Earley algorithm, finite state parsing methods [TB1-Ch10]
11. Features and Unifications, feature structures, unification of feature structures, features structures in grammar, implementing unification, parsing with unification constraints, types and inheritance [TB1-Ch11-Optional]
12. Lexicalized and probabilistic parsing, probabilistic context free grammars, problems with PCFGs, probabilistic lexicalized CFGs, dependency grammars, human parsing [TB1-Ch12]
13. Language and complexity, the Chomsky Hierarchy, How to tell if a language is not regular, Is Natural language context free, Complexity and human processing [TB1-Ch13-Optional]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
Reference Materials:

1. Daniel Jurafsky and James H. Martin. 2008. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition. Second Edition. Prentice Hall.
2. Christopher D. Manning and Hinrich Schütze. 1999. Foundations of Statistical Natural Language Processing. MIT Press.
3. Steven Bird. 2009. Natural Language Processing with Python. O'Reilly. (Free on SearchWorks)
4. Philipp Koehn. 2010. Statistical Machine Translation. Cambridge.
5. Yoshua Bengio. 2009. Learning Deep Architectures for AI. Technical Report. (Free from Stanford network)
6. Frederick Jelinek. 1998. Statistical Methods for Speech Recognition. MIT Press.
7. James Allen. 1995. Natural Language Understanding. Benjamin/Cummings, 2ed.
8. Psycholinguistics: Tanenhaus & Trueswell (2006), Human Sentence Processing website

CMPC-302 Information Security			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Explain key concepts of information security such as design principles, cryptography, risk management, and ethics.	C	2
2. Discuss legal, ethical, and professional issues in information security.	C	2
3. Apply various security and risk management tools for achieving information security and privacy.	C	3
4. Identify appropriate techniques to tackle and solve problems in the discipline of information security.	C	4
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

1. Information security foundations, security design principles; security mechanisms [TB 1: Ch 1]
2. Vulnerabilities and protections: Malwares [TB 1: Ch 6]
3. Hash functions [TB 1: Ch 2, 21]
4. Digital signatures [TB 1: Ch 2]
5. Key management [TB 1: Ch 2,20]
6. Authentication: Access control [TB 1: Ch 3,4]
7. Symmetric cryptography: Symmetric Encryption Principles, Data Encryption Standard, 8. Advanced Encryption Standard, Cipher Block Modes of Operation [TB 1: Ch 20]
8. Asymmetric cryptography: HMAC, The RSA Public-Key Encryption Algorithm, Diffie-Hellman and Other Asymmetric Algorithms [TB 1: Ch 21]
9. Software security [TB 1: Ch 11]

10. Database security: The Need for Database Security, Database Management Systems
    1. Relational Databases, SQL Injection Attacks, Database Access Control, Inference, Database Encryption [TB 1: Ch 5]
11. Network security: Secure E-Mail and S/MIME, Domain Keys Identified Mail, Secure Sockets Layer (SSL) and Transport Layer Security (TLS), HTTPS, IPv4 and IPv6 Security, Wireless Security, Mobile Device Security [TB 1: Ch 22, 24]
12. Firewalls: The Need for Firewalls, Firewall Characteristics and Access Policy, Types of Firewalls, Firewall Basing [TB 1: Ch 9]
13. Intrusion detection: Intruders, Intrusion Detection, Analysis Approaches, Types of IDS [TB 1: Ch 8]
14. Security policies, policy formation and enforcement, risk assessment [TB 1: Ch 14,15]
15. Cybercrime, law and ethics in information security, privacy and anonymity of data [TB 1: Ch 19]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Computer Security: Principles and Practice, 3rd edition by William Stallings[TB1]
2. Principles of Information Security, 6th edition by M. Whitman and H. Mattord
3. Computer Security, 3rd edition by Dieter Gollmann
4. Computer Security Fundamentals, 3rd edition by William Easttom
5. Official (ISC)2 Guide to the CISSP CBK, 3rd edition

SEE-416 IOT			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understanding the structure of Internet of Things.	C	1
2. Understand the basic principles of implementing IoT with Fog and Cloud.	C	2
3. Familiarity with Programming frameworks and Big Data analytics in real IoT Applications.	C	2

*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**

Course Content:

1. Internet of Things: An Overview, IoT emergence, Internet of EveryThing. [TB1:Ch 1, 3]
2. IoT infrastructures: Open Source Semantic web architecture for managing IoT resources in Cloud. [TB1:Ch 2]
3. Device/Cloud Collaboration Framework for Intelligence Applications IoT. [TB1: Ch,3]
4. Communication Protocols for IoT, Network Layers, Transport and Application layer [TB1: Ch 1, 13]
5. Fog Computing: Principles, Architectures, and Applications.[TB1: Ch 4]
6. Programming Frameworks for Internet of Things, Embedded device Programming languages, IoT programming languages [TB1: Ch 5]

7. Virtualization on Embedded Boards as Enabling Technology for the Cloud of Things[TB1: Ch 6]
8. Micro Virtual Machines (MicroVMs) for Cloud-Assisted Cyber-Physical Systems [TB1: Ch 7]
9. Design and Implement Scalable, Flexible, and open IoT solutions using Web technologies [TB4: Ch 1]
10. IoT data management and Analytics: IoT and Cloud, Real time Analytics in IoT and Fog Computing, [TB1: Ch 8, TB2 : Ch 1]
11. A Framework for Distributed Data Analysis for IoT [TB1:Ch 9]
12. Security and Privacy in the Internet of Things, TinyTO: Two-Way Authentication for Constrained
    Devices in the Internet of Things [TB2 : Ch 12]
13. Internet of Things Applications, Monitoring and Actuating, Internet of Vehicles and Applications[Tb1 : Ch 15, 16]
14. Cloud-Based Smart-Facilities Management, IoT Services LifeCycle, Scheduling and Resource Management, Validating Applications and use cases [TB1:Ch 17]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Internet of Things: Principles and Paradigms 1st Edition, ISBN-10: 012805395X
2. Big Data Analytics: Tools and Technology for Effective Planning, Published October 26, 2017, ISBN 9781138032392
3. *https://pdfs.semantiCSCCholar.org/2006/d0fca0546bdeb7c3f0527ffd299cff7c7ea7.pdf*
4. *Building the Web of Things, ISBN-10:9781617292682*

CMPC-308 Information Security			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
5. Explain key concepts of information security such as design principles, cryptography, risk management, and ethics.	C	2
6. Discuss legal, ethical, and professional issues in information security.	C	2
7. Apply various security and risk management tools for achieving information security and privacy.	C	3
8. Identify appropriate techniques to tackle and solve problems in the discipline of information security.	C	4
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

16. Information security foundations, security design principles; security mechanisms [TB 1: Ch 1]

17. Vulnerabilities and protections: Malwares [TB 1: Ch 6]
18. Hash functions [TB 1: Ch 2, 21]
19. Digital signatures [TB 1: Ch 2]
20. Key management [TB 1: Ch 2,20]
21. Authentication: Access control [TB 1: Ch 3,4]
22. Symmetric cryptography: Symmetric Encryption Principles, Data Encryption Standard, 8. Advanced Encryption Standard, Cipher Block Modes of Operation [TB 1: Ch 20]
23. Asymmetric cryptography: HMAC, The RSA Public-Key Encryption Algorithm, Diffie-Hellman and Other Asymmetric Algorithms [TB 1: Ch 21]
24. Software security [TB 1: Ch 11]
25. Database security: The Need for Database Security, Database Management Systems 2. Relational Databases, SQL Injection Attacks, Database Access Control, Inference, Database Encryption [TB 1: Ch 5]
26. Network security: Secure E-Mail and S/MIME, Domain Keys Identified Mail, Secure Sockets Layer (SSL) and Transport Layer Security (TLS), HTTPS, IPv4 and IPv6 Security, Wireless Security, Mobile Device Security [TB 1: Ch 22, 24]
27. Firewalls: The Need for Firewalls, Firewall Characteristics and Access Policy, Types of Firewalls, Firewall Basing [TB 1: Ch 9]
28. Intrusion detection: Intruders, Intrusion Detection, Analysis Approaches, Types of IDS [TB 1: Ch 8]
29. Security policies, policy formation and enforcement, risk assessment [TB 1: Ch 14,15]
30. Cybercrime, law and ethics in information security, privacy and anonymity of data [TB 1: Ch 19]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

6. Computer Security: Principles and Practice, 3rd edition by William Stallings[TB1]
7. Principles of Information Security, 6th edition by M. Whitman and H. Mattord
8. Computer Security, 3rd edition by Dieter Gollmann
9. Computer Security Fundamentals, 3rd edition by William Easttom
10. Official (ISC)2 Guide to the CISSP CBK, 3rd edition

PHYS-101 Applied Physics			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understand the basic laws of physics, circuiting and basics of transistors.	C	2

*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**

Course Content:

1. Zero Reference Level, Chassis Ground, Ohm's Law, Formula Variations of Ohm's Law, Graphical Representation of Ohm's Law, Linear Resistor, Non Linear Resistor, Cells in

Series and Parallel.[TB 1: Ch 1]
2. Resistive Circuits. [TB 1: Ch 2]
3. Resistors(5.1-15), Inductors(5.19-21) Capacitors(5.35-48) .[TB 1: Ch 5]
4. Energy Sources. [TB 1: Ch 6]
5. Magnetism and electromagnetism [TB 1: Ch 7].
6. Solid State. Atomic structure, Electron distribution of different atoms, Energy bands in solids, Bonds in solids, Conduction in solids, Conductors, Semiconductors and types of semiconductors, Insulators, Majority and Minority charge carriers, Mobile charge carriers and immobile ions, Drift current in good conductors.[TB 1: Ch 12]
7. P-N Junction. Formation of depletion layer, Junction or barrier voltage, Forward biased P-N Junction, Forward V/I Characteristics, Reverse biased P-N Junction, Re-verse Saturation Current, Reverse V/I Characteristics, Junction breakdown, Junction Capacitance. [TB 1: Ch 13]
8. Optoelectronics Devices. Spectral response of human eye, Light Emitting Diode (LED), Photoemissive Devices, Photomultiplier Tube, Photovoltaic Devices, Bulk type Photoconductive cells, Photodiodes, P-N junction Photodiode, PIN Photodiode, and Avalanche Photodiode. [TB 1: Ch 16]
9. DC Power Supplies. Unregulated and Regulated Power Supply, Steady and Pulsating DC Voltages, Rectifiers (17.5-17.8), Filters (17.9-17.2), Voltage Multipliers (17.24-17.30), Silicon Controlled Rectifier SCR(17.33-17.37)[TB 1: Ch 17]
10. The Basic Transistor. Transistor Biasing, Transistor Circuit Configuration. [TB 1: Ch 18]
11. Modulation and Demodulation. Carrier Waves, Modulation, Demodulation or Detection, Comparison between Amplitude Modulation (AM) and Frequency Modulation (FM). [TB 1: Ch 30]
12. Integrated Circuits. Advantages of ICs and Drawbacks of ICs, Scale of Integration, Classification of ICs by function, Linear and Digital Integrated Circuits, IC Terminology, Fabrication of IC Components, Popular Application of ICs, Operational Amplifier. [TB 1: Ch 31]
13. Fiber Optics. Structure of Optical Fibres, Classification of Optical Fibres, Fibre Characteristics, Choice of Wavelength, Optical Fibre cable, Application of Fibre Optic Communication. [TB 1: Ch 38]

Teaching Methodology:

Lecturing, Written Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam

Reference Materials:

1. A Practical English Grammar by A. J. Thomson and A. V. Martinet,4th Edition Oxford University Press (1986).
2. Basic English Usage by Michael Swan, Oxford UnivPr (Sd) (January 1986). ISBN-10: 0194311872
3. Functional English In Aglobal Society: Vocabulary Building and Communicative Grammar by Nicanor L. Guintomary Ann R. Sibal Brian D. Villaverde Dept. of Languages, Literature and Humanities College of Arts and Sciences Southern Luzon State University (2012).
4. AQA Functional English Student Book: Pass Level 2 by Mr David Stone, Heinemann; 1st Edition (28 Jun 2010). ISBN-10: 0435151401
5. English Composition and Grammar: Complete Course by John E. Warriner, Harcourt Brace Jovanovich; Complete Course Benchmark Edition (January 1988). ISBN-10: 0153117362

6. Companion to English: Vocabulary (Learners Companion) by George Davidson, Prim-Ed Publishing (March 1, 2003). ISBN-10: 9814070904
7. Word Power Made Easy by Norman and Lewis, Goyal Publishers (September 1, 2009). ISBN-10: 8183071007
8. 1000 Most Important Words by Norman W. Schur, Ballantine Books (July 12, 1982). ISBN-10: 0345298632
9. High School English Grammar and Composition by P.C Wren, Chand & Co (July 13, 2008). ISBN-10: 812192197X

BUSB-204 Human Resource Management			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. After successfully completing of this course, students will be able to understand the core aspects of Human Resource Management required in 21st Century organizations.	C	2
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

1. Managing Human Resources. [TB 1: Ch. 1]
2. Understanding the External and Organizational Environments. [TB 1: Ch. 2]
3. Ensuring Fair Treatment and Legal Compliance. [TB 1: Ch. 3]
4. HR Planning for Alignment and Change. [TB 1: Ch. 4]
5. Using Job Analysis and Competency Modeling. [TB 1: Ch. 5]
6. Recruiting and Retaining Qualified Employees. [TB 1: Ch. 6]
7. Selecting Employees to Fit the Job and the Organization. [TB 1: Ch. 7]
8. Training and Developing a Competitive Workforce. [TB 1: Ch. 8]
9. Conducting Performance Management. [TB 1: Ch. 9]
10. Developing an Approach to Total Compensation. [TB 1: Ch. 10]
11. Using Performance-Based Pay to Achieve Strategic Objectives. [TB 1: Ch. 11]
12. Providing Benefits and Services for Employees' Well-Being. [TB 1: Ch. 12]
13. Risk Management, Employee Relations, and Risk Management, Health, Safety, and Employee Well-Being. [TB 1: Ch. 13]
14. Understanding Unionization and Collective Bargaining. [TB 1: Ch. 14]

Teaching Methodology:

Lectures, Written Assignments, Class Discussion

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Final Exam

Reference Materials:

1. Managing Human Resources by Susan E. Jackson, Randall S. Schuler and Steve Werner, South-Western College Pub; 11th Edition (June 16, 2011).ISBN-10: 1111580227
2. Management of Human Resources by Gary Dessler, CarolinRekar Munro and Nina D. Cole, Pearson Education Canada; 3rd Edition (February 28, 2010). ISBN-10: 0321687140
3. Human Resource Management by Robert L. Mathis and John H. Jackson, South-

Western Cengage Learning; 13th Edition (August 19, 2010). ISBN-10: 053845315X
4. Human Resource Management Applications: Cases, Exercises, Incidents, and Skill Builders by Stella M. Nkomo, Myron D. Fottlerand R. Bruce McAfee, South-Western Cengage Learning; 7th Edition (September 29, 2010). ISBN-10: 0538468076

BUSB-202 Organizational Behavior			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. This course introduces the student to multidisciplinary approaches to human behaviour in organizational settings. Attention will be paid to both public and private sector organizations.	C	2
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

1. Organizational Behavior: The Quest for People-Centered Organizations and Ethical Conduct [TB 1: Ch.1]
2. Organizational Culture, Socialization, and Mentoring [TB 1: Ch. 3]
3. Key Individual Differences and the Road to Success [TB 1: Ch. 5]
4. Values, Attitudes, Job Satisfaction, and Counterproductive Work Behaviors [TB 1: Ch. 6]
5. Social Perceptions and Attributions [TB 1: Ch.7]
6. Foundations of Motivation [TB 1: Ch.8]
7. Improving Job Performance with Goals, Feedback, Rewards, and Positive Reinforcement [TB 1: Ch.9]
8. Group Dynamics [TB 1: Ch.10]
9. Developing and Leading Effective Teams [TB 1: Ch.11]
10. Individual and Group Decision Making [TB 1: Ch.12]
11. Managing Conflict and Negotiating [TB 1: Ch.13]
12. Communicating in the Digital Age [TB 1: Ch.14]
13. Leadership, Influence, Empowerment, and Politics [[TB 1: Ch.15, 16]
14. Organizational Design, Effectiveness, and Innovation [TB 1: Ch.17]

Teaching Methodology:

Lectures, Written Assignments, Class Discussions

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Final Exam

Reference Materials:

1. Organizational Behavior by Robert Kreitnerand AngeloKinicki, McGraw-Hill/Irwin; 10 Edition (January 17, 2012). ISBN-10: 0078029368
2. Organizational Behavior by Stephen P. Robbins and Timothy A. Judge, Prentice Hall; 15th Edition (January 16, 2012). ISBN-10: 0132834871
3. Meeting the Ethical Challenges of Leadership: Casting Light or Shadow by Craig E. Johnson, SAGE Publications, Inc; 4thEdition (February 28, 2011). ISBN-10:

1412982227

ECON-402 Business Economics			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. This course is mean for understanding core matters of economics so that student shall be able to understand what is going on globally. This course, along with Entrepreneurship course, shall help students to establish their own business.	C	2
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:
1. Introduction to Business and the economic environment [TB 1: Ch. 1] 2. The working of competitive markets [TB 1: Ch. 2] 3. Demand and the consumer [TB 1: Ch. 3] 4. Supply decisions in a perfectly competitive market [TB 1: Ch. 4] 5. Pricing and output decisions in imperfectly competitive markets [TB 1: Ch. 5] 6. Business growth and strategy [TB 1: Ch. 6] 7. Multinational corporations and business strategy in a global economy [TB 1: Ch. 7] 8. Government, the firm and the market [TB 1: Ch. 9] 9. The economy and business activity [TB 1: Ch. 10] 10. National macroeconomic policy [TB 1: Ch. 11] 11. The global trading environment [TB 1: Ch. 12]
Teaching Methodology:
Lectures, Class Discussions
Course Assessment:
Sessional Exam, Home Assignments, Quizzes, Final Exam
Reference Materials:
1. John Sloman and Elizabeth Jones, Essentials Economics for Business, 5th Ed., Pearson, 2017. 2. Alan Griffiths and Stuart Wall, Economics for Business & Management: A Student Text, Prentice Hall, 2005 3. Dermot McAleese, Economics for Business: Competition, Macro-stability and Globalization, 3rd Ed., Prentice Hall, 2009.

BUSB-401 Entrepreneurship			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***

1. The course gives students the tools necessary to think creatively, to plan out whether their idea is marketable to investors, guide them through the launch their own business, or to support an employer in launching and growing an entrepreneurial venture.	C	2

*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**

Course Content:

1. Entrepreneurship and the Entrepreneurial Mind-Set. [TB 1: Ch. 1]
2. Entrepreneurial Intentions and Corporate Entrepreneurship. [TB 1: Ch. 2]
3. Entrepreneurial Strategy: Generating and Exploiting New Entries. [TB 1: Ch. 3]
4. Creativity and the Business Idea. [TB 1: Ch. 4]
5. Identifying and Analyzing Domestic and International Opportunities. [TB 1: Ch. 5]
6. Intellectual Property and Other Legal Issues for the Entrepreneur. [TB 1: Ch. 6]
7. The Business Plan: Creating and Starting the Venture. [TB 1: Ch. 7]
8. The Marketing Plan. [TB 1: Ch. 8]
9. The Organizational Plan. [TB 1: Ch. 9]
10. The Financial Plan. [TB 1: Ch. 10]
11. Sources of Capital. [TB 1: Ch. 11]
12. Informal Risk Capital, Venture Capital, and Going Public. [TB 1: Ch. 12]
13. Strategies for Growth and Managing the Implication of Growth. [TB 1: Ch. 13]
14. Succession Planning and Strategies for Harvesting and Ending the Venture. [TB 1: Ch. 15]

Teaching Methodology:

Lectures, Written Assignments, Class Discussions

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Final Exam

Reference Materials:

1. Entrepreneurship by Robert Hisrich, Michael Peters and Dean Shepherd, McGraw-Hill/Irwin; 9th Edition (September 27, 2012). ISBN-10: 0078029198
2. Entrepreneurship: Ideas in Action by Cynthia L. Greene, South-Western Educational Pub; 5th Edition (January 6, 2011). ISBN-10: 0538496894
3. Entrepreneurship by William D. Bygrave and Andrew Zacharakis, Wiley; 2nd Edition (October 12, 2010). ISBN-10: 0470450371
4. Entrepreneurship: Theory, Process, and Practice by Donald F. Kuratko, South-Western College Pub; 8th Edition (November 14, 2008). ISBN-10: 0324590911
5. Entrepreneurship: Successfully Launching New Ventures by Bruce R. Barringer and Duane Ireland, Prentice Hall; 4th Edition (October 27, 2011)

CSEC-303 Big Data Analytics			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understand the Big Data Platform and its Use cases.	C	2

2. Provide an overview of Apache Hadoop, HDFS Concepts and Interfacing with HDFS.	C	3
3. Understand Map Reduce Jobs and learn Apache Spark.	C	3
4. Apply analytics on Structured, Unstructured Data and Exposure to Data Analytics with Scala.	C	3
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

1. Overview of Big Data: This includes topics such as history of big data, its elements, career related knowledge, advantages, disadvantages and similar topics. [TB 1: Ch. 13, TB2: Ch. 7]
2. Big Data in Real Life: This module focuses on the application perspective of Big Data covering topics such as using big data in marketing, analytics, retail, hospitality, consumer good, defense etc.
3. Technologies for Handling Big Data: Big Data is primarily characterized by distributed data processing frameworks like Hadoop. This module cover topics such as Introduction to Hadoop, functioning of Hadoop, Cloud computing (features, advantages, applications) [TB 1: Ch. 3]
4. Hadoop EcoSystem: This includes learning about Hadoop and its ecosystem which includes HDFS, MapReduce, YARN, HBase, Hive, Pig, Sqoop, Zookeeper, Flume, Oozie etc.
5. Deeply Understanding MapReduce: This module should cover the entire framework of MapReduce and uses of mapreduce. [TB :3 Ch. 1,2]
6. Databases and Data Warehouses: This module should cover all about databases, data warehouses, data mining, and their related introductory knowledge. [TB 1: Ch. 14]
7. Data Storage using HDFS: This includes an entire module of HDFS, HBase and their respective ways to store and manage data along with their commands. [TB 3: Ch. 12]
8. Big Data Semester Project: Discussion about how to collect real data, store data in HDFS, process distributed data using Apache Spark. Justify how it improves performance.
9. Learn Scala Basics: Learn variables, functions, loops, class, objects, case classes
10. Learn Scala: Learn Tuples, Map, Fold, Split, Array Concatenation, Lists, Iterators
11. Apache Spark: Learn How Spark is better than Hadoop, Resilient Distributed Datasets, Immutability, Learn Spark Configurations, Spark Context. [TB 3: Ch. 13]
12. Apache Spark: Understand Map Partition with Index, Accumulators, Broadcasts, and How to run an Apache Spark Job on Cluster [TB 3: Ch. 14]

Teaching Methodology:

Lectures, Written Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam

Reference Materials:

1. Cady, Field. *The Data Science Handbook*. John Wiley & Sons, 2017.
2. Stephens-Davidowitz, Seth, and Steven Pinker. Everybody lies: Big data, new data, and what the internet can tell us about who we really are. HarperLuxe, 2017.
3. Bill Chambers and Matei Zaharia. Spark: The Definitive Guide: Big Data Processing Made Simple, OReilly, 2018.

CSEC-305 E-Commerce Applications Development			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understand the concepts and standards related to the discipline of E-Commerce.	C	2
2. Analyze complex real world problems found in E-Commerce.	C	3
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

1. E-Commerce: An overview of e-Commerce, Brick 'N Mortar stores vs Service-based companies, e-Commerce Models, e-Commerce popular sites: iStockphoto, WooThemes, eBay, Amazon, Play.com. [TB 1: Ch.1]
2. Planning an e-Commerce Framework: Designing a framework, Patterns, ModelView-Controller, Registry, Singleton, Structure, Building a framework, Routing requests. [TB 1: Ch.2]
3. Products and Categories: Product information, Category information, Structuring Content, Versioning, Building products, categories, and content functionality, Routing products and categories. [TB 1: Ch.3]
4. Product Variations and User Uploads: Giving user's choice, giving users control, shopping. [TB 1: Ch.4]
5. Enhancing the User Experience: The importance of user experience, Search, Providing wish lists, Making Recommendations, Stock Checking, Customer's Feed Back, Processing reviews/comments. [TB 1: Ch.5]
6. The Shopping Basket: Creating a Basket, Basket Contents, Managing the Basket, Cleaning the Basket. [TB 1: Ch.6]
7. The Checkout and Order Process: The Process, Authentication, Payment Method, Order Processed. [TB 1: Ch.7]
8. Shipping and Tax: Shipping Methods, Shipping Costs, Shipping Rules, Tracking, Tax Calculation. [TB 1: Ch.8]
9. Discounts, Vouchers, and Referrals: Discount codes, Purchasable Voucher Codes, Referrals. [TB 1: Ch.9]
10. Checkout: Checkout process consideration, Order process review, Authentication & Confirmation. [TB 1: Ch.10]
11. Taking Payment for Orders: Taking payment, Payment System, Payment gateway, Taking Payment Online, Taking payment offline. [TB 1: Ch.11]
12. User Account Features: User Account Area, Changing Details, Viewing & Managing Orders. [TB 1: Ch.12]
13. Administration: Dashboard, Managing Products and Categories, Managing Orders, Customers, Refunds, Voucher Codes, Shipping, etc. [TB 1: Ch.3]
14. Deploying, Security, and Maintenance, SEO. [TB 1: Ch.14, 15]

Teaching Methodology:

Lectures, Written Assignments, Project, Report Writing

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. PHP 5 E-commerce Development by Michael Peacock, Packt Publishing (January 20, 2010). ISBN-10: 184719964X
2. E-Commerce, Kenneth Laudon and Carol Guercio Traver, 13th Edition, Pearson, 2017.
3. PHP 5 E-commerce Development, Michael Peacock, Packt Publishing, 2010.
4. Introduction to E-Commerce, Jeffrey F. Rayport, McGraw-Hill, 2nd Edition, 2007.
5. Electronic Commerce, Gary Schneider, Course Technology; 12th Edition 2016

CSEC-306 Enterprise Resource Planning Systems			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	**Domain**	**BT Level***
1. To comprehend the technical aspects of ERP systems.	C	2
2. To understand the steps and activities in the ERP life cycle.	C	2
3. Understand the concepts of reengineering and able to map business processes using mapping techniques.	C	3

*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**

Course Content:

1. Introduction to Enterprise Resource Planning Systems. [TB 1: Ch. 1]
2. ERP Technology. [TB 1: Ch. 2]
3. ERP and Business Process Reengineering. [TB 1: Ch. 3
4. Systems Diagramming and the Process Map. [TB 1: Ch. 41]
5. ERP Life Cycle: Planning and Package Selection. [TB 1: Ch. 5]
6. ERP Life Cycle: Implementation and Operation and Maintenance. [TB 1: Ch. 6]
7. ERP Sales, CRM and Knowledge Management. [TB 1: Ch. 7
8. ERP Financials. [TB 1: Ch. 8]
9. Human Capital Management, Self-Service and Outsourcing. [TB 1: Ch. 9]
10. Manufacturing Systems and Supply Chain. [TB 1: Ch. 10]
11. Auditing ERP. [TB 1: Ch. 11]
12. Business Intelligence and Performance Management. [TB 1: Ch. 12]

Teaching Methodology:

Lectures, Written Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam

Reference Materials:

1. Modern ERP: Select, Implement & Use Today's Advanced Business Systems by Marianne Bradford, lulu.com (October 19, 2009). ISBN-10: 0557012910
2. Managerial Issues of Enterprise Resource Planning Systems by David Olson, McGraw-Hill/Irwin; 1st Edition (September 10, 2003). ISBN-10: 0072861126
3. Enterprise Resource Planning by Bret Wagner by Ellen Monk, Course Technology; 3rd

Edition (February 4, 2008). ISBN-10: 1423901797
4. ERP Systems by DimpiSrivastava by AartiBatra, I K International Publishing House (February 15, 2010). ISBN-10: 9380578148

CSEC-312 Mobile Application Development			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Discuss different architectures & framework for Mobile Application development.	C	1
2. Develop mobile applications using current software development environments.	C	3
3. Compare the different performance tradeoffs in mobile application development.	C	3

*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**

Course Content:

1. What is Android? Obtaining the Required Tools, Installing and Configuring the Android SDK Manager, Creating Your First Android Application, Anatomy of an Android Application. [Tb1: Ch 1]
2. The Big Picture, How to Get Started, Your First Android Project, A bit About Eclipse, Enhancing Your First Project [Tb2: Ch 1-6]
3. Understanding Activities, Linking Activities Using Intents, Fragments, Calling Built-In Applications Using Intents, Displaying Notifications. [Tb1: Ch 2]
4. Understanding the Components of a Screen, Adapting to Display Orientation, Managing Changes to Screen Orientation, Utilizing the Action Bar, Creating the User Interface Programmatically, and Listening for UI Notifications. [Tb1: Ch 3]
5. Using Basic Views, Using Picker Views, Using List View to Display Long Lists, Understanding Specialized Fragments. [Tb1: Ch 4]
6. Using Image Views to Display Pictures, Using Menus with Views, Analog Clock and Digital Clock Views. [Tb1: Ch 5]
7. Saving and Loading User Preferences, Persisting Data to Files, Creating and Using Databases. [Tb1: Ch 6]
8. Sharing Data in Android, using a Content Provider, Creating Your Own Content Providers, Using the Content Provider. [Tb1: Ch 7]
9. Sending SMS Messages Programmatically, Getting Feedback after Sending a Message, Sending SMS Messages Using Intent, Receiving SMS Messages, Sending E-mail. [Tb1:Ch 8]
10. Displaying Maps, Getting Location Data, Monitoring a Location, Building a Location Tracker. [Tb1:Ch 9]
11. Consuming Web Services Using HTTP, Accessing Web Services Using the Get Method, Consuming JSON Services, Sockets Programming. [Tb1:Ch 10]
12. Creating Your Own Services, Establishing Communication between a Service and an Activity, Binding Activities to Services, Understanding Threading. [Tb1:Ch 11]
13. Android games Development, Publishing Android Applications [Tb3, Tb1: Ch12]

14. Handling Telephone Calls, Fonts. [Tb2:Ch 41, 42]
Teaching Methodology:
Lectures, Written Assignments, Project, Report Writing
Course Assessment:
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
Reference Materials:
1. Professional Android application development, Reto Meier, Wrox Programmer to Programmer, 2015. 2. iOS Programming: The Big Nerd Ranch Guide, Conway, J., Hillegass, A., & Keur, C., 5th Edition, 2014. 3. Android Programming: The Big Nerd Ranch Guides, Phillips, B. & Hardy, B., 2nd Edition, 2014.

CSEC-309 Cloud Computing			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understand about fundamental concepts of distributed computing, how these techniques work inside today's most widely-used cloud computing systems.	C	1
2. Understanding the basic principles of cloud deployment and Service models.	C	2
3. Deployment of service models of Cloud through simulator/Vmware/Openstack etc.	C	2
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:
1. Distributed systems, Characteristics, Design goals, Types of distributed systems [TB2:1] 2. What is Cloud Computing? Different perspectives, Properties and characteristics, Benefits [TB1: Preface] 3. Service and deployment models of Cloud computing, Service models: IaaS, PaaS, SaaS[TB1:2] 4. From IaaS to PaaS, PaaS and SaaS properties, Issues, characteristics and Implementation[TB9] 5. Modern On-Demand Computing, Amazon's Elastic Cloud, Amazon EC2 Service, Characteristics, Amazon SimpleDB, Amazon Simple Queue Service (Amazon SQS), Amazon CloudFront, Amazon Elastic Block Store (EBS) [TB1: 2] 6. Virtualization, From emulation to virtualization, Goals of virtualization, Types of

Virtualization Hosted and Hypervisor, Server Virtualization, CPU Virtualization [TB1:4, 5]

7. Memory Virtualization: Background, Virtualization Techniques: Emulated TLB, Shadow Page Tables, Hardware supported Memory Virtualization, Nested Page Tables [6]
8. Virtualization Practicum. [TB 1: Appendix A]
9. Cloud Federation: Characterization and Conceptual Model, Voluntary or independent model, Horizontal, Vertical, Hybrid model, Architectural models for cloud federation: Semantics based, Market-oriented, Reservoir, Market-oriented, Reservoir, Service oriented architecture, Conceptual Model, Segments in a Federation [TB1: 5, 7]
10. Presence in the Cloud, Presence Protocols, Leveraging Presence, Presence Enabled, The Future of Presence, The Interrelation of Identity, Presence, and Location in the Cloud, Federated Identity Management, Cloud and SaaS Identity Management, Federating Identity, Identity-as-a-Service (IaaS), Compliance-as-a-Service (CaaS), The Future of Identity in the Cloud [TB1: 5]
11. Presence Protocols: XMPP, SIMPLE, SIP [8]
12. Privacy and Its Relation to Cloud-Based Information Systems, Privacy Risks and the Cloud, Cloud Security Challenges, Software-as-a-Service Security, Security Management (People), Security Governance, Risk Management, Risk Assessment, Security Portfolio Management, Security Awareness.[TB1:6]
13. End-User Access to Cloud Computing, YouTube, YouTube API Overview, Widgets, YouTube Player APIs, The YouTube Custom Player, YouTube Data API, Zimbra, Zimbra Collaboration Suite (ZCS), Facebook, Facebook Development, Zoho, Zoho CloudSQL, DimDim Collaborations[TB1:8]
14. Mobile Internet Device and the Cloud, [TB1: 9]
15. Cloud, IOT and Fog Computing [3,4]

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

Reference Materials:

1. Cloud Computing Implementation, Management, and Security by John W. Rittinghouse and James F. Ransome, Taylor and Francis Group, LLC (2010). ISBN 978-1-4398-0680-7
2. Distributed Computing: Principles and Applications Book by Mei-Ling L. Liu. ISBN-13: 978-0201796445
3. Internet of Things: Principles and Paradigms,book by rajkumar buyya and Amir vahid DastjerDi(Eds.), publisher: Morgan kaufmann, ISBN: 978-0-12-805395-9
4. https://arxiv.org/abs/1601.02752
5. *https://www.vmware.com/pdf/virtualization.pdf*
6. *https://www.vmware.com/pdf/virtualization_considerations.pdf*
7. https://www.researchgate.net/publication/270581440_Cloud_Federation_characterization_and_conceptual_model
8. https://xmpp.org/
9. Architecting the Cloud: Design Decision for Cloud Computing Service Models (SAAS, PAAS and IAAS) Publisher: Wiley India Private Limited; 2014 edition, ISBN-10: 8126550333

CSEC-310 Systems Programming			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Introduction to systems programming, system programming languages and application of those languages to systems level problems.	C	2
2. Design, write, and test moderately complicated low-level programs using a systems programming language	C	3
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

1. Introduction to the Microsoft Windows Operating System,
2. File Processing, Memory Management, Memory Mapped Files and DLLs,
3. Process management, Threads and scheduling, Thread synchronization,
4. Inter-process Communication, Input/Output, Device Drivers (USB or Parallel Port),
5. File System Drivers, Filter Drivers
6. Introduction to Assembly Language, 80x86 families; program layout. [TB 1: Ch. 1.1, 1.2; 2,3]
7. Data Definitions, Basic Instructions. [TB 1: Ch. 3, 4]
8. Unsigned Arithmetic; Logic and Bit Operations. [TB 1: Ch. 6, 7]
9. Modules; Separate Assembly; Argument Passing [TB 1: Ch. 5,8]
10. Libraries; Combining Assembly and C Code [TB 1: Ch. 13]
11. String Instructions; Arrays [TB 1: Ch. 9]
12. Macros; Structures [TB 1: Ch. 10]
13. Floating Point Instructions [TB 1: Ch. 12]
14. Bit MS-DOS. [TB 1: Ch. 14]
15. BIOS Disk Accessing
16. BIOS Keyboard/Video/Graphics
17. Interrupts; TSR Programs
18. Accessing I/O Ports; 8253 Timer

Teaching Methodology:

Lectures, Written Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam

Reference Materials:

1. Assembly Language for x86 Processors by Kip R. Irvine, Prentice Hall; latest Edition ISBN-10: 013602212X
2. Windows System Programming 3rd edition, Johnson M. Hart, Addison Wesley
3. The Windows NT Device driver book 2nd edition, Art Baker, Prentice Hall.

CSEC-311 Management Information Systems			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understand basic concepts of information technology management, its application, development themes, development methodologies, development tools and technologies of Information Systems.	C	2
2. Able to solve common business problems and produce effective solutions to business problems.	C	3
3. Able to design a database application to solve a business problem.	C	3
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

1. Introduction: Overview of Business Strategy Frameworks, Brief Overview of Organizational Strategies, Brief Overview of Information Systems Strategy [TB1: Ch. 1]
2. Understanding the IS Organization, What a Manager Can Expect from the IS Organization, What the IS Organization Does Not Do, IT Governance. [TB1: Ch. 8]
3. Evolution of Information Resources, Information Resources as Strategic Tools, How Can Information Resources Be Used Strategically? Strategic Alliances, Risks. Information Technology and Organizational Design, Information Technology and Management Control Systems, Information Technology and Culture. [TB1: Ch. 2 Ch.3]
4. Information Technology and the Design of Work. Information Technology and Changing Business Processes. Architecture and Infrastructure [TB1: Ch. 4,5,6,]
5. Information Systems Sourcing. Using Information Ethically [TB2: Ch. 7,9]
6. Techniques: Project management techniques, Organizational techniques, People techniques. IT Project Development Methodologies, Managing Business Knowledge [TB1: Ch. 11, 12]
7. Organizational Theory. Management and Control. Types of Business. Management, System Theory, Types of Business Information System, Interaction of Business Systems. System Content. [TB2: Ch.4, 5, 6]
8. Computer System Concepts, Computers in Business, System Development [TB2: 10, 11, 14]

Teaching Methodology:

Lectures, Written Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam

Reference Materials:

4. Experiencing MIS, D. M. Kroenke, A. Gemino and P. Tingling. P. 4th Edition. Toronto: Pearson.2016.
5. Business driven information systems, P. Baltzan, B. Detlor, and C. Welsh, 4th Ed., McGraw Hill Ryerson Press, 2015.
6. Fundamentals of Information Systems by Ralph Stair and George Reynolds, Course Technology; 6th Edition (January 1, 2011). ISBN-10: 0840062184
7. Information Systems Development: Methodologies, Techniques & Tools by David Avison and Guy Fitzgerald, McGraw-Hill; 4th Edition (May 1, 2006). ISBN-10: 0077114175
8. Information Systems Analysis and Design by Shouhong Wang and Hai Wang, Universal Publishers (January 1, 2012). ISBN-10: 1612330754

CSEC-401 Game Application Development			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Introduction to game development theory, framework, production and management.	C	2
2. Learn how to create a complete computer game from start to finish.	C	3
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

1. Building The Foundation, Historical Elements How Did We Get Here
2. Platform And Player Modes, What Is The Framework? [TB 1: Ch. 2]
3. Goals and Genres? What Are The Possibilities? [TB 1: Ch. 3]
4. Player Elements, Player Motivation, Geographic, Psychographics. [TB 1: Ch. 4]
5. Demographics, Gender, Generation, Rating, Applying Player Market to Platform. [TB 1: Ch. 4]
6. Story and Character Development: Classic Charters, Traditional Story Structure, Story Element. [TB 1: Ch. 5]
7. Plot, Game Story Devices, Game Characters [TB 1: Ch. 5]
8. Character Development Element, Point-of-view, Visual Character Development, Verbal Character Development, Movement, [TB 1: Ch. 5]
9. Visual Character Development, Verbal Character Development, Movements, Chracter Description, Game Storytelling and Documentation [TB 1: Ch. 5]
10. Gameplay: Rules to Play, Interactivity Modes, Game theory, Challenges, balance [TB 1: Ch. 6]
11. Levels: Level Design, Structure, Time, Space. [TB 1: Ch. 7]
12. Interface: Playe-Centerd Design, Interface & Game Feature, Interface Types, Usability. [TB 1: Ch. 8]
13. Audio: The Importance of Game Audio, Sound Effect, Voiceover, Music. [TB 1: Ch. 9]
14. Role & Responsibilities: Company Role, Team Roles, Tools, Business Side of Game Development. [TB 1: Ch. 10]
15. Production and Management, Development Phases, Game Documentation [TB 1: Ch. 11]

Teaching Methodology:

Lectures, Written Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam

Reference Materials:

1. Game Development Essentials by Jeannie Novak, Delmar Cengage Learning; 3rd Edition (August 17, 2011). ISBN-10: 1111307652
2. Game Development Essentials: An Introduction by Jeannie Novak, Delmar Cengage Learning; 3rd Edition (2011). ISBN-10: 1111307652
3. Game Development Essentials: Mobile Game Development by Kimberly Unger and

Jeannie Novak, Delmar Cengage Learning; 1st Edition (2011). ISBN-10: 1418052655
4. Game Development Essentials: Game Interface Design by Kevin Saunders and Jeannie Novak, Delmar Cengage Learning; 2nd Edition (2012). ISBN-10: 1111642885
5. Game Development Essentials: Online Game Development by Rick Hall and Jeannie Novak, Delmar Cengage Learning; 1 Edition (2008). ISBN-10: 1418052671
6. Beginning 3D Game Development with Unity: All-in-one, multi-platform game development by Sue Blackman, Apress; 1st Edition (2011). ISBN-10: 1430234229
7. Game Coding Complete by Mike McShaffry and David Graham, Course Technology PTR, 4th Edition, (2012). ISBN-10: 1133776574
8. The Essential Guide to Flash Games: Building Interactive Entertainment with Action Script by Jeff Fulton and Steve Fulton, friends of ED; 1st Edition (2010). ISBN-10: 1430226145

CSEC-403 Semantic Web Techniques			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. This course introduces techniques that are useful stand-alone and can be integrated for building a semantic web.	C	2
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

1. Introduction to the semantic web.
2. Introduction to ontologies.
3. Ontology languages for the semantic web.
4. Resource Description Framework (RDF).
5. Lightweight ontologies: RDF Schema.
6. Web Ontology Language (OWL).
7. Query language for RDF: SPARQL.
8. Ontology Engineering.
9. Semantic web and Web 2.0 and applications of Semantic Web.

Teaching Methodology:

Lectures, Written Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam

Reference Materials:

1. Introduction to the Semantic Web and Semantic Web Services, Liyang Yu, Chapman and Hall/CRC, 2007
2. Build Flexible Applications with Graph Data, Toby Segaran, Colin Evans, Jamie Taylor,302 pages O'Reilly Media, 2009
3. Foundations of Semantic Web Technologies, Pascal Hitzler, Markus Krotzsch, Sebastian Rudolph.

CSEC-404 Virtual Reality			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understand fundamental techniques, processes, technologies and equipment used in virtual reality systems.	C	2
2. Acquire the basic knowledge about the physiology of human vision, hearing, and perception.	C	2
3. Understand the human interaction with virtual reality interfaces.	C	2
4. Introduce and review recent applications of virtual reality.	C	2
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

1. Definition of VR, Modern Experiences, Historical Perspective. [TB1: Ch 1]
2. Overview of VR Systems: Hardware, Sensors, Displays, Software, Virtual World Generator, Game Engines, Human Senses, Perceptual Psychology, Psychophysics. [TB1: Ch 2]
3. Geometric Modelling, Transforming Rigid Bodies, Yaw, Pitch, Roll, Axis-angle Representation, Quaternions, 3D Rotation Inverses and Conversions, Homogeneous Transforms, Transforms to Displays, Look-at and Eye Transforms, Canonical View and Perspective Transforms, Viewport Transforms. [TB1: Ch 3]
4. Light Propagation, Lenses and Images, Diopters, Spherical Aberrations, Optical Distortion; More Lens Aberrations; Spectral Properties; The Eye as an Optical System; Cameras. [TB1: Ch 4]
5. Parts of the Human Eye, Photoreceptors and Densities, Scotopic and Photopic Vision, Display Resolution Requirements, Eye Movements, Neural Vision Structures, Sufficient Display Resolution, Other Implications of Physiology on VR. [TB1: Ch 5]
6. Depth Perception, Motion Perception, Vection, Stroboscopic Apparent Motion, Color Perception, Combining Information From Multiple Cues And Senses, Implications Of Perception On VR. [TB1: Ch 6]
7. Graphical Rendering, Ray Tracing, Shading, BRDFs, Rasterization, Barycentric Coordinates, VR Rendering Problems, Anti-Aliasing, Distortion Shading, Image Warping (Time Warp), Panoramic Rendering. [TB1: Ch 7]
8. Velocities, Acceleration, Vestibular System, Virtual World Physics, Simulation, Collision Detection, Avatar Motion, Vection. [TB1: Ch 8]
9. Tracking Systems, Estimating Rotation, IMU Integration, Drift Errors, Tilt and Yaw Correction, Estimating Position, Camera-Feature Detection Model, Perspective N-Point Problem, Sensor Fusion, Lighthouse Approach, Attached Bodies, Eye Tracking, Inverse Kinematics, Map Building, SLAM. [TB1: Ch 9]
10. Remapping, Locomotion, Manipulation, Social Interaction, Specialized Interaction Mechanisms. [TB1: Ch 10]
11. Sound Propagation, Ear Physiology, Auditory Perception, Auditory Localization, Fourier Analysis, Acoustic Modeling, Hrtfs, Rendering, Auralization. [TB1: Ch 11]
12. Perceptual Training, Recommendations for Developers, Best Practices, VR Sickness, Experimental Methods That Involve Human Subjects. [TB1: Ch 12]
13. Touch, Haptics, Taste, Smell, Robotic Interfaces, Telepresence, Brain-Machine Interfaces. [TB1: Ch 13]

Teaching Methodology:
Lectures, Written Assignments, Presentations
Course Assessment:
Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam
Reference Materials:
1. Virtual Reality by Steven M. LaValle. Cambrigde University Press (2017). 2. Fundamentals of Computer Graphics by Peter Shirley, MichaelAshikhmin, and Steve Marschner. A K Peters/CRC Press; 3rd Edition (2009). ISBN: 1568814690

CSEC-405 Mobile Computing			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Grasp the concepts and features of mobile computing technologies and applications.	C	1
2. Difficulties in Mobile App Development and standing of Mobile Application Development Today.	C	2
3. Design and implement Mobile Application	C	3
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

1. Introduction to Mobile Computing, Architecture of Mobile Software Applications, Introduction to Mobile Development Frameworks and Tools. [TB2: Ch. 1,2]
2. Creating Consumable Web Services for Mobile Devices: Intro to Web Services, Web Services Languages (Formats), Creating and Debugging Web Services [TB2: Ch. 3].
3. Memory Management: Design Patterns for Limited Memory, Strategies for Allocating Variable to Memory, Memory Management in Mobile Java, Symbian OS Memory Management. [TB1]
4. Mobile Applications: Components of Mobile Application, Workflow for Application Development, Techniques for Composing Application, Application Models in Mobile Java, Symbian OS Application Infrastructure. [TB1]
5. Mobile User-Interface Design: Effective Use of Screen, Understanding Mobile Application Users, Understanding Mobile Information Design, Understanding Mobile Platforms, Using the Tools of Mobile Interface Design. [TB 2: Ch. 4]
6. Dynamic Linking: Introduction to DLL, Implementation Techniques & Plugins, Managing Memory in DLL, Rules of Thumb for Using DLL, Mobile Java and Dynamic Linking, Symbian OS Dynamic Libraries. [TB1]
7. Concurrency: Introduction, Infrastructure for Concurrent Programming, Faking Concurrency, MIDP Java and Concurrency, Symbian OS and Concurrency. [TB1]
8. Managing Resources: Resource-Related Concerns in Mobile Devices, Common Concerns, MIDP Java, Symbian OS. [TB1]
9. Security: Secure Coding and Design, Infrastructure for Enabling Secure Execution,

Features in MIDP Java, Symbian OS Security. [TB1]
10. Introduction to Mobile Application Development with Android [TB2: Ch. 6]
11. Introduction to Mobile Application Development with IOS [TB2: Ch. 7]
12. Introduction to Mobile Application Development with Windows Phone [TB2: Ch. 8]
13. Introduction to Mobile Application Development with Blackberry [TB2: Ch. 9]

Teaching Methodology:

Lectures, Written Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam

Reference Materials:

1. Programming Mobile Devices: An Introduction for Practitioners by TommiMikkonen, Wiley; 1st Edition (March 19, 2007). ISBN-10: 0470057386.
2. Professional Mobile Application Development by Jeff McWherter& Scott Gowell, Wrox; 1st Edition (September 4, 2012). ISBN-10: 1118203909
3. Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML by Reza B'Far and Roy T. Fielding, Cambridge University Press (2004). ISBN-10: 0521817331.
4. Mobile Design and Development: Practical concepts and techniques for creating mobile sites and web apps (Animal Guide) by Brian Fling, O'Reilly Media; 1st Edition (2009). ISBN-10: 0596155441.
5. Fundamentals of Mobile and Pervasive Computing by Frank Adelstein, Sandeep KS Gupta, Golden Richard III and Loren Schwiebert, McGraw-Hill Professional; 1st Edition (2004). ISBN-10: 0071412379.
6. Mobile Design Pattern Gallery: UI Patterns for Mobile Applications by Theresa Neil, O'Reilly Media (2012). ISBN-10: 1449314325.
7. Programming Android: Java Programming for the New Generation of Mobile Devices by ZigurdMednieks, Laird Dornin, G. Blake Meike and Masumi Nakamura, O'Reilly Media; 2nd Edition (2012). ISBN-10: 1449316646.
8. Beginning Android 4 Application Development by Wei-Meng Lee, Wrox; 1st Edition (March 6, 2012). ISBN-10: 1118199545

CSEC-406 Data Warehousing			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Learn concepts and skills for designing data warehouses and creating data integration workflows.	C	2
2. Able to use tools for data warehousing: MS SQL and Teradata.	C	3

*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**

Course Content:

1. Introduction to Data Warehousing: Brief History, Characteristics, Architecture, Data Staging and ETL, Multidimentional Model, Meta-data, Accessing Data Warehouse,

ROLAP, MOLAP, and HOLAP. [TB1: Ch. 1]
2. Data Warehouse System Lifecycle: Risk Factors, Top-Down vs Bottom-Up, Data Mart Design Phases, Methodological Framework – Data-Driven, Requirement-Driven; Testing Data Marts. [TB1: Ch. 2]
3. Analysis and Reconciliation of Data Sources: Inspecting and Normalization Schemata, Integration Problems, Integration Phases, Defining Mapping. [TB 1: Ch. 3]
4. User Requirement Analysis: Interviews, Glossary-based Requirement Analysis, Additional Requirements. [TB 1: Ch. 4]
5. Conceptual Modeling: Dimensional Fact Model, Events and Aggregation, Temporal Aspects, Overlapping Fact Shcemata, Formalizing the Dimensional Fact Model. [TB 1: Ch. 6]
6. Conceptual Design: ER Schema-based Design, Relational Schema-based Design, XML Schema-based Design, Mixed-approach Design. Requirement-driven Approach Design. [TB 1: Ch. 6]
7. Workload and Data Volume [TB1: Ch. 7]
8. Logical Modeling: MOLAP and HOLAP Systems, ROLAP Systems, Views, Temporal Scenarios. [TB1: Ch. 8]
9. Logical Design: From Fact Schemata to Start Schemata, View Materialization, View Fragmentation. [TB1: Ch. 9]
10. Data-staging Design: Population Reconciled Databases, Cleansing Data, Populating Dimensional Tables, Populating Fact Tables, Populating Materialized View
11. Indexes for the Data Warehouse: B*-Tree Indexes, Bitmap Indexes, Projection Indexes, Join & Star Indexes, Spatial Indexes, Join-Algorithm. [TB1: Ch. 11]
12. Physical Design: Optimizers, Index Selection, Splitting a Database into Tablespaces, Allocating Data Files, Disk Block Size. [TB1: Ch. 12]
13. Data Warehouse Project Documentation: Data Warehouse Levels, Data Mart Level, Fact Level
14. Case Studies, Tools for Data Warehousing: MS SQL and Teradata

Teaching Methodology:

Lectures, Written Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam

Reference Materials:

1. Data Warehouse Design: Modern Principles and Methodologies by MatteoGolfarelli and Stefano Rizzi, McGraw-Hill Osborne Media; 1st Edition (May 26, 2009). ISBN-10: 0071610391
2. Building the Data Warehouse by William H. Inmon, Wiley; 4th Edition (2005). ISBN-10: 0764599445
3. The Data Warehouse Lifecycle Toolkit : Expert Methods for Designing, Developing, and Deploying Data Warehouses by Ralph Kimball, Laura Reeves, Margy Ross and Warren Thornthwaite, Wiley (August 13, 1998). ISBN-10: 0471255475
4. Data Warehousing Fundamentals for IT Professionals by PaulrajPonniah, Wiley; 2ndEdition (2010). ISBN-10: 0470462078
5. Data Mining and Data Warehousing: Practical Machine Learning Tools Techniques by Ram Kumar Singh and AmitAsthana, LAP LAMBERT Academic Publishing (2012). ISBN-10: 3659118419

CSEC-408 Business Intelligence and Analytics			
Credit Hours:	3+0	**Prerequisites:**	None

Course Content:

1. Business Intelligence - An Introduction, Value Drivers, Performance Metrics and Key Performance Indicators, Use Cases for BI. [TB 1: Ch. 1, 2]
2. BI Success Factors. Strategic Versus Tactical Planning, BI Strategy and Plan. [TB 1: Ch. 3,4]
3. BI Environment, BI and Analytics Platform and Strategy, Organizational BI Framework, Services & Systems Evaluation. [TB 1: Ch. 5]
4. Business Process and Information Flow: Information Need & Flow, Information Processing & Information Flow, Information Flow Model, Modeling Frameworks. [TB 1: Ch. 6]
5. Data Requirements Analysis: Business Uses of Information, Metrics: Facts, Qualifiers, and Models, Defining Business Rules, Data Requirement Analysis, Assessing Suitability. [TB 1: Ch. 7]
6. Data Warehouses and the Technical BI Architecture: Data Modeling and Analytics, Analytical Platforms, Operational Data Stores. Business Metadata: What is Metadata? Types of Metadata, Semantics Metadata Processes for Business Analytics. [TB 1: Ch. 8, 9]
7. Data Profiling: Data Sources, Data Profiling Activities, Data Model Inference, Attribute Analysis, Relationship Analysis, Management Issues. [TB 1: Ch. 10]
8. Business Rules: The Value of Proposition of Business Rules, The Business Rules Approach, Defining Business Rules, Business Rule Systems, Sources of Business Rules, Management Issues. [TB 1: Ch. 11]
9. Data Quality: Virtuous Cycle of Data Quality, Types of Data Flow, Business Impacts of Data Flow, Dimensions of Data Quality, Data Quality Assessment, Data Quality Rules, Data Quality Monitoring and Improvement, Data Quality for Business Analytics, Data Cleansing. [TB 1: Ch. 13]
10. Data Integration: Improving Data Accessibility, Extracting/ Transformation/Loading, Data Latency and Data Synchrony, Data Replication and Change Data Capture, Data Integration and Cloud Computing, Information protection, Merge/Purge and Record Consolidation. [TB 1: Ch. 13]
11. Deriving Insight from Data: Customer Profiles, Behavior, and Lifetime Value; Demographics, Psychographics, Geographic; Geographic Data, Behavior Analysis. [TB 1: Ch. 15, 16]
12. Knowledge Discovery & Delivery: Business Drivers, KD Virtuous Cycle, Direct Versus Unidirectional Knowledge Discovery, Data Mining Activities, Data Mining Techniques. [TB 1: Ch. 17]
13. BI User Types, Standards Reports, Interactive Analysis and Ad Hoc Querying, Parameterized Reports and Self-Service Reporting, Dimensional Analysis, Alerts/ Notifications, Visualizations, Scorcards and Dashboards, Geographical Visualizations, Integrated Analysis. [TB 1: Ch. 18]
14. Installations, Configuring and Maintaining the BI Server, Creating Repositories from Relational Sources, Creating Repositories from OLAP Data Sources, Creating Reports Using Answers and Dashboards.

Teaching Methodology:

Lectures, Written Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam
Reference Materials:
1. Business Intelligence by David Loshi, Morgan Kaufmann; 2nd Edition (October 31, 2012). ISBN-10: 0123858895 2. Oracle Business Intelligence 11g Developers Guide by Mark Rittman, McGraw-Hill Osborne Media; 1st Edition (September 18, 2012). ISBN-10: 0071798749 3. Delivering Business Intelligence with Microsoft SQL Server 2012 3/E by Brian Larson, McGraw-Hill Osborne Media; 3rd Edition (March 16, 2012). ISBN-10: 0071759387 4. Business Intelligence by Elizabeth Vitt, Michael Luckevich, and StaciaMisner, Microsoft Press (December 22, 2008). ISBN-10: 073562660X 5. The Data Warehouse Mentor: Practical Data Warehouse and Business Intelligence Insights, by Robert Laberge, 1st Edition, McGraw-Hill Companies, (2012). ASIN: B008UYJJ8C 6. Business Intelligence: A Managerial Approach by Turban, Sharda, Delen, King, 2nd Edition, Prentice Hall (2011). ISBN: 13-978-0-136-10066-9 7. Business Intelligence in Plain Language: A practical guide to Data Mining and Business Analytics by Jeremy Kolb, Applied Data Labs Inc. (2012). ASIN: B009K7INOY

CSEC-409 Database Administration & Management			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Fully understand the concepts and technical issues of database administration.	C	2
2. Develop understanding of internal functionality of DBMS.	C	3
3. Able to perform database administration tasks like backup and recovery and performance tuning of databases.	C	3
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

1. Installation; SQL* Plus; Oracle Enterprise Manager; DBA Tools. Oracle Architectural Components: Oracle Server; Oracle Instance.
2. Physical Structure; SGA; Shared Pool; Library Cache; Data Dictionary Cache; Large Pool; User Process; Server Process; Background Processes.
3. Managing an Oracle Instance: Parameter File; Creating SPFILE; Oracle Managed Files; Startup and Shutdown Database; Alert Log File; Background Trace File; User Trace File.
4. Creating Database and Data dictionary.
5. Managing Control Files and Redo Log Files.
6. Managing Tablespaces, Operations with Tablespaces.
7. Data File Management, Segments, Block.
8. Managing Undo Data, Undo Data Statistics: Managing Tables and Users:
9. Indexes Management, Maintaining Data Integrity, Constraints. Managing Privileges.

10. Basic Oracle Net Architecture: Types of Networks, Oracle Net Services, Oracle Shared Server, Connection Manager, Oracle Net Connections.
11. Server Side Configuration: The Listener Process; Configuring Listener, Sessions, Creating and Managing Listener.
12. Client Side Configuration: Host Naming Method, Local Naming Method, Net Assistant, Configurations. Usage and Configuration of Oracle Shared Server.
13. Backup and Recovery, Instance and Media Recovery, Configuration of Archive log mode, User Managed Complete Recovery, Loading Data into Database, Tuning Tools, Sizing Shared Pool, Sizing Buffer Cache, I/O Issues.
14. Tuning Rollback Segments, Latches, Rollback Segment Tuning Shared Servers, Types of Locks, Block Efficiency, Storage hierarchy, Avoiding Dynamic allocation, Statistics, PCTFREE and PCTUSED, Monitoring Index Usage.

Teaching Methodology:

Lectures, Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Final Exam

Reference Materials:

1. Oracle Database 11g DBA Handbook by Bob Bryla and Kevin Loney, McGraw-Hill Osborne Media; 1st Edition (December 6, 2007). ISBN-10: 0071496637
2. Database Administration: The Complete Guide to DBA Practices and Procedures by Craig S. Mullins, Addison-Wesley Professional; 2nd Edition (October 21, 2012). ISBN-10: 0321822943
3. Database Systems: A Practical Approach to Design, Implementation and Management by Thomas M. Connolly and Carolyn E. Begg, Addison-Wesley; 5th Edition (2009). ISBN-10: 0321523067
4. Oracle Database 11g The Complete Reference by Kevin Loney, McGraw-Hill Osborne Media; 1st Edition (2008). ISBN-10: 0071598758
5. Oracle Database 11g Release 2 Performance Tuning Tips & Techniques (Oracle Press) by Rich Niemiec, McGraw-Hill Osborne Media; 1st Edition (2012). ISBN-10: 0071780262
6. Online Material URL http://otn.oracle.com

CSEC-411 Business Process Management			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Understand the key Terms and concepts in Business Process Management.	C	2
2. Learn about the major methodologies and techniques for implementing BPM.	C	2
3. Learn what a BPM management and process-centric organization is and how it works.	C	2
4. Understand the metrics and measurements critical to managing processes	C	3
5. Learn how to identify critical processes.	C	3

*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**

Course Content:

1. Introduction: Motivation and Definitions, Business Process Lifecycle, Classification of Business Processes, Goals, Structure, and Organization. [TB 1: Ch. 1]
2. Evolution of Enterprise Systems Architectures: Traditional Application Development, Enterprise Applications and their Integration, Enterprise Modeling and Process Orientation, Workflow Management, Enterprise Services Computing. [TB 1: Ch. 2]
3. Business Process Modeling: Foundation, Conceptual Model and Terminology, Abstraction Concepts, From Business Functions to Business Processes, Activity Models and Activity Instances, Process Models and Process Instances, Process Interactions, Modeling Process Data, Modeling Organization, Modeling Operation, Business Process Flexibility, Architecture of Process Execution Environments. [TB 1: Ch. 3]
4. Process Orchestrations: Control Flow Patterns, Petri Nets, Event-driven Process Chains, Workflow Nets, Graph-Based Workflow Language, Business Process Model and Notation. [TB 1: Ch. 4]
5. Process Choreographies: Motivation and Terminology, Development Phases, Process Choreography Design, Process Choreography Implementation, Service Interaction Patterns, Choreography Modeling in BPMN. [TB 1: Ch. 5]
6. Properties of Business Processes: Data Dependencies, Object Lifecycle Conformance, Structural Soundness, Soundness, Relaxed Soundness, Weak Soundness, Lazy Soundness, Soundness Criteria Overview. [TB 1: Ch. 6]
7. Business Process Management Architectures: Workflow Management Architectures, Flexible Workflow Management, Web Services and their Composition, Advanced Service Composition, Data-Driven Processes: Case Handling. [TB 1: Ch. 7]
8. Business Process Management Methodology: Dependencies between Processes, Methodology Overview, Phases in Detail. [TB 1: Ch. 7]

Teaching Methodology:

Lectures, Written Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam

Reference Materials:

1. Business Process Management: Concepts, Languages, Architectures by Mathias Weske, Springer; 2nd Edition (May 3, 2012). ISBN-10: 3642286151.
2. Business Process Management Common Body Of Knowledge by Yvonne LedererAntonucci, et. al., CreateSpace Independent Publishing Platform (March 8, 2009). ISBN-10: 1442105666
3. Process Management: A Guide for the Design of Business Processes by Jörg Becker, Martin Kugeler and Michael Rosemann, Springer; 2nd Edition (January 21, 2011). ISBN-10: 3642151892
4. Business Process Management, Second Edition: Practical Guidelines to Successful Implementations by John Jeston and Johan Nelis, Butterworth-Heinemann; 2nd Edition (March 24, 2008). ISBN-10: 0750686561
5. Process Management: Practical Guidelines to Successful Implementation by T.S. Malik, Global India Publications Pvt Ltd; 1st Edition (December 31, 2009). ISBN-10: 9380228368
6. Business Process Management: Practical Guidelines to Successful Implementations by John Jeston& Johan Nelis, Butterworth-Heinemann; 2nd Edition (March 24, 2008). ISBN-10: 0750686561

7. BPMN Method and Style with BPMN Implementer's Guide: A structured approach for business process modeling and implementation using BPMN 2.0 by Bruce Silver, Cody-Cassidy Press (October 17, 2011). ISBN-10: 0982368119
8. Workflow Modeling: Tools for Process Improvement and Application Development by Alec Sharp and Patrick McDermott, Artech House; 2nd Edition (October 31, 2008). ISBN-10: 1596931922
9. Process Analysis and Improvement: Tools and Techniques by Seppanen, Marvic S., Kumar, Sameer & Chandra, Charu (2005). McGraw-Hill
10. Business Process Change: A Guide for Business Managers and BPM and Six Sigma Professionals (The MK/OMG Press) by Paul Harmon and Business Process Trends, Morgan Kaufmann; 2nd Edition (July 27, 2007). ISBN-10: 0123741521

CSEC-412 Knowledge Management			
Credit Hours:	3+0	**Prerequisites:**	None

Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Appraise current thought on knowledge management in the light of contemporary debates on knowledge productivity, strategic capability and organizational learning.	C	2
2. Apply theories of knowledge management relevant to current workplace practice.	C	3
3. Apply the tools and techniques of knowledge management.	C	3
*** BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain**		

Course Content:

1. History and paradigms of knowledge management; Types of knowledge: Explicit Knowledge, Tacit Knowledge, Embedded Knowledge, Embrained knowledge, Embodied knowledge, Encoded knowledge, Encultured knowledge; Organizational Internal & External Knowledge; Managers' Knowledge; Personal knowledge. Knowledge Economy: Knowledge Revolution, Globalization, Knowledge Economy, Knowledge Workers, Knowledge Artifacts, Knowledge Agents; Knowledge Management: Definitions, Knowledge management Cycles, Benefits of KM, Implications for KM, KM Core Competencies. [TB1: Ch. 1, 2, 4]
2. KM Processes: Knowledge Discovery/ Detection, Knowledge Capture and Codification, Knowledge Organization, Knowledge Sharing, Explicit Knowledge Sharing, Knowledge transfer, Knowledge Acquisition, Knowledge Verification, Knowledge Utilization, Knowledge Creation, Knowledge Reuse; [TB1: Ch. 3]
3. KM Frameworks and Models: The SECI Model, Alen Frost's Model, Boisot's KM Model, Hedlund's KM Model, Earl's KM Model, Carayannis's KM Model, Wiig's KM Model, Edvinsson's Model of Intellectual Capital, Snowden's KM Model, Inkpen&Dinur's KM Model. [TB1: Ch. 4]
4. KM Frameworks and Models: Van Buren's Model of IC Management, Bukowitz& Williams's KM Model, Gamble & Blackwell's KM Model, Demerest's KM Model, Frid's KM Model, Stankosky&Baldanza's KM Framework, Kogut& Zander's KM Model, Botha et. al. KM Model, Integrated Knowledge Management Model. [TB1: Ch.

4]

5. 4 Knowledge Capture and Codification: Tacit Knowledge Capture at the Individual, Group, and Organizational Levels, xplicit Knowledge Codification, Cognitive Maps, Decision Trees, Knowledge Taxonomies, The Relationships among Knowledge Management, Competitive Intelligence, Business Intelligence, and Strategic Intelligence; Strategic and Practical Implications of Knowledge Capture and Codification [TB2: Ch. 4]
6. Knowledge Sharing and Communities of Practice: Sociograms and Social Network Analysis, Knowledge-Sharing Communities, Types of Communities, Roles and Responsibilities in CoPs, Knowledge Sharing in Virtual CoPs, Obstacles to Knowledge Sharing, Strategic and Practical Implications of Knowledge Sharing. [TB2: Ch. 5]
7. Knowledge Application: Knowledge Application at the Individual Level, Characteristics of Individual Knowledge Workers, Bloom ' s Taxonomy of Learning Objectives, Task Analysis and Modeling, Knowledge Application at the Group and Organizational Levels, Knowledge Reuse, Knowledge Repositories, E-Learning and Knowledge Management Application, Strategic & Practical Implications of Knowledge Application. [TB3: Ch.6]
8. The Role of Organizational Culture: Different Types of Cultures, Organizational Culture Analysis, The Effects of Culture on Individuals, Organizational Maturity Models, KM Maturity Models, CoP Maturity Models, Transformation to a Knowledge-Sharing Culture, Impact of a Merger on Culture, Impact of Virtualization on Culture, Strategic and Practical Implications of Organizational Culture. [TB2: Ch.7]
9. Knowledge Management Tools: Knowledge Capture and Creation Tools, Content Creation Tools, Data Mining and Knowledge Discovery, Blogs, Mashups, Content Management Tools, Folksonomies and Social Tagging/Bookmarking, Personal Knowledge Management (PKM), Knowledge Sharing and Dissemination Tools, Groupware and Collaboration Tools, Wikis, Social Networking, Web 2.0, and KM 2.0, Knowledge Acquisition and Application Tools, Intelligent Filtering Tools, Adaptive Technologies, Strategic and Practical Implications of KM Tools and Techniques. [TB2: Ch. 8]
10. Knowledge Management Strategy: Developing a Knowledge Management Strategy, Knowledge Audit, Gap Analysis, The KM Strategy Road Map, Balancing Innovation and Organizational Structure, Types of Knowledge Assets Produced. [TB2: Ch. 9]
11. The Value of Knowledge Management: KM Return on Investment (ROI) and Metrics, The Benchmarking Method, The Balanced Scorecard Method, The House of Quality Method, The Results-Based Assessment Framework, Measuring the Success of Communities of Practice. [TB2: Ch. 10]
12. Organizational Learning and Organizational Memory: How Do Organizations Learn and Remember? Frameworks to Assess Organizational Learning and Organizational Memory, The Management of Organizational Memory, Organizational Learning, The Lessons Learned Process, Organizational Learning and Organizational Memory Models, A Three-Tiered Approach to Knowledge Continuity. [TB2: Ch. 11]
13. The KM Team: Major Categories of KM Roles, Senior Management Roles, KM Roles and Responsibilities within Organizations, The KM Profession, The Ethics of KM. [TB2: Ch. 12]

Teaching Methodology:

Lectures, Written Assignments, Presentations

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam

Reference Materials:

1. Essentials of Knowledge Management: Concepts, Theories and Practices by M. A. Pasha

& S. Pasha, Innovators Knowledge Services (2012). ISBN:978-969-9791-04-8
2. Knowledge Management in Theory and Practice by KimizDalkir, The MIT Press; 3nd Edition (March 4, 2011). ISBN-10: 0262015080
3. The Knowledge Management Toolkit: Orchestrating IT, Strategy, and Knowledge Platforms by AmritTiwana, Prentice Hall; 2nd Edition (August 29, 2002). ISBN-10: 013009224X
4. Principles of Knowledge Management: Theory, Practice and Cases by ElieGeisler and NilminiWickramasinghe, M.E.Sharpe (January 15, 2009). ISBN-10: 0765613220
5. Knowledge Management: Concepts, Methodologies, Tools and Applications (6-volume set) by Murray E. Jennex, IGI Global; Reprint Edition (August 10, 2007). ISBN-10: 1599049333