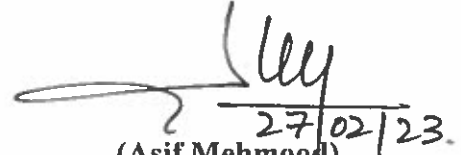




**NOTIFICATION**

On the recommendations of Academic Council made in its 16<sup>th</sup> (1/2023) meeting held on 02.01.2023, the Syndicate in its 61<sup>st</sup> (1/2023) meeting held on 27.01.2023 has approved the scheme of studies / curriculum of BS Information Technology (5<sup>th</sup> Semester Intake) for implementation w.e.f. Spring 2023 (Annex-'A').

  
27/02/23  
(Asif Mehmood)  
Deputy Registrar (Acad)

No. SU/Acad/157

Dated: 27.02.2023

**Distribution:**

- Incharge, Department of Computer Science & Information Technology
- Controller of Examinations

**C.C:**

- Director Academics
- Director, QEC
- Deputy Registrar (Affiliation)
- Deputy Registrar (Registration)
- Secretary to the Vice-Chancellor
- PA to Registrar
- Notification File

Curriculum  
of  
BS Information Technology



Department of Computer Science & Information Technology

University of Sargodha

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## Guidelines for Affiliated Colleges

- BSIT 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 domain elective courses, the affiliated institution(s)/college(s) shall follow -Regular Track I. However, the administration of any affiliated institution must get prior permission from the competent authority to offer any specialization tracks/courses approved by the BOS. 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/course shall be offered. The recommendations of the Convener BOS shall be solicited to allow the Institution to offer the requested specialization track/course already approved by the BOS.

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## The Discipline of Information Technology

In early days, 'Computer Science' was used as a common term for computing. With the passage of time, the nature of basic principles, methods, techniques and concepts evolved. Even some new concepts refuted the old ones. Before 1990s, computing was limited to three disciplines – Computer Science (CS), Computer Engineering (CE), and Information Systems (ISs). By 1990s, the global community realized that the field of computing had grown in many dimensions. Different academic institutions started offering different degree programs in Software Engineering (SE).

The inventions of personal computers revolutionized the conventional concepts of calculation and changed the way data was stored, retrieved and controlled. Computers became essential tools at every level and networked computer systems became the information backbone of organizations (Kotkin, 2000). It also expedited the pace of inventions (Thomson, 2007) resulting many innovations in communication and computation technologies which brought a paradigm shift in the business world - from data processing to information processing; converting industrial society into an information society (Cohen, 2009). While this paradigm shift improved productivity, it also brought new challenges regarding the development, operation, maintenance, and up-gradation of organizational information management infrastructure (Samuelson, 1995).

By the end of 1990s, the academia realized that the existing computing degree programs were not producing graduates who had the right mix of knowledge and skills to meet organizational challenges (Lunt, et. al., 2005). Consequently, universities developed new degree programs in Information Technology (IT) to fill this crucial void (Denning, 2001); Hence IT was introduced as a new family member of computing disciplines (Lunt, et. al., 2005).

According to Curricula 2005: The Overview Report: -Information technology is a label that has two meanings. In the broadest sense, the term information technology is often used to

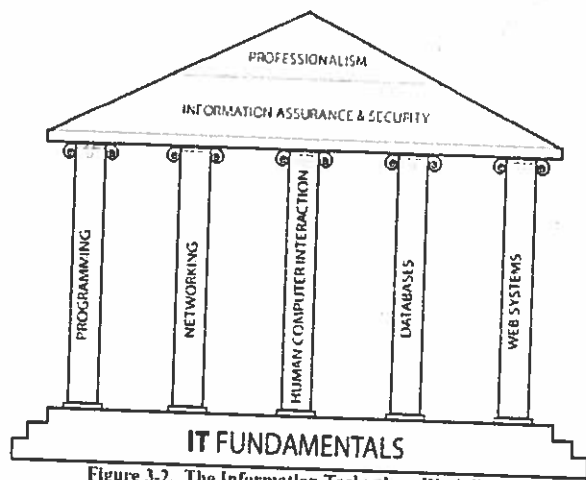


Figure 3-2. The Information Technology Discipline

refer to all of computing. In academia, it refers to undergraduate degree programs that prepare students to meet the computer technology needs of business, government, healthcare, schools, and other kinds of organizations. Curriculum Guidelines for Undergraduate Degree Programs in Information Technology (2008) explains that -Information Technology (IT) in its broadest sense encompasses all aspects of computing technology. IT, as an academic discipline, is concerned with issues related to advocating for users and meeting their needs within an organizational and societal context through the selection, creation, application, integration and administration of computing technologies. Figure 1<sup>1</sup> depicts the key pillars of academic discipline of Information Technology

<sup>1</sup>Curriculum Guidelines for Undergraduate Degree Programs in Information Technology (2008)

Information Technology as an academic discipline, as defined by The Information Technology Association of America (ITAA), is -the study, design, development, application, implementation, support or management of computer-based information systems, particularly software applications and computer hardware. It deals with the use of electronic computers and computer software to securely convert, store, protect, process, transmit, input, output, and retrieve information. [Wikipedia]

## Vision of Information Technology Education

As defined in cc2008 -Information Technology is very much an integrative discipline; it pulls together the IT pillars of databases, human-computer interaction, networking, programming, and web systems and uses a solid background in each of them to enable graduates to solve all types of computing and informational problems, regardless of their origin. As a discipline, IT emphasizes the pervasive themes of user centeredness and advocacy, information assurance and security, and the management of complexity through abstraction and modeling, best practices, patterns, standards, and the use of appropriate tools. In the light of this explanation, the curriculum committee formalized the Vision Statement for IT education in Pakistan as follows:

The IT education in Pakistan will focus on imparting the knowledge and training which enable students

- to understand and contribute to the scientific, mathematical and theoretical foundations on which information technologies are built;
- to use and apply current technical concepts, techniques, skills, tools and practices to analyze the local and global impact of IT on individuals, organizations, and society and to identify their computing needs, and select, design, create, implement, administer and evaluate a computer-based system, process, component, or program to meet the desired needs and integrate them into the user environment;
- to develop students' interpersonal and organizational skills to communicate effectively with a range of audience, create operative project plans and work in a collaborative environment;
- to strengthen students' understanding of professional, ethical, legal and social issues and responsibilities;
- to develop students' capacity for innovation and passion for lifelong learning.

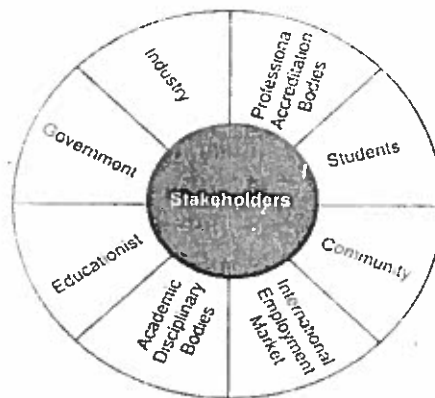
IT curriculum thus aims to achieve the targets set in the vision statement. It should strive to meet the professional demands of the industry and academia both in terms of immediate needs and the capacity for longer term development to avail the opportunities and face the challenges of the modern world. The committee is of the view that the curriculum must focus on building a solid foundation in the early stages of learning. Thus, Information Technology concepts should be taken up as early as the start of 1<sup>st</sup> year. These should gradually be strengthened through developing the core competencies and desired skill-sets during the second, third and fourth years. The students must also be provided opportunities to bring together the knowledge gained in a wide variety of courses to solve realistic problems in a team-based environment through lab sessions, practical assignments, course projects and a capstone design project.

## Information Technology Programs' Rational

The digital revolution not only reshaped the way scientists conduct their research but also expedite the pace of inventions. Consequently, the latest advancements in technologies for communication, computation, and delivery of information brought a paradigm shift in the business world - from data processing to information processing - converting computer technology into information technology (IT) and industrial society into an information society. While this paradigm shift improves productivity, it also created new work place challenges regarding the development, operation, maintenance, and up-gradation of organizational IT infrastructure. Inventions like the Internet, the World Wide Web, email, bulletin board systems, virtual communities, E-business and other online technologies forced organizations to find IT based solutions to all kinds of business challenges. For this, organizations need appropriate systems that work properly and professionals who make these systems secured, upgraded, and maintained. In parallel, employees require support from these professionals to make technology effective for enhancing organizational productivity. This has created a huge demand of IT professionals both locally and globally. Meeting this demand is the key rationale behind the IT programs. In this regard, the IT programs offer a curriculum structure that can produce graduates who can meet above discussed challenges of the 21st century's knowledge driven complex work places. The curriculum structure will create, expand, disseminate and teach the information technology body of knowledge through academics, applications and research which positively impact society (locally, nationally, and internationally). It will also provide an integration of all components that allow accessing all of the new knowledge and technologies for meeting the above discussed challenges.

## Underlying Principles of Information Technology 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. Therevised 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.

In the light of these principles, the curriculum of the program 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 the 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. To achieve the curricula have focused 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 than just having programming skills.
- vi. Values: Moral, ethical and professional practices.

To strengthen the curriculum further, specialization tracks/courses have also been integrated within the curriculum. These specialization tracks/courses 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.

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## Curriculum for BS Information Technology Program

### Details of BS Information Technology

#### Program's Aims & Objectives

The aim of the BS (IT) program is to produce entrepreneurs of great character, competence, vision and drive equip 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 information technology domain or proceed to further or higher education or training. One of the key objectives of the program is to equip students with skills and knowledge that enable them to take on appropriate professional positions in IT and grow into leading roles. The goals of the program are to produce, in coordination with organizational management, IT graduates who have ability to:

- Apply knowledge of computing and mathematics appropriate to the discipline.
- Analyze a problem, and identify and define the computing requirements appropriate to its solution.
- Design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
- Function effectively on teams to accomplish a common goal.
- Understand the professional, ethical, legal, security and social issues and responsibilities.
- Communicate effectively with a range of audiences.
- Analyze the local and global impact of computing on individuals, organizations, and society.
- Recognize the need for and an ability to engage in continuing professional development.
- Use the current techniques, skills, and tools necessary for computing practice.
- Use and apply the latest technical concepts and practices in the core information technologies.
- Identify and analyze user needs and take them into account in the selection, creation, evaluation and administration of computer-based systems.
- Integrate IT-based solutions into the user environment.
- Understand the best practices and standards and their application.
- Assist in the creation of an effective project plan.

#### Program's Outcome

BSIT program will produce entrepreneurs of great character, competence, vision and drive equip 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 information technology domain or proceed to further or higher education or training.

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University of

### Program's Structure

The structure of BSIT bridge program is very 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:

#### Degree Requirement

To become eligible for award of BSIT bridge degree program, a student must satisfy the following requirements:

- a) Must have studied and passed the prescribed courses, totaling at least 69 credit hours.
- b) Must have earned CGPA (Cumulative Grade Point Average) of at least 2.0 on a scale of 4.0.

#### Duration

The minimum duration for completion of BSIT bridge degree is two years. According to HEC maximum period of four years is to complete BSIT bridge degree requirements.

#### Eligibility Criteria

1. Maximum age limit 26 years at the time of admission.
2. ADP/ ADS Specialization in (Computer Science or Computing relevant) of two years (Semester system) with minimum CGPA of 2.5. Minimum credit hours should not be less than 61. (5 R)
3. ADP/B.Sc of two years (Annual System) minimum marks obtained should not be less than 45 percent. ADP/B.Sc with (Computer Studies out of 200 + Mathematics out of 200) Minimum.

#### Assessment & Evaluation

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

## Course Coding Scheme

Scheme for Course Code				
Discipline Code	Course Level	Course Category	Course Type	Course Number
2-4 Letters	1 Digit	1 Digit	1 Digit	1 Digits
XX - XXXX	0-9	0-9	0-9	0-9

Course Level		
Level	Degree	Explanation
1	<b>UNDER-GRADUATE</b>	Non-Credited Courses
2		Foundation + Core Level 1 Courses
3		Core Level 2 + Specialization Level 1
4		Specialization Level 2

Course Type	
1	Theory Breadth
2	Theory + Practical (Breadth)
3	Multidisciplinary (Breadth)
4	Theory Depth
5	Theory + Practical (Depth)
6	Multidisciplinary (Depth)
7	Practical
8	Seminar
9	Research

Discipline Code	
CMPC	Computing Core
ITCC	Information Technology Core
ITSC	IT Supporting Courses
PKSS	Social Sciences Courses
BUSB	Business Courses
MATH	Mathematics Courses
ENGL	English Courses
PHYS	Science Foundation
URCC	University Elective Course
ITEC	IT Elective Courses

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Course Categories	
0	<b>Introductory &amp; General Courses</b>
1	<b>Programming Fundamentals &amp; Programming Languages , Discrete Structures, Algorithms and Complexity</b>
	Programming Languages
	Discrete Structures
	Algorithms & Complexity
2	<b>Architecture and Organization</b>
	Architecture & Organization
3	<b>Software Engineering (SE)</b>
	Software Development Fundamentals
	Software Engineering
	Systems Fundamentals
4	<b>Information Systems</b>
	Information Management
	Information Assurance and Security
5	<b>Net-Centric Computing (NC)</b>
	Networking and Communications
	Parallel & Distributed Computing
	Technology Infrastructure
	Platform-based Development
6	<b>Operating Systems (OS)</b>
	Operating Systems
7	<b>Business Management</b>
	Human Resource Management
	Business Economics
8	<b>Intelligent Systems (IS)</b>
	Intelligent Systems
9	<b>Computational Science , Capstone Project &amp; Professional Issues(CN)</b>
	Social & Professional Issues
	Computational Science

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## Scheme of Study for BS (Information Technology)

### List of Deficiency Courses

Code	Course Title	Credit Hours
ICTC-2021	Introduction to ICT	2-1
CMPC-2122	Programming Fundamentals	3-1
ENGL-2411	English Composition & Comprehension	3-0
MATH-2213	Calculus & Analytical Geometry	3-0
PHYS-2210	Applied Physics/Quantum Computing	3-0
CMPC-2123	Object Oriented Programming	3-1
ENGL-2412	Communication & Presentation Skills	3-0
ITSC-2210	Digital Logic Design	3-0
MATH-2110	Probability & Statistics	3-0
BUSB-2731	Business Economics	3-0
BUSB-2212	Principle of Management	3-0
CMPC-3122	Data Structures & Algorithms	3-1
CMPC-2111	Discrete Structures	3-0
PKSS-3910	Professional Practices	3-0
ITSC-3543	Enterprise Systems	3-0
MATH-3215	Linear Algebra	3-0
CMPC-3621	Operating Systems	3-1
CMPC-3310	Software Engineering	3-0
CMPC-2550	Computer Networks	3-1
ITCC-4349	IT Project Management	3-0
BUSB-3762	IT Entrepreneurship	3-0
PKSS-2311	Islamic Studies	2-0
PKSS-2312	Pakistan Studies	2-0

## Semester - V

Code	Course Title	Credit Hours	Pre-requisite
CMPC-3450	Database Systems	3-1	Data Structures & Algorithms
CMPC-4542	Information Security	3-0	
ITSC-3113	Design & Analysis of Algorithm	3-0	
ITCC-4511	System and Network Administration	3-1	Operating Systems
ITEC-4544	Cloud Computing	3-0	
	Total	15-2	

## Semester - VI

Code	Course Title	Credit Hours	Pre-requisite
ITCC-3548	Web Technologies	3-0	
BUSB-2732	Human Resource Management	3-0	
ITEC-3541	Network Design & Management	3-0	
ITEC-4442	Data Mining	3-0	
ENGL-2413	Technical & Business Writing	3-0	
ITCC-3540	Wireless Technologies	3-0	
	Total	15-0	

## Semester - VII

Code	Course Title	Credit Hours	Pre-requisite
ITCC-4545	Virtual Systems and Services	3-1	
CMPC-4970	Final Year Project -- I	0-3	
ITCC-4543	IT Infrastructure	3-0	
ITEC-4569	Routing & Switching	3-0	
ITSC-4340	UI/UX Web Designing	2-1	
ITEC-3810	Artificial Intelligence	3-0	
	Total	14-5	

## Semester - VIII

Code	Course Title	Credit Hours	Pre-requisite
CMPC-4971	Final Year Project - II	0-3	
ITCC-4543	Cyber Security	3-0	
ITEC-4546	Internet of Everything	3-0	
ITCC-4450	Database Administration and Management	3-1	
ITSC-4431	Technology Management	3-0	
URCC-5110	Citizenship Education and Community Engagement	0-0	
	Total	12-4	

### Computing Core Courses

Computing Core Courses – 39 Credit Hours				
#	Code	Pre-Req	Course Title	Cr. Hrs.
1	CMPC-2122	-	Programming Fundamentals	4 (3+1)
2	CMPC-2123	CMPC-2122	Object Oriented Programming	4 (3+1)
3	CMPC-2111	-	Discrete Structures	3 (3+0)
4	CMPC-3112	CMPC-2123	Data Structure and Algorithms	4 (3+1)
5	CMPC-3621	-	Operating Systems	4 (3+1)
6	CMPC-3310	-	Software Engineering	3 (3+0)
7	CMPC-2540	-	Computer Networks	4 (3+1)
8	CMPC-3450	-	Database Systems	4 (3+1)
9	CMPC-4542	-	Information Security	3 (3+0)
10	CMPC-4970	-	Final Year Project – I	3 (0+3)
11	CMPC-4971	-	Final Year Project – II	3 (0+3)

### Mathematics and Science Foundation Courses

Mathematics and Science Foundation Courses - 12 Credit Hours				
#	Code	Pre-Req	Course Title	Cr. Hrs.
12	MATH-2213	-	Calculus and Analytical Geometry	3 (3+0)
13	MATH-2110	-	Probability and Statistics	3 (3+0)
14	MATH-3215	-	Linear Algebra	3 (3+0)
15	PHYS-2210	-	Applied Physics	3 (3+0)

### General Education Courses

General Education Courses – 19 Credit Hours				
#	Code	Pre-Req	Course Title	Cr. Hrs.
16	ENGL-2411	-	English Composition & Comprehension (English-I)	3 (3+0)
17	ENGL-2412	ENGL-2411	Communication and Presentation Skills (English-II)	3 (3+0)
18	ENGL-2413	ENGL-2412	Technical and Business Writing (English-III)	3 (3+0)
19	PKSS-2311	-	Islamic Studies	2 (2+0)
20	PKSS-2312	-	Pakistan Studies	2 (2+0)
21	ICTC-2021	-	Introduction to Information & Communication Technologies	3 (2+1)
22	PKSS-3910	-	Professional Practices	3 (3+0)

### IT — Core Courses

IT — Core Courses (27 Credits Hours)				
#	Code	Pre-req	Course Name	Cr. Hrs.
23	ITCC-4543		Cyber Security	3 (3+0)
24	ITCC-4450		Database Administration & Management	4 (3+1)
25	ITCC-4349		IT Project Management	3 (3+0)
26	ITCC-4543		Information Technology Infrastructure	3(3+0)
27	ITCC-4511		Systems and Network Administration	4 (3+1)
28	ITCC-4545		Virtual Systems and Services	4 (3+1)
29	ITCC-3548		Web Systems and Technologies	3 (3+0)
30	ITCC-3540		Wireless Technologies	3 (3+0)

### IT — Supporting Courses

IT — Supporting Courses (18 Credits Hours - Any 6 Courses)				
#	Code	Pre-req	Course Name	Credit hours
31	ITSC-3543	-	Enterprise Systems	3 (3+0)
32	ITSC-3431		Technology Management	3 (3+0)
33	ITSC-3311	-	Object Oriented Analysis & Design	3 (3+0)
34	ITSC-3241	-	Optimization Techniques	3 (3+0)
35	ITSC-2210	-	Digital Logic Design	3 (3+0)
36	ITSC-3143	-	Design and Analysis of Algorithm	3 (3+0)
37	ITSC-4340		UI/ UX Web Designing	3 (2+1)

### University Electives Courses

University Electives Courses (12 Credits Hours)				
#	Code	Pre-req	Course Name	Cr. Hrs.
38	BUSB-2731	-	Business Economics	3 (3+0)
39	BUSB-2732	-	Human Resource Management	3 (3+0)
40	BUSB-3761	-	Principles of Management	3 (3+0)
41	BUSB-3762	-	IT-Entrepreneurship	3 (3+0)
42	URCC-1010	-	Citizenship	0 (0+0)

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### Information Technology Elective Courses

Regular Track IT Elective Courses (18 Credit Hours - Any 6 Courses)				
43	ITEC-4548	-	Mobile Application Development	3(3+0)
44	ITEC-4544	-	Cloud Computing	3(3+0)
45	ITEC-4441	-	Data Warehousing	3(3+0)
46	ITEC-3442	-	Knowledge Management	3(3+0)
47	ITEC-3541	-	Network Design and Management	3 (3+0)
48	ITEC-3441	-	Business Intelligence and Analytics	3(3+0)
49	ITEC-4746	-	E-Commerce Applications Develop- ment	3(3+0)
50	ITEC-4546	-	Internet of EveryThing	3(3+0)
51	ITEC-4747	-	Semantic Web	3(3+0)
52	ITEC-4442	-	Data Mining	3(3+0)
53	ITEC-4461	-	Enterprise Resource Planning	3(3+0)
54	ITEC-3542	-	Network Programming	3(3+0)
55	ITEC-4444	-	Information Systems and Audit	3(3+0)
56	ITEC-4569	-	Routing and Switching	3(3+0)
57	ITEC-4365	-	Business Process Management	3(3+0)
58	ITEC-3810	-	Artificial Intelligence	3(3+0)

## Course Contents for BS Information Technology

### Contents of Computing Core Courses

CMPC-2122 Programming Fundamentals		
<b>Credit Hours:</b>	4(3,1)	<b>Prerequisites:</b>

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

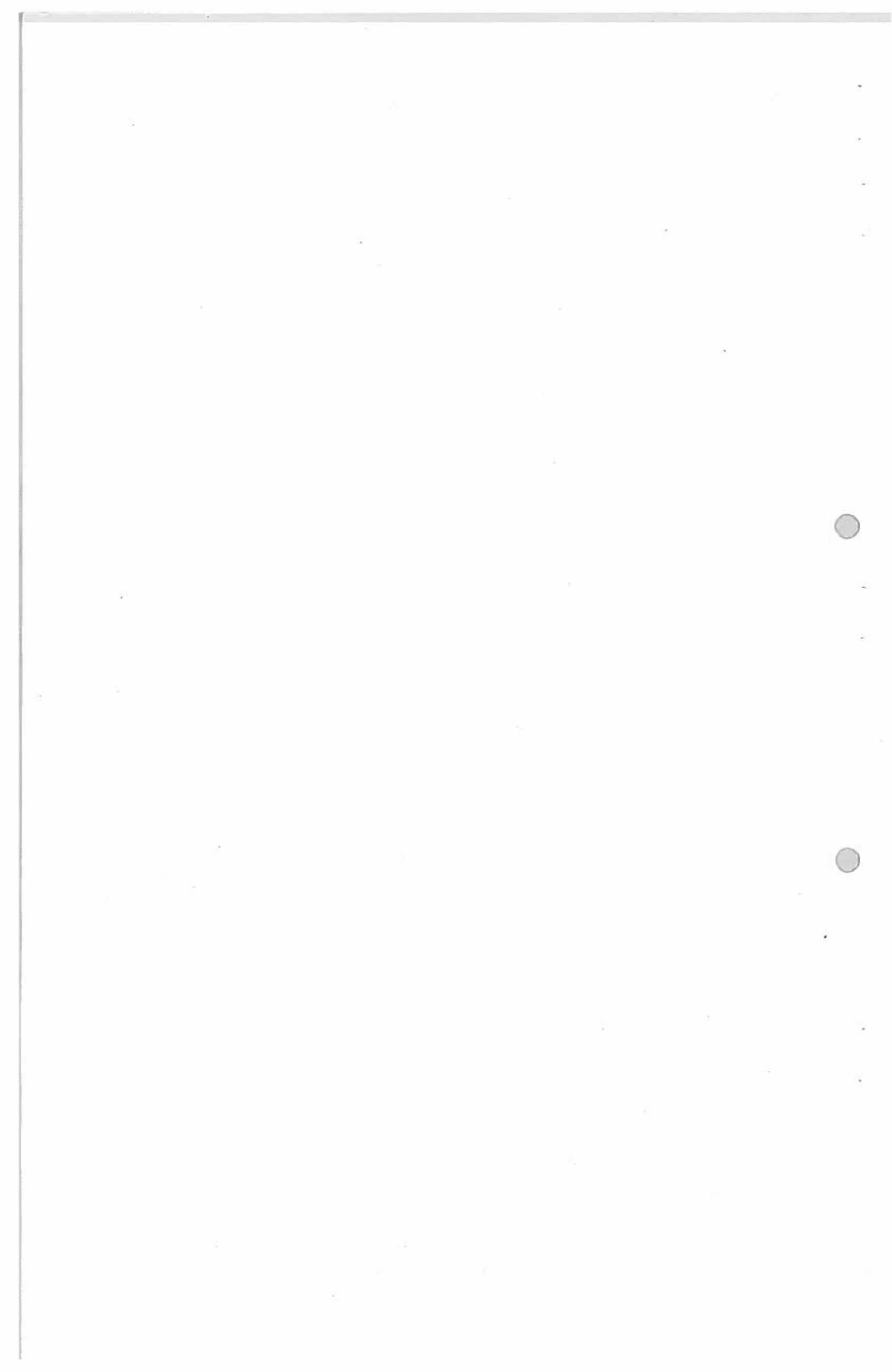
Course Content:
<ol style="list-style-type: none"> <li>1. Introduction, Introduction to Computer Programming: Machine Languages, Assembly Languages and High-Level Languages. History of C. C Standard Library. Typical C Program Development Environment, Memory Concepts, white spaces, comments. [Ch. 1]</li> <li>2. Principles of Structured and Modular Programming: Algorithms, Pseudo code, flowchart representation. Basic Data Types (variables, constants). [Ch. 2]</li> <li>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]</li> <li>4. Decision Statements: if statement, if-else statement. Multi if-else-if statement. Decision Statements: Nested if-else statements, Switch Statement. [Ch. 3]</li> <li>5. Decision Statements: Conditional operator, Logical Operators, Programming Practices, and Summary. Program Control: Repetition Essentials, Counter-Controlled Repetition. forloop. [Ch. 3]</li> <li>6. Loops: while loop, do while loop [Ch. 4]</li> <li>7. Nested loop structures. Other Control Statements, break and continue Statements, Logical Operators, Confusing Equality (==) and Assignment (=) Operators. Programming Practices, Summary. [Ch. 4]</li> <li>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]</li> <li>9. Strings: String Library Functions Characters and Strings: Fundamentals of Strings and Characters. Strings: Character-Handling Library, Programming Practices, Summary. [Ch. 8]</li> <li>10. Functions: Function declaration, definition, Passing Arguments to functions, Returning values from functions. Functions: Arguments pass by reference and pass by copy. [Ch. 8]</li> <li>11. Functions: Passing arrays and strings to functions. Functions: Inline functions, Default arguments, Local and global variables, Summary. [Ch. 8]</li> <li>12. Pointers: Pointers and their purpose. Pointer expressions. Pointers: Pointers and arrays, Pointers in functions. [Ch. 8]</li> </ol>

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. [Ch.10]
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]
<b>Teaching Methodology:</b>
Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>
1. C How to Program by Paul Deitel and Harvey Deitel, Prentice Hall; 7 <sup>th</sup> Edition (March 4, 2012)
2. Programming in C by Stephen G. Kochan, Addison-Wesley Professional; 4 edition (September 25, 2013). ISBN-10: 0321776410

CMPC-2123 Object Oriented Programming			
<b>Credit Hours:</b>	4(3,1)	<b>Prerequisites:</b>	Programming Fundamentals

Course Learning Outcomes (CLOs):			
At the end of the course the students will be able to:		<b>Domain</b>	<b>BT Level*</b>
1. Describe the key terminologies of object oriented programming		C	2
2. Explain the Classes and objects paradigm		C	3
3. Identify various programming techniques in object oriented.		C	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective Domain			

Course Content:
1- Objects and Classes, Abstraction, Encapsulation [TB1: Ch9-11]
2- Final Classes, Nested and Inner Classes. [TB2: Ch. 5]
3- Inheritance, Abstract Classes, Concrete Classes, Inheritance and Encapsulation.[TB1:Ch12]
4- The is-a Relationship, Inheritance via Abstract Classes. Extending the Hierarchy, Up casting and Down casting, Interfaces.[TB1: Ch12]
5- Composition, the has-a Relationship.[TB1: Ch12]
6- Polymorphism.[TB1:Ch 13]
7- Polymorphism, Dynamic (or Late) Binding. [TB1:Ch 13]
8- Interfaces and Polymorphism.[TB1: Ch13]
9- The Wrapper Classes, Boxing and Un-Boxing, Packages.[TB1: Ch14, Ch9.4]
10- Exceptions and Exception Handling.[TB2:Ch 7]
11- File Systems and Paths, File and Directory Handling and Manipulation, Input/output Streams, Reading Binary Data, Writing binary Data. Writing Text(Character), Reading



Text (Characters), Logging with Print Stream, Random Access Files, Object Serialization. [TB1: Ch. 15]
12- Collections, for-each Loop.[TB1: Ch16, 17]
13- GUI Concepts, Components and Containers, Abstract Windows Toolkit and Swing, Windows and Frames, Layout Managers, Panels.[TB1: Ch. 18]
14- Event-Driven Programming, The delegation Event Model.[TB1:Ch 19]
15- Event Classes, Mouse Events, Keyboard Events, Using Actions.[TB1: Ch19]
16- Component and J Component, Buttons, Labels, Text Fields, Text Areas, Dialog Boxes, Checkboxes and Radio Buttons, Menus, J-Slider, J-Tabbed Pane.[TB1: Ch. 19]
<b>Teaching Methodology:</b>
Lectures, Written Assignments, Practical labs, Semester Project, Presentations
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>
1- Java Programming: From the Ground Up by Ralph Bravaco and Shai Simonson. McGraw-Hill Higher Education New York, 2010, ISBN 978-0-07-352335-4
2- Ivor Horton's Beginning Java by Ivor Horton, John Wiley & Sons, Inc. 7th Edition. 2011, ISBN: 978-0-470-40414-0

CMPC-2111 Discrete Structures			
<b>Credit Hours:</b>	3(3.0)	<b>Prerequisites:</b>	None

Course Learning Outcome (C/Os):		
At the end of the course the students will be able to:	<b>Domain</b>	<b>BT Level*</b>
1- The course provides a solid theoretical foundation of discrete structures as they apply to computer science problems and structures.	C	2
2- The students will learn how to use mathematical notation and solve problems using mathematical tools.	C	3
* 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 Re-

lations, 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]
<b>Teaching Methodology:</b>
Lectures, Class Exercises
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Final Exam
<b>Reference Materials:</b>
1. K. H. Rosen, Discrete Mathematics and Its Applications. McGraw-Hill Science/Engineering/Math, 7 <sup>th</sup> Ed. 2011. ISBN-10: 0073383090[TB]
2. R. Johnsonbaugh, Discrete Mathematics, Pearson; 7 <sup>th</sup> Ed., 2008. ISBN-10: 0131593188
3. S. B. Maurer and A. Ralston, Discrete Algorithmic Mathematics, A K Peters/CRC Press; 3 <sup>rd</sup> Ed., 2004. ISBN-10: 1568811667
4. B. Kolman, R. Busby and S. C. Ross, Discrete Mathematical Structures, Pearson, 6 <sup>th</sup> Ed. 2008. ISBN-10: 0132297515

<b>CMPC-3122 Data Structure and Algorithms</b>			
<b>Credit Hours:</b>	4(3,1)	<b>Prerequisites:</b>	Object Oriented Programming

<b>Course Learning Outcomes (CLOs):</b>		
At the end of the course the students will be able to:	Domain	BT Level*
1. Learn the theory, practice and methods of data structures and algorithm design.	C	2
2. Learn and practice elementary data structures such as stacks, queues, linked lists, sequences, trees and graphs and the algorithms designed for manipulating these data structures.	C	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective Domain		

<b>Course Content:</b>
1. Introduction to Data Structure, primitive java, Reference Types, Algorithm Analysis.[ TB1:Ch1, 2, 5]
2. Java collections API (The Java Collections Framework). [TB1:Ch 6]
3. Recursion, Sorting Algorithms (Bubble Sort, Selection Sort, Insertion Sort, Shell Sort).[TB1: Ch 6, 7]
4. Sorting Algorithms (Merge Sort, Quick Sort, Heap Sort, Speed Limit for comparison Sorts, Radix Sort, Bucket Sort), Randomization. [TB1: Ch 7, 8]
5. Stack and Queue. [TB1:Ch 16, TB2:Ch 6, 7]
6. Linked Lists. [TB1:Ch 16]
7. Linked Lists. [TB1:Ch 16, TB2:Ch8]
8. Hash Table. [TB1: Ch 20]
9. Trees. [TB1:Ch18]
10. Binary Search Trees, Priority Queue: the Binary Heap. [TB1: Ch 19, Ch 21]

11. Splay Trees, Merging Priority Queues. [TB1:Ch22, Ch23]
12. Graphs (Simple Graphs, Graph Terminology, Paths and Cycles, Isomorphic Graphs, the Adjacency Matrix for a Graph, the Incidence Matrix for a Graph, the Adjacency List for a Graph, Digraphs). [TB1:Ch14, TB2:16]
13. Graphs(Paths in a Digraph, Weighted Digraphs and Graphs, Euler Paths and Hamiltonian Cycles, Dijkstra's Algorithm, Graph Traversal Algorithms) [TB1:Ch14, TB2:16]
14. Data Structure Applications (Balanced-Symbol Checker, A Simple Calculator, File Compression, A Cross-reference Generator, The Josephus problem, Event-Driven Simulation) [TB: Ch 11, 12, 13]

**Teaching Methodology:**

Lecturing, Written Assignments, Project, Report Writing

**Course Assessment:**

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

**Reference Materials:**

1. Data Structures & Problem Solving Using Java by Mark Allen Weiss, Addison-Wesley, 4th Edition (October 7, 2009). ISBN-10: 0321541405
2. Schaum's Outline of Data Structures with Java by John Hubbard, McGraw-Hill; 2nd Edition (May 26, 2009). ASIN: B0035X1BQ6
3. Data Structures: Abstraction and Design Using Java by Koffman and Wolfgang, Wiley; 2nd Edition (January 26, 2010). ISBN-10: 0470128704
4. Data Structures and Algorithm Analysis in Java by Mark Allen Weiss, Prentice Hall; 3rd Edition (November 28, 2011). ISBN-10: 0132576279

**CMPC-3621 Operating Systems**


<b>Credit Hours:</b>	4(3,1)	<b>Prerequisites:</b>	None
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**Course Learning Outcomes (CLOs):**

At the end of the course the students will be able to:	Domain	BT Level*
1- Describe the general understanding of the principles and concepts governing the functions of operating systems	C	3
2- Explain the layered approach that makes design, implementation and operation.	C	3
3- Identify aspect of complex operating system	C	3

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

**Course Content:**

  
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- 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]
- 5- Process Synchronization: Background, Monitors, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization. [TB: Ch. 6]
- 6- Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance. Deadlock Detection, Recovery from Deadlock. [TB: Ch. 7]
- 7- Main Memory: Swapping, Contiguous Memory Allocation, Paging, and Structure of the Page Table, Segmentation, and Example: The Intel Pentium. [TB: Ch.8]
- 8- Virtual Memory: Allocating Kernel Memory, Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing. [TB: Ch. 9]
- 9- 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]
- 10- I/O Systems: STREAMS, Hardware, Performance, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Requests to Bibliographical Notes, Hardware Operations. [TB: Ch. 13]
- 11- 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]
- 12- Case studies: Linux, Windows Operating Systems.

**Teaching Methodology:**

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

**Course Assessment:**

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

**Reference Materials:**

- 1- Operating System Concepts Essentials by Abraham Silberschatz, Peter B. Galvin and Greg Agne, Wiley; 8th Edition (July 5, 2008). ISBN-10:0470128720
- 2- Applied Operating Systems Concepts by Silberschatz A., Peterson, J.L., & Galvin P.C. Wiley; 8th Edition (2011). ISBN-10: 1118112733

CMPC-3310 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	C	3
4: Have knowledge of software configuration management.	C	3

\* 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]
4. 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]
5. Introduction to SDLC, SDLC Phases, System Planning, Preliminary Investigation, SWOT Analysis. [TB1: Ch. 2]
6. 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]
7. Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Requirements Model. [TB1: Ch. 5]
8. Requirements Modelling Strategies, Difference between Structured Analysis and Object Oriented Analysis; Difference between FDD Diagrams & UML Diagrams. [TB2:Ch. 3]
9. Data & Process Modelling, Diagrams: Data Flow, Context, Conventions, Detailed Level DFD_s Diagram 0, Levelling, Balancing, Logical Versus Physical Models. [TB2: Ch. 4]
10. Design Within the Context of Software Engineering, The Design Process, Design Concepts, Design Models: Data Design Elements. [TB1: Ch. 8]
11. Architecture Design Elements. Interface Design Elements, Component-Level Design Elements, Deployments Design Elements. [TB: Ch. 8]
12. System Architecture, Architectural Styles, User Interface Design: The Golden Rules. User Interface Analysis and Design. WebApps Interface Design. [ TB1: Ch. 9-11]
13. Software Quality Assurance: Background Issues. Elements of Software Quality Assurance, Software Testing Strategies, Strategic Issues, Test Strategies for Conventional Software. [TB1: Ch.16-17]
14. Validation Testing, System Testing, Internal and External View of Testing: White Box Testing and Black Box Testing Techniques. [TB1: Ch. 17-18]]
15. Introduction to Project Management, Project Scheduling: Gantt Chart, Risk Management: Proactive versus Reactive Risk Strategies, Software Risks, Maintenance and

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Reengineering: Software Maintenance, Software Reengineering. [TB1: Ch. 28-29]
<b>Teaching Methodology:</b>
Lecturing, Written Assignments, Report Writing
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam
<b>Reference Materials:</b>
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

CMRC-2550 Computer Networks			
<b>Credit Hours:</b>	4(3,1)	<b>Prerequisites:</b>	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. [TBI: Ch. 14]
11. IP addressing, Internet Protocol Operation, virtual private networks and IP Security and Subnetting, CIDR. [TBI: Ch. 14].
12. Transport layer protocols, ports and sockets and connection-oriented transport protocol mechanisms [TBI: Ch. 15]
13. Routing protocols OSPF ,EIGRP,RIP and routing in packet-switching networks [TBI: Ch. 19]
14. Connection establishment, flow and congestion control, effects of congestion, TCP congestion control and datagram congestion control protocol [TBI: Ch. 20]
15. Application layer protocols, electronic mail (SMTP and MIME), Web Access: HTTP and DNS [TBI: Ch. 24]
16. Latest trends in computer networks , real-time traffic and voice over IP [TBI: 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-3450 Database Systems			
<b>Credit Hours:</b>	4(3,1)	<b>Prerequisites:</b>	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

  
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**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-4542 Information Security****Credit Hours:**

3(3,0)

**Prerequisites:**

Computer Networks

**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.	A	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:Ch1]
2. Vulnerabilities and protections: Malwares [TB:Ch6]
3. Hash functions [TB:Ch2, 21]
4. Digital signatures [TB:Ch2]
5. Key management [TB:Ch2,20]
6. Authentication: Access control [TB:Ch3,4]
7. Symmetric cryptography: Symmetric Encryption Principles, Data Encryption Standard.
8. Advanced Encryption Standard, Cipher Block Modes of Operation [TB:Ch20]
9. Asymmetric cryptography: HMAC, The RSA Public-Key Encryption Algorithm, Diffie-Hellman and Other Asymmetric Algorithms [TB:Ch21]
10. Software security [TB:Ch11]
11. Database security: The Need for Database Security, Database Management Systems
1. Relational Databases, SQL Injection Attacks, Database Access Control, Inference, Database Encryption [TB:Ch5]
12. Network security: Secure E-Mail and S/MIME, DomainKeys Identified Mail, Secure Sockets Layer (SSL) and Transport Layer Security (TLS), HTTPS, IPv4 and IPv6 Security, Wireless Security, Mobile Device Security [TB:Ch22, 24]
13. Firewalls: The Need for Firewalls, Firewall Characteristics and Access Policy, Types of Firewalls, Firewall Basing [TB:Ch9]
14. Intrusion detection: Intruders, Intrusion Detection, Analysis Approaches, Types of IDS [TB:Ch8]
15. Security policies, policy formation and enforcement, risk assessment [TB:Ch14,15]
16. Cybercrime, law and ethics in information security, privacy and anonymity of data [TB:Ch19]

### 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

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4. Computer Security Fundamentals, 3rd edition by William Easttom  
Official (ISC)2 Guide to the CISSP CBK, 3rd edition

### CMPC-4970 Final Year Project I

**Credit Hours:** 3(0,3)      **Prerequisites:** None

#### Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:

- |   | Domain | BT Level* |
|---|--------|-----------|
| 1. Gives an opportunity for participants to put their leadership competencies into practice.  | C      | 2         |
| 2. Allows the student to identify and develop a project that puts into practice the leadership skills and competencies learned during the courses of study. | A      | 3         |

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

#### Course Content:

1. Project Proposal
2. Introduction
3. Software Requirements Specification
4. Software Function Specification

Detailed guideline and documentation templates are available with the Department.

#### Teaching Methodology:

Lecturing, Written Assignments, Report Writing

#### Course Assessment:

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

#### Reference Materials:

### CMPC-4971 Final Year Project II

**Credit Hours:** 3(0,3)      **Prerequisites:** None

#### Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:

- |   | Domain | BT Level* |
|---|--------|-----------|
| 3. Gives an opportunity for participants to put their leadership competencies into practice.  | C      | 2         |
| 4. Allows the student to identify and develop a project that puts into practice the leadership skills and competencies learned during the courses of study. | A      | 3         |

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

#### Course Content:

1. Project Proposal
2. Introduction
3. Software Requirements Specification
4. Software Function Specification

Detailed guideline and documentation templates are available with the Department.

**Teaching Methodology:**

Lecturing, Written Assignments, Report Writing

**Course Assessment:**


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

**Reference Materials:**

## Contents of Mathematics and Science Foundation Courses

MATH-2213 Calculus and Analytical Geometry			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	<b>Domain</b>	<b>BT Level*</b>
Understand the foundation and basic ground for calculus and analytical geometry background.	C	2

  
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* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective Domain
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<b>Course Content:</b>
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| <ol style="list-style-type: none"> <li>1. Real Numbers and the Real Line, Coordinates, Lines, and Increments, Functions, Shifting Graphs, Trigonometric Functions. [TB: Preliminaries]</li> <li>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]</li> <li>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]</li> <li>4. Applications of Derivatives: Extreme Values of Functions, The Mean Value Theorem, The First Derivative Test for Local Extreme Values, Graphing with <math>y_+</math> and <math>y_-</math>. [TB: Ch. 3]</li> <li>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]</li> <li>6. Applications of Integrals: Areas between Curves, Finding Volumes by Slicing, Volumes 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]</li> <li>7. Transcendental Functions: Inverse Functions and Their Derivatives, Natural Logarithms, The Exponential Function, <math>a^x</math> and <math>\log_a x</math>, 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]</li> <li>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]</li> <li>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]</li> </ol> |
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<b>Teaching Methodology:</b>
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Lecturing, Written Assignments
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<b>Course Assessment:</b>
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Sessional Exam, Home Assignments, Quizzes, Final Exam
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<b>Reference Materials:</b>
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| <ol style="list-style-type: none"> <li>1. Calculus and Analytic Geometry by George B. Thomas and Ross L. Finney, Addison Wesley; 10th Edition (1995) ISBN-10: 0201531747</li> <li>2. Calculus and Analytical Geometry by Swokowski, Olinick and Pence, 6th Edition, (1994), Brooks/Cole Publishers.</li> <li>3. Calculus by Howard Anton, Irl C. Bivens, Stephen Davis, Wiley; 10th Edition (2012), ISBN-10: 0470647728</li> </ol> |
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4. Calculus with Analytic Geometry: Student Solution Manual by Howard Anton. Wiley; 5th Edition (1995). ISBN-10: 0471105899

### MATH-2110 Probability and Statistics

<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None
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#### Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	Domain	BT Level*
Understand the concepts of data analysis, presentation, counting techniques, probability and decision making.	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, and the Role of Probability, Sampling Procedures: Collection of Data, Measures of Location: The Sample Mean and Median, Measures of Variability, Discrete and Continuous Data, Statistical Modeling, Scientific Inspection, and Graphical. General Types of Statistical Studies: Designed Experiment, Observational Study, and Retrospective Study. [TB: Ch. 1]
2. 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]
3. Random Variables and Probability Distributions: Concept of a Random Variable, Discrete Probability Distributions, Continuous Probability Distributions, Joint Probability Distributions. [TB: Ch. 3]
4. 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. [TB: Ch. 4]
5. Discrete Probability Distributions: Binomial and Multinomial Distributions, Hypergeometric Distribution, Negative Binomial and Geometric Distributions, Poisson Distribution and the Poisson Process. [TB: Ch. 5]
6. 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. [TB: Ch. 6]
7. Fundamental Sampling Distributions and Data Descriptions: Random Sampling, Sampling Distributions, Sampling Distribution of Means and the Central Limit Theorem, Sampling Distribution of  $S^2$ , t-Distribution, F-Quantile and Probability Plots. [TB: Ch. 8]
8. One- and Two-Sample Estimation Problems: Introduction, Statistical Inference, Classical Methods of Single Sample: Estimating the Mean, Standard Error of a Point, Prediction In-

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<p>tervals, Tolerance Limits, Estimating the Difference between Two Means. [TB: Ch. 9]</p> <p>9. Single Sample: Estimating a Proportion, Estimating the Difference between Two Proportions, Single Sample: Estimating the Variance, Estimating the Ratio of Two Variances. [TB: Ch. 9]</p> <p>10. 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. [TB: Ch. 10]</p> <p>11. 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. [TB: Ch. 10]</p> <p>12. One- and Two-Sample Tests Concerning Variances. Goodness-of-Fit Test, Test for Independence (Categorical Data), Test for Homogeneity [TB: Ch. 10]</p> <p>13. 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. [TB: Ch. 11]</p> <p>14. Multiple Linear Regression and Certain: Nonlinear Regression Models, Introduction, Estimating the Coefficients, Linear Regression Model Using Matrices, Properties of the Least Squares Estimators. [TB: Ch. 12]</p>
<b>Teaching Methodology:</b>
Lecturing, Written Assignments
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Final Exam
<b>Reference Materials:</b>
<ol style="list-style-type: none"> <li>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</li> <li>2. Probability and Statistics for Engineers and Scientists by Anthony J. Hayter, Duxbury Press; 3rd Edition (February 3, 2006), ISBN-10: 0495107573</li> <li>3. Schaum's Outline of Probability and Statistics, by John Schiller, R. AluSrinivasan and Murray Spiegel, McGraw-Hill; 3rd Edition (2008). ISBN-10: 0071544259</li> <li>4. Probability: A Very Short Introduction by John Haigh, Oxford University Press (2012). ISBN-10: 0199588481</li> </ol>

MATH-3215 Linear Algebra			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None
<b>Course Learning Outcomes (CLOs):</b>			
At the end of the course the students will be able to:		<b>Domain</b>	<b>BT Level*</b>
Understand the fundamentals of solution for system of linear equations, operations on system of equations, matrix properties, solutions and study of their properties.		C	2
* 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  $Ax = 0$ , 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]
5. Orthogonally: Orthogonally of the Four Subspaces, Projections, Least Squares Approximations, Orthogonal Bases and Gram-Schmidt. [TB1: Ch. 4]
6. Determinants: The Properties of Determinants, Permutations and Cofactors, Cramer's Rule, Inverses, and Volumes. [TB1: Ch. 5]
7. 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]
8. 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.
9. Numerical Linear Algebra: Gaussian Elimination in Practice, Norms and Condition Numbers, Iterative Methods for Linear Algebra. [TB1: Ch. 9]
10. 10. Complex Vectors and Matrices: Complex Numbers, Hermitian and Unitary Matrices, Matrix Factorizations. [TB1: Ch. 10]

**Teaching Methodology:**

Lecturing, Written Assignments

**Course Assessment:**

Sessional Exam, Home Assignments, Quizzes, Final Exam

**Reference Materials:**

1. Introduction to Linear Algebra by Gilbert Strang, Wellesley Cambridge Press; 4th Edition (February 10, 2009). ISBN-10: 0980232716
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.
5. Linear Algebra and Its Applications by David C. Lay, 2nd Edition, Addison-Wesley, 2000.
6. Linear Algebra by Harold M. Edwards, Birkhäuser; 1st Edition (2004). ISBN-10: 0817643702
7. Linear Algebra: A Modern Introduction by David Poole by Brooks Cole; 3rd Edition (May 25, 2010). ISBN-10: 0538735457

**PHYS-2210 Applied Physics / Quantum Computing****Credit Hours:**

3(3,0)

**Prerequisites:**

None

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Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	Domain	BT Level*
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. [Ch 1]
2. Resistive Circuits. [Ch 2]
3. Resistors(5.1-15), Inductors(5.19-21) Capacitors(5.35-48) .[Ch 5]
4. Energy Sources. [Ch 6]
5. Magnetism and electromagnetism [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.[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. [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. [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)[Ch 17]
10. The Basic Transistor. Transistor Biasing, Transistor Circuit Configuration. [Ch 18]
11. Modulation and Demodulation. Carrier Waves, Modulation. Demodulation or Detection, Comparison between Amplitude Modulation (AM) and Frequency Modulation (FM). [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. [Ch 31]
13. Fibre Optics. Structure of Optical Fibres, Classification of Optical Fibres, Fibre Characteristics, Choice of Wavelength, Optical Fibre cable, Application of Fibre Optic Communication. [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 Lan-guages, 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

## Contents of General Education Courses

### ENGL-2411 English Composition and Comprehension

**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. can articulate clearly, take and pass on messages, deal with customers effectively, read, understand and follow a widerange of documents and write fluently and accurately, using accepted business conventions of format, spelling, grammar and punctuation.	C	2
2. This course is developed to strengthen students these skills which enable them to deal with the practical problems and challenges of life – at home, in education and at work.	C	2

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

#### Course Content:

1. Punctuation: Periods, Question Marks, Exclamation Marks, Semicolons, Colons, Com-mas, Apostrophes, Quotation Marks.
2. Writing Mechanics: Capitals, Abbreviations; Vocabulary: Frequently Confused Words, Frequently Misused Words,
3. Vocabulary: Phrases, Synonyms, Antonyms, Idioms. General Vocabulary

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4. Use Of Articles And One, A Little/ A Few, This, That, Care. Like, Love, Hate, Prefer, Wish. All, Each, Every, Both, Neither, Either, Some, Any, No, None; Interrogatives: Wh- ? Words And How?
5. Kinds of Nouns; Kinds of Adjectives; Adverbs: Kinds, Form, Position and Use
6. Prepositions; Possessive, Personal and Reflexive Pronouns; Relative Pronouns and Clauses
7. Classes of Verbs: Ordinary Verbs, Auxiliary Verbs (Be, Have, Do); May and Can for Permission and Possibility; Can and Be Able for Ability; Ought, Should, Must, Have To, Need for Obligation; Must, Have, Will and Should for Deduction and Assumption; The Auxiliaries Dare and Used
8. The Present Tenses
9. The Past and Perfect Tenses
10. The Future; The Infinitive
11. The Gerund & The Participles; Commands, Requests, Invitations, Advice, Suggestions; The Subjunctive
12. The Passive Voice; Indirect Speech
13. Conjunctions, Purpose
14. Clauses: Noun Clauses; Clauses of Reason, Result, Concession, Comparison, Time Numerals, Dates, and Weights And Measures; Spelling Rules; Phrasal Verbs; List Of Irregular Verbs

#### 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 Lan-guages, 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

ENGL-2412 Communication and Presentation Skills			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None

Course Learning Outcomes (CLO):		
At the end of the course the students will be able to:	Domain	BT Level*
1. To sensitize students to their communicative behavior	C	2
2. To enable them to reflect and improve on their communicative behavior/performance		
3. To build capacities for self-criticism and facilitate growth		
4. To lead students to effective performances in communication		
* BT= Bloom's Taxonomy. C=Cognitive domain. P=Psychomotor domain. A= Affective domain		

Course Content:
<ol style="list-style-type: none"> <li>1. Communication Skills: What Is Communication. The Importance of Communication. What Are Communication Skills? The Communication Process : Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context. Perspectives in Communication: Introduction, Visual Perception, Language, Other Factors Affecting Communication Perspective, Past Experiences, Prejudices, Feelings, Mood, Relationship, Environment.</li> <li>2. Internal Representation: Introduction, Internal Representation of Our World, Language as a Representational System, Verbal Clues, Visual Representation System, Auditory Representational System, Kinaesthetic Representational System, Auditory Digital Representational System, Eye Movements as an Indication, Visual Recall, Visual Construct, Auditory Recall, Auditory Construct, Kinaesthetic, Internal Auditory, Phrases for Use in Response to Each Representational System.</li> <li>3. Elements of Communication: Introduction, Face to Face Communication, Tone of Voice, Body Language, Verbal Communication, Physical Communication. Communication Styles: Introduction, The Communication Styles Matrix, Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style, Examples of Communication for Each Style, Direct Style, Spirited Style, Systematic Style Considerate Style.</li> <li>4. Listening: Real Vs. Introduction, Self-Awareness, Pseudo Listening, Active Listening, Blocks to Listening, Assessing Your Listening, Four Steps to Effective Listening, Total Listening, Becoming an Active Listener.</li> <li>5. Expressing: The Four Kinds of Expression, Whole Message, Contaminated Messages, Preparing Your Message, Practicing Whole Message, Rules of Effective Expression, Body Language: Body Movement, Spatial Relationships, Paralanguage and Meta-messages: The Element of Paralanguage, Changing Your Paralanguage, Meta-message, Coping with Meta-message, Hidden Agendas: The Eight Agendas, Purpose of the Agenda.</li> <li>6. Clarifying Language: Understanding a Model, Challenging the Limits of a Model, Challenging Distortion in a Model, Assertiveness: Your Legitimate Right, Three Communication Styles, Identifying Communication Style, Your Assertive Goals, Assertive Expression and Listening, Combining Assertive Expression and Listening, Responding to Criticism, Special Assertive Strategies.</li> <li>7. Making Contact: Fear of Stranger, Guidelines for Making Contact, The Art of Conversa-</li> </ol>

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- tion, Putting It All Together. Negotiations: Four Stages of Negotiation, Dealing with Conflicts, Rules of Principles Negotiation, When The Going Get Tough.
8. Prejudgment: Prejudgment Traps, Stereotypes, Approval and Disapproval in Prejudgment, Parataxic Distortion, Perpetuating Illusion, Clarifying First Impression. Validation Strategies: What is validation, Why Does Validation Work? What Validation Is Not? Components of Validation, Successful Validation Strategies, The Power of Validation.
  9. Influencing Others: What is Persuasion? Persuading Audience, Ineffective Strategies for Influencing Change, Effective Strategies, for Influencing Others, Your Plan for Influencing Change, Lisa\_s Plan for Influencing Change Art of Persuasion.
  10. Public Speaking: Defining Your Purpose, Outlining The Subject, Presentation, Organization, Audience Analysis, Style, Supporting Materials. The Outline, Delivery, Deal-ing with Stage Fright.
  11. Preparing A Formal Oral Presentation: Presentation Design: Introduction, Consistency, Aspects of Consistency Language, Color, Fonts, Images, Contrast, Alignment, Simplicity, White Spaces, Charts, Graphics & Tables, How to Choose Which Type of Graph to Use? Graph Types, Multimedia Presentations, Adding Quotations.
  12. Delivering Presentation: Introduction, Delivery, Managing Voice. Passion, Language, Movement, Facial Expressions, Body Language, Some Useful Tips: Active Listening, Inventing Stories, Feedback, Preliminary Preparations Proximity, Tension & Nerves, Questions, Tips to Handle Questions, Habits, Handling Tough Situations, Common Mistakes & Their Remedies, Dealing with Unexpected Disasters, Presentation for International Audience, Dealing People with Disabilities, Things to Remember, Last Minute Tips.
  13. Interviewing: Clarifying What You Want, If You are the Interviewer, If You Are the Interviewee.
  14. Effective Written Communication: Introduction, When and When Not to Use Written Communication, Complexity of the Topic, Amount of Discussion Required, Shades of Meaning Formal Communication, Writing Effectively, Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message.
  15. Building Rapport: Introduction, Six Steps to Building Rapport, Match the Person\_s Sensory Modality, Mirror the Person\_s Physiology, Match the Person\_s Voice, Match the Person\_s Breathing, Match the Way the Person Deals with Information, Match Common Experiences, Calibration, Perceptual Positions.

**Teaching Methodology:**

Lecturing, Written Assignments, Report Writing, Presentations

**Course Assessment:**

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

**Reference Materials:**

1. Effective Communication Skills, MTD Training & Ventus Publishing ApS.( 2010) ISBN 978-87-7681-598-1 (TB1)
2. Messages: The Communication Skills Book by Matthew McKay PhD , Martha Davis PhD, and Patrick Fanning, New Harbinger Publications; Third Edition (March 3, 2009). ISBN-10: 1572245921
3. Secrets of Successful Presenters: A Guide for Successful Presenters by Dr. M. A. Pasha & Dr. S. Pasha, Lambert Academic Publishing (2012). ISBN-10:3659217557
4. Communication Skills in English by Prof P N Kharu, Dr. Varinder Gandhi Publisher: Laxmi. EAN: 9788131806920

5. Essential Communication Skills: Teacher Edition with Talking Points by Patty Ann. Patty Ann; 1st Edition (July 5, 2012). ASIN: B008HYUDWQ
6. Communication Skills Magic: Improve Your Relationships & Productivity through Better Understanding Your Personality Style and the Personality Styles of Those Around You by E.G. Sebastian, CreateSpace Independent Publishing Platform (January 5, 2010). ISBN-10: 1450513344
7. People Skills: How to Assert Yourself, Listen to Others, and Resolve Conflicts by Robert Bolton, Touchstone (June 6, 1986). ISBN-10: 067162248X
8. The Handbook of Communication Skills by Owen Hargie, Routledge; 4th Edition. Taylor & Francis, (12-Oct-2012).

### ENGL-2413 Technical and Business Writing

<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None
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#### Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	Domain	BT Level*
Effectively plan and structure technical reports and to recognize the various stages in writing a technical report.	C	2
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

#### Course Content:

1. Writing for Readers: Academic, Public, and Work Communities; Analyzing Electronic Communities; c. Myths and Realities about Writing.
2. Discovering and Planning: Discovering Topics; Generating Ideas; Organizing Information; Planning in Digital Environments.
3. Purpose, Thesis, and Audience: Identifying Your Focus and Purpose; Creating a Thesis; Understanding Your Readers.
4. Drafting: Moving from Planning to Drafting. Drafting Collaboratively, Drafting in Digital Environments.
5. Revising, Editing, and Proofreading: Making Major Revisions; Making Minor Revisions; Revising Collaboratively; Revising in Digital Environments; Editing; Editing Collaboratively; Proofreading.
6. Paragraphs: Unfocused Paragraphs; Revising for Focus; Incoherent Paragraphs: Revising for Coherence; Poorly Developed Paragraphs; Revising for Development: Using Special-Purpose Paragraphs.
7. Clear and Emphatic Sentences: Unclear Sentences; Revising for Clear Sentences: Revising for Variety and Emphasis.
8. Reasoning Critically: Recognizing Critical Reasoning, Building a Chain of Reasoning, Representing Your Reasoning.
9. Reading Critically: Reading to Understand; Reading to Respond and Evaluate: Using Journals to Turn Reading into Writing.
10. Arguing Persuasively: Recognizing an Issue. Developing Your Stance. Creating an Argumentative Thesis, Developing Reasons and Evidence. Acknowledging Other Perspectives.

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tives, Arguing Logically, Writing a Position Paper.
11. Designing Documents: Goals of Document Design, Format Choice, Layout, Type Choice, Visuals, Sample Documents. Creating a Visual Argument: Presenting an Is-sue, Providing Evidence.
12. Writing in Online Communities: Online Expectations, E-mail Conventions, Online Communities, Web Pages, Avoiding Plagiarism and Behaving Ethically Online.
13. Speaking Effectively: Oral Presentations, Preparing an Oral Presentation, Managing Speech Anxiety, Fielding Questions.
14. Academic Writing: Social and Natural Sciences: Goals of Writing in the Social and Natural Sciences, Audiences in the Social and Natural Sciences, Writing Tasks in the Social and Natural Sciences, Types of Writing in the Social and Natural Sciences,
15. Abstract, Informative Report, Lab Report, Research Report,
16. Public Writing: Goals of Public Writing, Public Audiences, Public Writing Tasks, Types of Public Writing, Public Flyer, Letter to the Editor, Oral Presentation.
17. Researching and Writing: Beginning Your Research, Types of Research Writing, Developing a Research Question, Developing a Preliminary Thesis, Creating a Re-search File and a Timeline, Reading and Notetaking, Summarizing, Paraphrasing, and Synthesizing.
<b>Teaching Methodology:</b>
Lecturing, Written Assignments, Report Writing, Presentations
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam
<b>Reference Materials:</b>
1. Writer's Companion – The Longman by Chris M. Anson, Robert A. Schwegler and Marcia F. Muth, Pearson Longman, 4th Edition (2007) . ISBN10: 0-20556-252-3
2. Technical English: Writing, Reading, and Speaking by Pickett and Laster. 8th Edition.
3. The Technical Writer_s Companion by Alfred, Gerald, Charles T. Brusaw and Walter E. Oliu, 3rd Edition. ISBN 0-312-25978-6.

PKSS-2311 Islamic Studies			
<b>Credit Hours:</b>	2(2,0)	<b>Prerequisites:</b>	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	Domain	BT Level*
1- Enhance understanding of the students regarding Islamic Civilization	C	2
2- Improve Students skill to perform prayers and other worships	C	2
3- Enhance the skill of the students for understanding of issues related to faith and religious life.	C	2
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
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 Department  
 University

The approved Syllabus of respective department of UOS will be followed

**Teaching Methodology:**

Lecturing, Written Assignments, Class Discussion

**Course Assessment:**

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

**Reference Materials:**

**PKSS-2312 Pakistan Studies**

**Credit Hours:** 2(2,0) **Prerequisites:** None

**Course Learning Outcomes (CLOs):**

At the end of the course the students will be able to:

- |   | Domain | BT Level* |
|---|--------|-----------|
| 1: Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan. | C      | 2         |
| 2: Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan. | C      | 2         |

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

**Course Content:**

The approved Syllabus of respective department of UOS will be followed

**Teaching Methodology:**

Lecturing, Written Assignments, Class Discussion

**Course Assessment:**

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

**Reference Materials:**

**ICTC-2021 Introduction to Information and Communication Technology**

**Credit Hours:** 3(2,1) **Prerequisites:** None

**Course Learning Outcomes (CLOs):**

At the end of the course the students will be able to:

- |   | Domain | BT Level* |
|---|--------|-----------|
| 1. Get basic understanding of computer software, hardware, and associated technologies. | C      | 2         |
| 2. Learn how computers are used in the workplace, how commu-                            | C      | 2         |

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nications systems can help boost productivity, and how the Internet technologies can influence the workplace.

\* 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. Computer Software, Categories of Computers, Elements of an Information System, Examples of Computer Usage, Computer Applications in Society [Ch. 1].
2. 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 [Ch. 2].
3. Application Software: Business Software, Graphics and Multimedia Software, Software for Home, Personal, and Educational Use. Web Applications, Application Software for Communications. [Ch. 3]
4. The System Unit: Processor, Data Representation, Memory, Expansion Slots and Adapter Cards, Ports and Connectors, Buses, Bays, Power Supply. [Ch. 4]
5. 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. [Ch. 5]
6. Output Devices: What is Output? Display Devices, Printers, Speakers, Headphones, and Ear buds, Other Output Devices. [Ch. 6]
7. Storage: Hard Disks, Flash Memory Storage. Cloud Storage, Optical Discs. Other Types of Storage. [Ch. 7]
8. System Software: Operating Systems, Operating System Functions, Types Of Operating Systems, Stand-Alone Operating Systems, Server Operating Systems, Embedded Operating Systems, Utility Programs [Ch. 8]
9. 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. [Ch. 9]
10. Databases: Data, and Information, The Hierarchy of Data, Maintaining Data, File Processing Versus Databases, Database Management Systems, Relational, Object-Oriented, and Multidimensional Databases, Web Databases, Database Administration
11. Computer Security and Safety, Ethics, and Privacy: Computer Security Risks, Internet And Network Attacks, Unauthorized Access And Use. Hardware Theft And Vandalism, Software Theft, Information Theft, System Failure, Backing Up, Wireless Security, Health Concerns Of Computer Use, Ethics And Society

### Teaching Methodology:

Lecturing, Written Assignments, Class Discussion

### Course Assessment:

Sessional Exam, Home Assignments, Quizzes, 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, AhsanRaza, Tariq Mahmood and ZafarHussain, 6th Edition, IT Series Publications.
5. The Essential Guide to Computing: The Story of Information Technology by E Garrison Walters, Prentice Hall PTR (August 11, 2000). ISBN-10: 0130194697
6. Computer Applications by Tasleem Mustafa, Tariq Mahmood, Imran Saeed and ZahidJaved, IT Publication Series

**PKSS-3910 Professional Practice**

<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None
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**Course Learning Outcomes (CLOs):**

At the end of the course the students will be able to:	Domain	BT Level*
1. Understand responsibilities with respect to the society	C	2
2. Understand historical, social, economic, ethical, and professional issues related to the discipline of Computing	C	2
3. It identifies key sources for information and opinion about professionalism and ethics.	C	2
4. Analyze, evaluate, and assess ethical and professional computing case studies.	C	2

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

**Course Content:**

1. The Engineering Profession [TB: Ch. 1]
2. The Structure of Organizations [TB: Ch. 2]
3. Finance and Accounting [TB: Ch. 3]
4. Anatomy of a Software House [TB: Ch. 4]
5. Computer Contracts [TB: Ch. 5]
6. Intellectual Property Rights [TB: Ch. 6]
7. The Framework of Employee Relations Law and Changing Management Practices [TB: Ch. 7]
8. Human Resource Management and Software Engineering [TB: Ch. 8]
9. Health and Safety at Work [TB: Ch. 9]
10. Software Liability: Liability and Practice [TB: Ch. 10]
11. Computer Misuse and the Criminal Law [TB: Ch. 11]
12. Regulation and Control of Personal Information: Data Protection, Defamation and Related Issues

[TB: Ch. 12]
13. The British Computer Society Code of Conduct [Online]
14. IEEE Code of Ethics [Online]
15. ACM Code of Ethics and Professional Conduct [Online]
16. ACM/IEEE Software Engineering Code of Ethics and Professional Practice [Online]
<b>Teaching Methodology:</b>
Lecturing, Written Assignments, Class Discussion
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam
<b>Reference Materials:</b>
1. Professional Issues in Software Engineering by Frank Bott, Allison Coleman, Jack Eaton and Diane Rowland, CRC Press; 3rd Edition (2000). ISBN-10: 0748409513
2. Online Resources
3. A Gift of Fire: Social, Legal, and Ethical Issues for Computing and the Internet (3rd Edition) by Sara Baase, Prentice Hall; 3rd Edition (2008). ISBN-10: 0136008488
4. Applied Professional Ethics by Gregory R. Beabout. University Press Of America (1993). ISBN-10: 0819193747.
5. The Dark Side of Software Engineering: Evil on Computing Projects by Johann Rost and Robert L. Glass, Wiley-IEEE Computer Society Pr; 1st Edition (2011). ISBN-10: 0470597178
6. Software Engineering Best Practices: Lessons from Successful Projects in the Top Companies by Capers Jones, McGraw-Hill Osborne Media; 1st Edition (2009). ISBN-10: 007162161X

## Contents of University Elective Courses

BUSB-2731 Business Economics			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	Domain	BT Level*
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	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
1. Introduction to Business and the economic environment [TB: Ch. 1]
2. The working of competitive markets [TB: Ch. 2]
3. Demand and the consumer [TB: Ch. 3]
4. Supply decisions in a perfectly competitive market [TB: Ch. 4]
5. Pricing and output decisions in imperfectly competitive markets [TB: Ch. 5]

6. Business growth and strategy [TB: Ch. 6]
7. Multinational corporations and business strategy in a global economy [TB: Ch. 7]
8. Government, the firm and the market [TB: Ch. 9]
9. The economy and business activity [TB: Ch. 10]
10. National macroeconomic policy [TB: Ch. 11]
11. The global trading environment [TB: Ch. 12]
<b>Teaching Methodology:</b>
Lectures, Class Discussions
<b>Course Assessment:</b>
Midterm Exam, Home Assignments, Quizzes, Final Exam
<b>Reference Materials:</b>
1. John Sloman and Elizabeth Jones, Essentials Economics for Business, 5 <sup>th</sup> Ed., Pearson, 2017.[TB]
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 Globalisation, 3 <sup>rd</sup> Ed., Prentice Hall, 2009.

<b>BUSB-2732 Human Resources Management</b>			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None

<b>Course Learning Outcomes (CLOs):</b>		
At the end of the course the students will be able :	<b>Domain</b>	<b>BT Level*</b>
1- Core aspects of Human Resource Management required in 21st Century organizations	C	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

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

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14- Understanding Unionization and Collective Bargaining. [TB: Ch. 14]
<b>Teaching Methodology:</b>
Lecturing, Written Assignments, Problem Solving
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam
<b>Reference Materials:</b>
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[TB]
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

<b>BUSB-2212 Principles of Management</b>			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None

<b>Course Learning Outcomes (OLOs):</b>		
At the end of the course the students will be able to :	<b>Domain</b>	<b>BT Level*</b>
1. Cover topics fundamentals and principles of management, administrative police, objectives, and procedures and problems of organizational control and leadership.	C	2
* 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]
<b>Teaching Methodology:</b>
Lecturing, Written Assignments, Class Discussion
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam
<b>Reference Materials:</b>
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
4. Principles of Management by Charles W. L. Hill and Steven McShane, McGraw-Hill/Irwin; 1st Edition (2006). ISBN-10: 0073530123
5. Principles of Management by Mason Carpenter, Flat World Knowledge, Inc. (2009). ISBN-10: 0982043074
6. Management by Richard L. Daft, South-Western College Pub; 10th Edition (January 27, 2011). ISBN-10: 0538479531
7. Fundamentals of Management by Stephen P. Robbins, David A. DeCenzo and Mary Coulter, Prentice Hall; 7th Edition (January 13, 2010). ISBN-10: 0136109829

<b>BUSB-3762 IT Entrepreneurship</b>			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None

<b>Course Learning Outcomes (CLOs):</b>		
At the end of the course the students will be able to :	Domain	BT Level*
1. Understand the entrepreneurship process. This course exposes them to the concepts, practices and tools of the entrepreneurial world. This will be accomplished through a combination of readings, cases studies and projects designed to convey the unique environment of the entrepreneurs and new ventures.	C	2
2. 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..		
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective		

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**Course Content:**

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

**Teaching Methodology:**

Lecturing, Written Assignments, Case Studies

**Course Assessment:**

Sessional Exam, Home Assignments, Quizzes, Presentations, 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)

## Contents of Information Technology Core Courses

ITCC-4349 Information Technology Project Management			
<b>Credit Hours:</b>	3 (3,0)	<b>Prerequisites:</b>	Software Engineering

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	Domain	BT Level*
1. Plan and manage software development projects successfully	C	2

2. Maximizing the return from each stage of the software development life cycle.	C	2
3. Basic project management tools and their usage during SDLC	C	4
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

### Course Outline

1. Introduction: Software Project Versus Other Type of Projects Dimensions of a Software Project, Activities in SPM, Setting Goals & Objectives, Business Case, Significance of Processes, Project Vs. Program Management, [TB1: Ch. 1. Handouts]
2. Introduction of PM Tools, PMI's Knowledge Areas, Technical Fundamentals in SPM, Lifecycle Relationships, Classic Mistakes Product-Process-Peoples-Technology Mistakes [TB2, Handouts]
3. PMI Framework, PMI Process Groups: Process Initiating Process Group, Planning Process Group, Executing Process, Process Monitoring and controlling, Closing Process Group, Project Charter, Statement of Work.[ TB2, Handouts]
4. Understanding Organizations, Organizational Structures, Functional -Project -Matrix, Organizational Impact on Projects, Identifying stakeholders: Define Responsibilities, Authority Relationships, Position Qualifications [TB2, Handouts]
5. Project Planning: Project Selection, Project Scope, Project Infrastructure, Analyze Project Characteristics, Identify Project & Product Activities. Work Break Down Structure [TB1:

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6. Project Evaluation: Strategic Assessment, Technical Assessment, Economic Assessment, Project Portfolio Management, Cost-Benefit Analysis, Cash Flow Forecasting, Cost-Benefit Evaluation Techniques, Procurement Management, Procurement Tools & Techniques, Types of Contracts [TB1: Ch. 2]
7. Selection of an Appropriate Approach in Project: Choosing Technologies, Technical Plan, Waterfall Model, V-Model, Spiral Model, Software Prototyping, Incremental Delivery, Agile Process Model: Dynamic Systems Development Method, Extreme Programming, Selection of Most Appropriate Process Model [TB1: Ch. 4 ]
8. Software Effort Estimation: Work Breakdown Structure (WBS) and Its Types, Estimation Problems, Software Estimation Techniques: Expert Judgment, Estimating By Analogy, LOC, Function Point Estimation, and COCOMO [TB1: Ch. 5]
9. Activity Planning: Project and Activities, Sequencings and Scheduling Activities, Network Planning Models, Formulation of Network Model, Adding the Time Dimensions. The Forward Pass, The Backward Pass [TB1: Ch. 6]
10. Identifying the Critical Path, Identifying the Critical Activities Project, AOA, Gantt Chart, (Installation & Configuration of Software Tools like MS-Project). [ TB1: Ch. 6 ]
11. Risk Management: Categories of Risks, A Framework for Dealing with Risks, Evaluating the Risks to the Schedule: PERT, Importance of Risk, Types Of Risk, Risk Identification Techniques, Project Risk and Change Management [TB1: Ch. 7]
12. Risk Control, RMMM, Configuration Management & Maintenance, Environment for Configuration Control, Configuration Control vs. Version Control [TB1: Ch. 7, OLM]
13. Resource Allocation: Nature of Resources, Identifying Resource Requirements, Scheduling Resources, Resource Scheduling Techniques [TB1: Ch. 8]
14. Monitoring & Control: Creating Framework, Collecting Data, Visualizing Progress, Cost Monitoring, Earned Value, Change Control [TB1: Ch. 9]
15. Review and Evaluation: Determining Satisfaction of Requirements, Reviewing And Evaluating Performance, Project Closure: Project Documentation, Cutover/Migration, Quality Standards, Project Closing. [TB2]
16. Challenges of Outsourcing in Project Management, Presentations

**Teaching Methodology:**

Lectures, Written Assignments, Semester Project.

**Course Assessment:**

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

**Reference Materials:**

1. Software Project Management by Bob Hughes and Mike Cotterell, McGraw-Hill Education; 5th Edition (2009). ISBN-10: 0077122798
2. A Guide to the Project Management Body of Knowledge. 3rd Edition (PMBOK Guides), ISBN-13: 978-1930699458
3. Applied Software Project Management by Andrew Stellman and Jennifer Greene, O'Reilly Media; 1st Edition (2005). ISBN-10: 0596009488
4. Software Project Survival Guide (Pro -- Best Practices) by Steve McConnell, Microsoft Press; 1st Edition (1997), ISBN-10: 1572316217
5. Mastering Software Project Management: Best Practices, Tools and Techniques by Murali K. Chemuturi and Thomas M. Cagley Jr., J. Ross Publishing (2010). ISBN-10: 1604270349
6. Effective Project Management: Traditional, Agile, Extreme by Robert K. Wysocki, Wiley; 6th Edition (2011). ISBN-10: 111801619X
7. The Software Project Manager's Handbook - Principles that work at work by Dwayne Phil-

lips, 2nd Edition, IEEE Computer Society Press and Wiley Inter-science, 2004. ISBN 0-471-67420-6

ITCC-4511 System and Network Administration			
Credit Hours:	4(3.1)	Prerequisites:	Operating Systems

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 System and network administration.	C	2
2. Explain the services and functions provided by different data centers.	C	2
3. Identify various OS used to handle system and network administration routines.	C	3
4. Analyze the different services of Linux and windows.	C	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
1. Introduction to System Administration, Systems. SA Components, Building a Site from Scratch, Growing a Small Site, Going Global, Replacing Services, Moving a Data Center, Handling a High Rate of Office Moves, Assessing a Site. [TB1:Ch. 1]
2. Server Environment (Microsoft and Linux): Known for Reliable Products, Understand the Cost of Server Hardware, Consider Maintenance Contracts and Spare Parts, maintaining Data Integrity, Put Servers in the Data Center, Client Server OS Configuration, and Provide Remote Console Access. ). [TB1:Ch. 4]
3. Services and Comparative Analysis of most demanded OS: Important Attributes. Key Features, pros and Cons. [TB1:Ch. 5]
4. Linux Installation and verification. [TB2:Ch 1]
5. Configuring Local services and managing basic system issues. [TB2:Ch 8]
6. Administer users and groups. [TB2:Ch 5]
7. Software Management. [TB2:Ch 4]
8. Managing Network Services and Network monitoring tools. [TB2:Ch 11,12]
9. Boot Management and Process Management. [TB2:Ch 6]
10. IP Tables and filtering. [TB2:Ch 13]
11. Securing network traffic. [TB2:Ch 14,Ch 15]
12. Advance File systems and logs. [TB2:Ch 7]
13. Bash Shell Scripting and Command line. [TB2:Ch 3]
14. Configuring Servers (FTP, DNS, Apache) LAB. [TB2:Ch 16,17,18]
15. Configuring Servers Cont. (DHCP, Samba, NFS) LAB. [TB2:Ch 23,24]
16. Configuring Active Directory on Windows Server 2012 LAB [TB3:Ch 7]

#### Teaching Methodology:

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

#### Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>
1- Study guide for Practice of System and Network Administration by Thomas A. Limoncelli, Cram101; 2nd Edition (2011). ISBN-10: 1428851755.
2- Linux Administration: A Beginner's Guide, Seventh Edition 7th Edition by Wale Soyinka
3- Active Directory: Designing, Deploying, and Running Active Directory Fifth Edition by Barian Desmond

ITCG-3548 Web Technologies			
<b>Credit Hours:</b>	3 (3,0)	<b>Prerequisites:</b>	Programming Fundamentals

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	Domain	BT Level*
1. Learn basic WWW, its structure and working.	C	1
2. Describe the constraints that the web puts on developers.	C	2
3. Implement basic client side and server side languages.	C	4
4. Design and Implement a simple web application.	C	4
5. Review an existing web application against a current web standard.	C	4
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
<ol style="list-style-type: none"> <li>1. Overview of WWW, Web Pages, Web Sites, Web Applications, TCP/IP, TCP/IP Application</li> <li>2. Services, Web Servers, WAMP, LAMP, WAMP Configuration.</li> <li>3. Introduction to HTTP, HTML &amp; HTML5 Tags, and Dynamic Web Content.[Ch. 1]</li> <li>4. CSS and CSS3 [Ch. 18,19]</li> <li>5. Client Side Programming: Programing in JavaScript: Basics. Expressions and Control Flow[Ch. 13, 14, 15, 20]</li> <li>6. Javascript Functions, Objects, and Arrays, Accessing CSS from JavaScript [Ch. 13, 14, 15, 20]</li> <li>7. Form Handling [Ch. 11]</li> <li>8. Server Side Programing: Programing in PHP, [Ch. 3, 4]</li> <li>9. PHP functions and objects, PHP arrays [Ch. 5,6]</li> <li>10. Introduction MySQL, MySQL Functions, Normalization, Relationships [Ch.9]</li> <li>11. Accessing MySQL via PHP [Ch. 10]</li> <li>12. Cookies, Sessions, and Authentication [Ch. 12]</li> <li>13. Introduction to Ajax [Ch. 17]</li> <li>14. Introduction to JQuery</li> <li>15. Browsers and the DOM [W3 Schools Tutorial]</li> <li>16. Designing a Social Networking Site [Ch. 21]</li> </ol>
Teaching Methodology:
Lecturing, Written Assignments, Project, Report Writing
Course Assessment:
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam

**Reference Materials:**

1. Learning PHP, MySQL, JavaScript, and CSS. A Step-by-Step Guide to Creating Dynamic Websites By Robin Nixon, O'Reilly Media; Second Edition 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

**ITCC-3540 Wireless Technologies**

<b>Credit Hours:</b>	<b>3(3,0)</b>	<b>Prerequisites:</b>	None
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**Course Learning Outcomes (CLOs):**

At the end of the course the students will be able to:	Domain	BT Level*
1. Introduction to mobile networking, with an emphasis on the mechanisms, protocols and standards	C	1
2. Understanding of the architecture and operating principles of mobile and wireless networks	C	2
3. Operations of wireless LANs, WANs and PANs	C	2
4. Solutions and effectiveness of routing schemes for mobile hosts and application-level features	C	3

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

**Course Content:**

1. Basics of Wireless Local Area Networks: Networks Large and Small, WLANs from LANs. 802.11 WLANs, HiperLAN and HiperLAN 2. From LANs to PANs. [TB1: Ch2]
2. Radio Transmitters and Receivers. Multiple Access Methods: Overview of Radios. Radio Components, FDMA, TDMA, CDMA, Random Access, ALOHA, Slotted ALOHA, Reservation-based ALOHA. [TB1: Ch3]
3. Radio Propagation: Radio Propagation, Mechanisms of Radio Wave Propagation, Diffraction, Scattering, Path Loss, Multipath Phenomena. [TB1: Ch4]
4. Antennas and Transmission Lines: Introduction and Antenna Characteristics. Types of Antenna. [TB1: Ch5]
5. Communication Protocols and Modulation: Baseband Data Format and Protocol. Baseband Coding, RF Frequency and Bandwidth, Modulation, RFID. [TB1: Ch6]
6. High-Speed Wireless Data: System Types, Standards-Based and Proprietary Solutions: Fixed Networks, Nomadic Networks, Mobile Networks, Standards-Based Solutions and Proprietary Solutions, Overview of the IEEE 802.11 Standard. Overview of the IEEE 802.16 Standard, 10-66 GHz Technical Standards, 2-11 GHz Standards, Overview of the IEEE 802.20 Standard. [TB1: Ch7]
7. GSM/Cellular Networks: First-Generation Analog, Second-Generation TDMA, Second-Generation CDMA, Third-Generation Systems, 4G and Beyond, LTE. [TB2: Ch10] (William Stallings Ch. 5 and from GSM to LTE book)
8. Security in Wireless Local Area Networks: Introduction Key Establishment in 802.11, Anonymity in 802.11, Authentication in 802.11, Confidentiality in 802.11, Data Integrity in 802.11, Loopholes in 802.11 Security. WPA, WPA2 (802.11i). [TB1: Ch10]


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9. Voice Over Wi-Fi and Other Wireless Technologies: Introduction and Ongoing 802.11 Standard Work, Wi-Fi and Cellular Networks, WiMax, VoWi-Fi and Bluetooth, VoWi-Fi and DECT, VoWi-Fi and Other Ongoing 802.x Wireless Project. [TB1: Ch11]
10. Mobile Ad Hoc Networks: Mobile Ad Hoc Networks. Physical Layer and MAC, Routing in Ad Hoc Networks. [TB1: Ch12]
11. Wireless Sensor Networks: Application, Plant Network Layouts, Plant Network Architecture, Sensor Subnet Selection, Functional Requirements. [TB1: Ch13]
12. Reliable Wireless Networks for Industrial Applications: Benefits of Using Wireless, Issues in Deploying Wireless Systems, Wireless Formats, Wireless Mesh Networks,
13. Industrial Applications of Wireless Mesh Networks [TB1: Ch14]
14. Applications and Technologies: Wireless Local Area Networks (WLAN) and PAN: Bluetooth, Zigbee, Conflict and Compatibility, Ultra-wideband Technology. [TB1: Ch15]
<b>Teaching Methodology:</b>
Lectures, Written Assignments, Semester Project.
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Final Exam
<b>Reference Materials:</b>
1. Wireless Networking: Know It All By Praphul Chandra, Daniel M. Dobkin, Dan Bensky, Ron Olexa, David Lide, Farid Dowla: Publisher: Newnes [TB]
2. Wireless Communications & Networks (2nd Edition) by William Stallings. ISBN: 0131918354. Revised in 2009.
3. Wireless Networks: Design and Integration for LTE, EVDO, HSPA and Wimax by Clint Smith 3 <sup>rd</sup> edition ( 2014). ISBN-10: 0071819835

ITCC-4545 Virtual Systems and Services			
<b>Credit Hours:</b>	4(3,1)	<b>Prerequisites:</b>	Programming Fundamentals, Computer Networks*

Course Learning Outcomes (CLOs)		
At the end of the course the students will be able to:	<b>Domain</b>	<b>BT Level*</b>
1: How virtualization is changing today's IT consumption trends.	C	4
2: Implementation, Management and control of different Virtual environments	C	5
3: Windows and Linux based systems administration*	C	4
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
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 University of Jammu, Jammu

1. Overview of virtualization technology and its application. Comparison of traditional and virtual systems
2. Overview of Intel x86 platform
3. Parallel and distributed systems
4. Types of virtualization, Virtualization at Software and Hardware level
5. Virtual Machines and configuration of VMs: Managing CPU, storage, networking etc for VMs
6. Key features of VMs, Hypervisors and Configuration of Vmware
7. Hyper-V and Xen hypervisors
8. Types of hypervisors: Type-1 and Type-2 hypervisor
9. Features and limitations of hypervisors
10. Para-virtualization and Para-virtualized software components
11. Vmware ESXi, Xen and Microsoft virtualization implementation in the context of datacenters (lab sessions)
12. Virtualization in Cloud Computing
13. Virtualization in IoT
14. Virtualization security: security at hypervisor level, VM security
15. Future of Virtualization
16. Semester project

W

Final  
Date: 10/10/2023  
Unit: 10/10/2023

<b>Teaching Methodology:</b>
Lectures, Labs, Labs Assignments, Semester Project, Presentations,
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>
1. Virtualization from Desktop to the Enterprise, Chris Wolf and Erick M. Halter, Latest Edition
2. The Definitive Guide to the Xen Hypervisor, David Chisnall. Latest Edition
3. Windows Server 2012 Hyper-V Installation and Configuration Guide, Aidan Finn, Michel Luescher, Patrick Lownds, 2013
4. Xen Hypervisor Case Study - Designing Embedded Virtualized Intel® Architecture Platforms
5. Handbook of Virtual Environments: Design, Implementation, and Applications (Human Factors and Ergonomics), Edited by Kay M Stanney, Lawrence Erlbaum Associates Virtual Reality Technology by GRIGORE

<b>ITCC-4543 Information Technology Infrastructure</b>		
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>

<b>Course Learning Outcomes (CLOs):</b>		
At the end of the course the students will be able to:	Domain	BT Level*
1. Information technology architectures including software systems, hardware, operating systems, databases, component technologies, networking, and architecture patterns.	C	2
2. IT Infrastructure Management.	C	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

<b>Course Outline:</b>
1. Introduction and Definition of IT Infrastructure, IT building block, process building blocks, Application building block, Application Platform building block, Infrastructure building block [TB1: Ch.1,2]
2. Non-functional Attributes; introduction, non-functional requirements, Availability Concepts, Calculating availability, Sources of Unavailability, Availability Patterns.
3. Performance concepts: introduction, Perceived performance, Performance during Infrastructure Design, Performance of a running system, performance pattern, Sources of Performance Metrics, Performance Pattern. [TB1: Ch.5]
4. Security Concepts: Risk Management, Cryptography, Computer Crime, Security Patterns. [TB1: Ch.6]
5. Datacentres: Introduction & History, Building Blocks, Datacentre Availability, Datacentre Security. [TB1: Ch.7]
6. Networking: Building Blocks, Network virtualization [TB1: Ch.8]
7. Network Availability, Network Performance, Network Security [TB1: Ch.8]

8. Storage: Introduction and History, Building blocks, Availability, Performance, Security. [TB1: Ch.9]
9. Compute: Introduction, Building Blocks, Availability, Performance, Security [TB1: Ch.10]
10. Operating Systems: Introduction, Building Blocks, Implementing Various OSs. OS availability, OS Performance, OS Security. [TB1: Ch.11]
11. End User Devices: Introduction & History, Building Blocks, Desktop virtualization, Device Availability, Performance, Security [TB1: Ch.12]
12. Infrastructure life cycle [TB1:13]
13. Infrastructure deployment options: Introduction, Hosting options, Enterprise infrastructure deployment, Software defined data-centre, (Hyper) Converged Infrastructure, Cloud computing, infrastructure as a code [TB1:14]
14. Purchasing Infrastructure And Services [TB:15]
15. Deploying The Infrastructure [TB:16]
16. Maintaining The Infrastructure, Deploying applications, [TB:17,18]
<b>Teaching Methodology:</b>
Lectures, Written Assignments, Semester Project, Presentations
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>
1. IT Infrastructure Architecture: Infrastructure building blocks and concepts by Sjaak-I.aan. Lulu.com; 3 <sup>rd</sup> edition (2017). ISBN-978-1-326-92569-7
2. IT Infrastructure and its Management by Prof Phalguni Gupta, Tata McGraw Hill Education Private Limited (October 6, 2009). ISBN-10: 0070699798
3. IT Architecture For Dummies by Kalani Kirk Hausman and Susan Cook, For Dummies; 1st Edition (November 9, 2010). ISBN-10: 0470554231
4. Standards Policy for Information Infrastructure by Brian Kahin and, Janet Abbate, The MIT Press (August 14, 1995). ISBN-10: 026211206X
5. IT Architectures and Middleware: Strategies for Building Large, Integrated Systems by Chris Britton and Peter Bye, Addison-Wesley Professional; 2nd Edition (June 3, 2004). ISBN-10: 0321246942

<b>ITCC-4543 Cyber Security</b>		
<b>Credit Hours:</b>	3 (3,0)	<b>Prerequisites:</b>

<b>Course Learning Outcomes (CLOs):</b>		
At the end of the course the students will be able to:	<b>Domain</b>	<b>BT Level*</b>
1. Describe the core information assurance (IA) principles.	C	3
2. Identify the key components of cyber security architecture.	C	3
3. Distinguish system and application security threats and vulnerabilities.	C	3
4. Define types of incidents including categories, responses and timelines for response	C	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

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<b>Course Content:</b>
1- Vulnerabilities in information system, measuring vulnerabilities. [TB1:Ch1]
2- Threat classification, cyber security starts at home and international awareness.[TB1:Ch1]
3- Vulnerabilities in the organization, access authorization and authentication, security services in wireless networks and cloud security.[TB1:Ch2]
4- Risk in information system infrastructure, hardware, software, and cyberspace. [TB1:Ch3].
5- Assets identification, resource access control and securing the assets communication. [TB1:Ch4]
6- Secure information system, information security management. .[TB1:Ch4]
7- Cyber security and the CIO, data backup and archiving , cyber trainings and cyber policy.[TB1:Ch5]
8- Building a secure organization, system access control and computer network management securely.[TB1:Ch6]
9- Personal, physical and environmental security and business continuity planning. [TB1:Ch6]
10- Cyberspace Intrusions, ID/PS configuration, ID/PS management and ID/PS classification. [TB1:Ch7]
11- ID/PS implementation and operation in organization. [TB1:Ch7]
12- Cyberspace defense, file protection application, PC performance applications. [TB1:Ch8]
13- Protection tools, security analyzer, password analyzer, firewalls and email protection. [TB1:Ch8]
14- Cyberspace and law, international law and cyber related laws. [TB1:Ch9]
15- Cybercrime, trends in cyber abuse, combating cybercrime. [TB1:Ch9]
16- Cyber warfare and homeland security and distributed defense. [TB1:Ch10]
<b>Teaching Methodology:</b>
Lecturing, Written Assignments, Project, Report Writing
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>
1. Cyberspace and Cyber security 1st Edition by George Kostopoulos
2. Security+ Guide to Network Security Fundamentals, Fifth Edition Mark Ciampa
3. Essential Cyber Security Handbook Kindle Edition by Nam Nguyen

<b>ITCC-4450 Database Administration and Management</b>			
<b>Credit Hours:</b>	4(3,1)	<b>Prerequisites:</b>	Database Systems

<b>Course Learning Outcomes (CLOs):</b>		
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. Have good understanding of internal functionality of Database Management System.	C	2
3. Administrator Huge Database implemented in a DBMS.	C	4

4. Database Administration tasks i.e. Backup and Recovery and Performance Tuning of Databases.	C	4
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

<b>Course outline:</b>
<ol style="list-style-type: none"> <li>1. Installation; SQL* Plus; Oracle Enterprise Manager; DBA Tools. Oracle Architectural Components: Oracle Server; Oracle Instance.</li> <li>2. Physical Structure; SGA; Shared Pool; Library Cache; Data Dictionary Cache; Large Pool; User Process; Server Process; Background Processes.</li> <li>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.</li> <li>4. Creating Database and Data dictionary.</li> <li>5. Managing Control Files and Redo Log Files.</li> <li>6. Managing Tablespaces, Operations with Tablespaces.</li> <li>7. Data File Management, Segments, Block.</li> <li>8. Managing Undo Data, Undo Data Statistics: Managing Tables and Users:</li> <li>9. Indexes Management, Maintaining Data Integrity. Constraints. Managing Privileges.</li> <li>10. Basic Oracle Net Architecture: Types of Networks, Oracle Net Services. Oracle Shared Server, Connection Manager, Oracle Net Connections.</li> <li>11. Server Side Configuration: The Listener Process: Configuring Listener, Sessions. Creating and Managing Listener.</li> <li>12. Client Side Configuration: Host Naming Method, Local Naming Method, Net Assistant. Configurations. Usage and Configuration of Oracle Shared Server.</li> <li>13. Backup and Recovery, Instance and Media Recovery, Configuration of Archive log mode. User Managed Complete Recovery</li> <li>14. Loading Data into Database, Tuning Tools, Sizing Shared Pool, Sizing Buffer Cache. I/O Issues</li> <li>15. Tuning Rollback Segments, Latches, Rollback Segment Tuning Shared Servers. Types of Locks, Block Efficiency, Storage hierarchy</li> <li>16. Avoiding Dynamic allocation, Statistics, PCTFREE and PCTUSED, Monitoring Index Usage.</li> </ol>
<b>Teaching Methodology:</b>
Lectures, Written Assignments, Practical labs, Semester Project, Presentations
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>
<ol style="list-style-type: none"> <li>1. Oracle Database 11g DBA Handbook by Bob Bryla and Kevin Loney, McGraw-Hill Osborne Media; 1st Edition (December 6, 2007). ISBN-10: 0071496637</li> <li>2. Oracle Database 12c DBA Handbook by Bob Bryla, McGraw-Hill; (2015), ISBN-978-0-07-179879-2</li> <li>3. 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</li> <li>4. 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</li> <li>5. Oracle Database 11g The Complete Reference by Kevin Loney, McGraw-Hill Os-borne</li> </ol>

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Media; 1st Edition (2008). ISBN-10: 0071598758

6. Oracle Database 11g Release 2 Performance Tuning Tips & Techniques (Oracle Press) by Rich Niemic, McGraw-Hill Osborne Media; 1st Edition (2012). ISBN-10: 0071780262
7. Online Material URL <http://otn.oracle.com>

### URCC-1010 Citizenship

**Credit Hours:** 0 (0,0)      **Prerequisites:**

### Course Learning Outcomes (CLO):

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 to Citizenship Education and Community Engagement: Orientation
2. Introduction to Active Citizenship: Overview of the ideas, Concepts, Philosophy and Skills
3. Identity, Culture and Social Harmony: Concepts and Development of Identity
4. Components of Culture and Social Harmony, Cultural & Religious Diversity
5. Multi-cultural society and inter-cultural dialogue: bridging the differences, promoting harmony
6. Significance of diversity and its impact, Importance and domains of inter-cultural harmony
7. Active Citizen: Locally active, globally connected
8. Importance of active citizenship at national and global level
9. Understanding community, Identification of resources (human, natural and others)
10. Human rights, Constitutionalism and citizens' responsibilities: Introduction to human rights
11. Universalism vs relativism, Human rights in constitution of Pakistan
12. Public duties and responsibilities
13. Social Issues in Pakistan: Introduction to the concept of social problem, Causes and solutions
14. Social Issues in Pakistan (Poverty, Equal and Equitable access of resources, unemployment)
15. Social Issues in Pakistan (Agricultural problems, terrorism & militancy, governance issues)
16. Social action and project: Introduction and planning of social action project
17. Identification of problem, Ethical considerations related to project
18. Assessment of existing resources

<b>Teaching Methodology:</b>
Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>
<ol style="list-style-type: none"> <li>1. Kennedy, J. K. Brunold, A. (2016). Regional context and citizenship education in asia and europe. New York: Routledge Falmer.</li> <li>2. Macionis, J. J. Gerber, M. L. (2010). Sociology. New York: Pearson Education.</li> </ol>

## Contents of Information Technology Supporting Courses

ITSC-3543 Enterprise Systems			
<b>Credit Hours:</b>	3 (3,0)	<b>Prerequisites:</b>	

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	Domain	BT Level*
1. Discover Demonstrate an understanding of the issues in systems use of an Enterprise Systems package (e.g. ERP) to support business operations and decision.	C	2
2. Understand the scope of common Enterprise Systems modules (e.g., MM, SCM, CRM, HRM, procurement).	C	3
3. Discuss the challenges associated with implementing enterprise systems and their impacts on organizations.	C	3
4. Develop models for selected business process in enterprise systems.	C	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
1- Introduction to Enterprise system management.[TB: 1 Ch:1]
2- Business Process Management and system integration. [TB: 1 Ch: 2].
3- Architecture and Platform of Enterprise systems.[TB: 1 Ch:3]
4- Enterprise Systems and development lifecycle technology. [TB: 1 Ch:4]
5- Enterprise Systems and Business Process Reengineering. implementation and strategies. [TB: 1 Ch:5]
6- Software and vendor selection [TB: 1 Ch:6]
7- Operation and post-implementation. [TB: 1 Ch:7]
8- Program and project management. [TB: 1 Ch:8]
9- Global, Ethics and security management. [TB: 1 Ch:9]
10- Supply chain management. [TB: 1 Ch:10]
11- Customer Relationship management and its factor. [TB: 1 Ch:11]
<b>Teaching Methodology:</b>
Lecturing, Written Assignments, Project, Report Writing

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**Course Assessment:**

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

**Reference Materials:**

1. Enterprise Systems for Management 2nd edition, Published by PEARSON: ISBN-13: 978-0-13-214576-3 Luvai F. Motiwalla and Jeff Thompson (2011).[TB]
2. Modern ERP: Select, Implement & Use Today's Advanced Business Systems by Marianne Bradford, lulu.com (October 19, 2009). ISBN-10: 0557012910.
3. Business Process Management: Concepts, Languages, Architectures by Mathias Weske, Springer; 2nd Ed. 2012
4. Business Process Management Common Body Of Knowledge by Yvonne LedererAntonucci, et. al., CreateSpace Independent Publishing Platform, 2009

**Course Learning Outcomes (CLOs):****ITSC-3311 Object Oriented Analysis and Design**

<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None
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**Course Learning Outcomes (CLOs):**

At the end of the course the students will be able to:	Domain	BT Level*
1. Describe how to produce detailed object models and designs from system requirements.	C	2
2. Use the modeling concepts provided by UML	C	2
3. Analyze identify use cases and expand into full behavioral designs.	C	4

\* 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.8.2-

5,9.2-4,10.1-4,11.1-7,12.1-4]
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]
<b>Teaching Methodology:</b>
Lectures, Written Assignments, Semester Project, Presentations
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>
1- Applying UML and patterns: An introduction to Object-Oriented Analysis and Design and Iterative Development by Craig Larman, Prentice Hall; 3rd Edition (October 30,2004). ISBN-10: 0131489062
2- Fundamental of Object-Oriented Design in UML by Meiler Page-Jones, AddisonWesley, 2000. ISBN: 020169946X.
3- The Unified Modeling Language User Guide by G. Booch, J. Rambaugh and I. Jakobson, Addison-Wesley Professional; 2nd Edition (2005). ISBN-10: 0321267974

ITSC-324 Optimization Techniques			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	<b>Domain</b>	<b>BT Level*</b>
1- 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:
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HL

- 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].  
Unconstrained Optimization:
- 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].  
Constrained Optimization:
- 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 Fiaccoco 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; 4<sup>th</sup> ed., 2004.

**ITSC-2210 Digital Logic Design**

<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None
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**Course Learning Outcomes (CLOs):**

At the end of the course the students will be able to:	Domain	BT Level*
1- Describe the key terminologies of digital circuit of large complexity.	C	2
2- Explain how such circuits could be built in a methodological way	C	2
3- Analyze from starting from Boolean logic and applying a set of rigorous techniques.	C	4
* 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, Decimal-to-Binary Conversion, Binary Arithmetic, 1'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 Karnaugh 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 Converters: 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)

**ITSC-3431 Technology Management****Credit Hours:**

3(3,0)

**Prerequisites:****Course Learning Outcomes (CLOs):**

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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	G	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 Contents:
1. Introduction to Technology Management, TM activities and tools, The TM framework, TM activities behind technological capabilities, TM tools. Cases illustrating different TM system configurations. [TB 1: Ch. 1]
2. TM Activities – Identification: Introduction, Definition. Identification processes, Case study. [TB 1: Ch. 2]
3. TM Activity- Selection: Introduction, Definition, Selection processes, Case study. [TB 1: Ch. 3]
4. TM Activity – Acquisition: Introduction, Definition, Internal acquisition, R&D processes, External technology acquisition, External acquisition processes , Case study. [TB 1: Ch. 4]
5. TM Activity – Exploitation: Introduction, Definition, Commercialization/marketing, Marketing processes, Technology transfer, Technology utilization, Utilization processes. Case study. [TB 1:Ch. 5 )
6. TM Activity- Protection: Introduction, Definition, Protection processes, Case study. [TB 1: Ch. 6)
7. TM Activity – Learning: Introduction, Definition, Learning processes, Case study. [TB 1: Ch. 7]
8. TM Tools-S –curve: Introduction, Where and why it is used. Process, Case study. [TB1: Ch. 8]
9. TM Tools-Patent Analysis: Introduction, Where and why it is used, Process, Case study. [TB1: Ch. 10]
10. TM Tools-Portfolio Management: Introduction, Where and why it is used. Process. Case study. [TB 1: Ch. 11 )
11. TM Tools-Roadmapping: Introduction, Where and why it is used, Process, Case study. [TB 1: Ch. 12)
12. TM Tools-Value Analysis/Value Innovation: Introduction, Where and why it is used, Process, Case studies. [TB 1: 13]
13. TM-Functions - Planning and Forecasting: Nature of Planning, The Foundation For Planning, Planning Concepts, Forecasting, Strategies For Managing Technology. TM-Functions - Decision Making: Nature of Decision Making, Management Science, Tools for Decision Making, Computer-Based Information Systems, and Implementation. [TB 2: Ch. 3]
14. TM-Functions – Organizing: Nature of Organizing, Traditional Organization Theory, Technology and Modern Organization Structures, Teams, Staffing Technical Organizations, Authority and Power, Delegation, Committees and Meetings, Teams. [TB2: Ch. 5]
15. TM-Functions - Leading Technical People: Leadership, Motivation, Motivating and Leading Technical Professionals. Controlling: The Process of Control. Financial Controls. [TB 2: Ch. 7)
<b>Teaching Methodology:</b>
Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>

**Textbook(s):**

- Technology Management: Activities and Tools by Dilek Cetindamar, Rob Phaal, and David Probert, Palgrave Macmillan (April 27, 2010). ISBN-10: 0230233341 (TB1)
- Managing Engineering and Technology by Lucy C. Morse And Daniel L. Babcock, Prentice Hall; 5<sup>th</sup> Edition (August 20, 2009). ISBN-10: 0136098096 (TB2)

**Reference Material:**

- Management of Technology: Managing Effectively in Technology-Intensive Organizations by Hans J. Thamhain, Wiley; 2<sup>nd</sup> Edition (May 25, 2005). ISBN-10: 0471415510
- Managing Information Technology by Carol V. Brown, Daniel W. DeHayes, Jeffrey A. Hoffer, Wainright E. Martin, and William C. Perkins, Prentice Hall; 7<sup>th</sup> Edition (March 18, 2011). ISBN-10: 0132146320
- Technology Management: Activities and Tools by Dilek Cetindamar, Rob Phaal, and David Probert, Palgrave Macmillan (April 27, 2010). ISBN-10: 0230233341

**ITSC-3143 Design and Analysis of Algorithms**

<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	Discrete Structure
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**Course Learning Outcomes (CLOs):**

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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:

16. Role of Algorithms in Computing, Analysing Algorithms, Designing Algorithms, Growth of Functions, Asymptotic Notation, Standard Notations and Common Functions. [TB: Ch1,2,3]
17. Divide-and-Conquer, Strassen's Algorithm for Matrix Multiplication, Recursion. [TB: Ch. 4]
18. Recurrences: Substitution Method for Solving Recurrences, Recursion-Tree Method for Solving Recurrences, Master Method for Solving Recurrences. [TB: Ch. 4]
19. Sorting and Order Statistics: Heapsort Algorithm, Priority Ques, Quicksort Algorithm, Analysis of Quicksort. [TB: Ch. 6, 7]
20. Sorting in Linear Time: Lower Bounds for Sorting, Counting Sort, Radix Sort, Bucket Sort. [TB: Ch. 8]
21. Medians and Order Statistics, Binary Search Trees, Querying a Binary Search Tree, Insertion and Deletion. [TB: Ch. 9, 12]
22. Red-Black Trees: Properties of Red-Black Trees, Rotations, Insertion, Deletion; Minimum Spanning Trees: Introduction, Growing a Minimum Spanning Tree. [TB: Ch. 12]
23. Dynamic Programming: Elements of Dynamic Programming, Longest Common Subsequence, Optimal Binary Search Trees [TB: Ch. 15]
24. Greedy Algorithms: Elements of The Greedy Strategy, Huffman Codes, Matroids and Greedy Methods, Task-Scheduling Problem. [TB: Ch. 16]
25. Elementary Graph Algorithms, Representations of Graphs, Breadth-First Search, Depth-First Search, Topological Sort. [TB: Ch. 22]
26. Single-Source Shortest Paths: The Bellman-Ford Algorithm, Single-Source Shortest Paths in Directed Acyclic Graphs, Dijkstra's Algorithm. [TB: Ch. 24]
27. All-Pairs Shortest Paths: Floyd-Warshall Algorithm, Johnson's Algorithm for Sparse Graphs. [TB: Ch. 25]
28. Maximum Flow: Flow Networks, Ford-Fulkerson Method, Push-Relabel Algorithms, Relabel-to-Front Algorithm. [TB: Ch. 26]
29. 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; 3rd Edition (2009). ISBN-10: 0262033844
- 2- Introduction to the Design and Analysis of Algorithms by Anany Levitin, Addison Wesley; 2nd Edition (2006). ISBN-10: 0321358287
- 3- Algorithms in C++ by Robert Sedgewick (1999). ASIN: B006UR4BJS
- 4- Algorithms in Java by Robert Sedgewick, Addison-Wesley Professional; 3rd Edition (2002). ISBN-10: 0201361205

### ITSC-4340 UI / UX Web Designing

<b>Credit Hours:</b>	3 (2 +1)	<b>Prerequisites:</b>	N/A
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#### Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	Domain	BT Level*
1. Create prototypes of mobile, tablet and web user experience designs based on industry user experience design principles.	C	2
2. Critique existing user experience designs.	C	3
3. Design effective and useable mobile, tablet and web applications.	C	3
4. Use industry standard user experience design processes and tools for prototyping.	C	4

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

#### Course Content:

1. There's No Success Without Strategy: Fail to Plan = Plan to Fail; Strategy Starts with Research; There's More Than One Way; Start with Stakeholders; Next, Move to Users; Walking the Walk; Strategy, Simplicity and Success [Ch: 1]
2. Identifying Business Goals: UX Means Business; Conducting Stakeholder Interviews; Asking the Right Questions; Addressing the Competition [Ch: 2]
3. Identifying User Needs: Identifying Business-to-Business (B2B) User Needs; Asking the Right Questions; Identifying Business-to-Consumer (B2C) User Needs; Asking the Right Questions; Questions Specific to Redesign Projects [Ch: 3]
4. Three Critical Questions You Must Ask: One: What's Worth Doing?; Two: What Are We Creating?; Three: What Value Does it Deliver?; The High Cost of Misunderstanding [Ch: 4]
5. Turning Strategy Into Scope: Avoiding the Neverending Project; Scope Tradeoffs; Avoiding Perpetual Beta; Know What You're Building (and What You're Not); Scope Creep: Just Say No [Ch: 5]
6. Strategic Tradeoffs & Product Evolution: Tradeoff Case Study - IKEA; Product Evolution: the Long WOW; Anatomy of a Long WOW Experience; Motivation and Mastery; Repeated, Recognized Reward; What "Fun" Really Means [Ch: 6]
7. Requirements - There's a Better Way: What People Say They Need; What People Actually Need; What People Don't Know They Need; Creating Useful; Requirements with Use Scenarios; What About Use Cases and User Stories?; Looking Beyond Tasks and Activities; Making Use Scenarios Contextual with Personas; Persona Creation Happens Immediately; The Empathy Mapping Template; The Situation Mapping Template; When You Finish: Questions to Ask [Ch: 7]
8. User interfaces
9. Adoop XD , 3D Mya, Canva, Filmora, Figma, Marvel, Google forms, flutter

**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. Natoli, Joe. Think first: My no-nonsense approach to creating successful products, memorable user experiences+ very happy customers. BookBaby, 2015.

## Contents of Information Technology Elective Courses

IPEC-4548 Mobile Application Development		
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>

Course Learning Outcomes (CLOs)		
At the end of the course the students will be able to:	<b>Domain</b>	<b>BT Level*</b>
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
<ol style="list-style-type: none"> <li>1. A Little Background. What It Isn't. An Open Platform for Mobile Development. Native Android Applications. Android SDK Features. Introducing the Open Handset Alliance. What Does Android Run On? Why Develop for Android? Introducing the Development Framework. What Comes in the Box? [TB1: Ch 1 TB2: Ch 1].</li> <li>2. Developing for Android. Developing for Mobile Devices. To-Do List Example. Android Development Tools. [TB1: Ch 2]</li> <li>3. What Makes an Android Application? Introducing the Application Manifest. Using the Manifest Editor. The Android Application Life Cycle. Understanding Application Priority and Process States. Externalizing Resources. A Closer Look at Android Activities. [TB1: Ch 3]</li> <li>4. Fundamental Android UI Design. Introducing Views. Introducing Layouts. Creating New Views. Creating and Using Menus. [TB1: Ch 4].</li> <li>5. Introducing Intents. Introducing Adapters. Using Internet Resources. Introducing Dialogs. Creating an Earthquake Viewer. [TB1: Ch 5].</li> <li>6. Android Techniques for Saving Data. Saving Simple Application Data. Saving and Loading Files. Databases in Android. Introducing Content Providers. [TB1: Ch 6]</li> </ol>

7. Saving and Loading User Preferences, Persisting Data to Files, Creating and Using Databases. [ TB1: Ch 6].
8. Using Location-Based Services. Setting up the Emulator with Test Providers. Selecting a Location Provider. Finding Your Location. Using Proximity Alerts. Using the Geocoder. Creating Map-Based Activities. Mapping Earthquakes Example. [ TB1: Ch 7].
9. Introducing Services. Using Background Worker Threads. Let's Make a Toast. Introducing Notifications. Using Alarms. Using Alarms to Update Earthquakes. [TB1:Ch 8]
10. Peer-to-Peer Communication. Introducing Android Instant Messaging. Introducing SMS. [ TB1:Ch 9 TB4:Ch 8].
11. Accessing Android Hardware. Using the Media APIs. Using the Camera. Introducing the Sensor Manager. Using the Accelerometer and Compass. [TB1:Ch 10].
12. Android Telephony. Using Bluetooth. Managing Network and Wi-Fi Connections. Controlling Device Vibration. [TB1:Ch 10].
13. Creating Your Own Services, Establishing Communication between a Service and an Activity, Binding Activities to Services, Understanding Threading. [TB1: Ch 11].
14. Consuming Web Services Using HTTP, Accessing Web Services Using the Get Method, Consuming JSON Services, Sockets Programming. [Tb4: Ch 10].
15. Creating Your Own Services, Establishing Communication between a Service and an Activity, Binding Activities to Services, Understanding Threading. [Tb4: Ch 11].
16. Publishing Android Applications, App store [TB4: Ch12].

**Teaching Methodology:**

Lecturing, 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.[TB]
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
4. Beginning Android 4 Application Development by Wei-Menge Lee, John Wiley & Sons, 2012

**ITEC-4746 E-Commerce Application Development****Credit Hours:** 3(3,0) **Prerequisites:****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: Ch.1]
2. Planning an e-Commerce Framework: Designing a framework, Patterns, ModelView-Controller, Registry, Singleton, Structure, Building a framework, Routing requests. [TB: Ch.2]
3. Products and Categories: Product information, Category information, Structuring Content, Versioning, Building products, categories, and content functionality, Routing products and categories. [TB: Ch.3]
4. Product Variations and User Uploads: Giving users choice. Giving users control, Shopping. [TB: Ch.4]
5. 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: Ch.5]
6. 6. The Shopping Basket: Creating A Basket, Basket Contents. Managing the Basket, Cleaning the Basket. [TB: Ch.6]
7. The Checkout and Order Process: The Process, Authentication, Payment Method, Order Processed. [TB: Ch.7]
8. Shipping and Tax: Shipping Methods, Shipping Costs, Shipping Rules, Tracking, Tax Calculation. [TB: Ch.8]
9. Discounts, Vouchers, and Referrals: Discount codes, Purchasable Voucher Codes, Referrals. [TB: Ch.9]
10. Checkout: Checkout process consideration, Order process review, Authentication & Confirmation. [TB: Ch.10]
11. Taking Payment for Orders: Taking payment, Payment System, Payment gateway, Taking Payment Online, Taking payment offline. [TB: Ch.11]
12. User Account Features: User Account Area, Changing Details, Viewing & Managing Orders. [TB: Ch.12]
13. Administration: Dashboard, Managing Products and Categories, Managing Orders, Customers, Refunds, Voucher Codes, Shipping, etc. [TB: Ch.3]
14. Deploying, Security, and Maintenance, SEO. [TB: Ch.14, 15]

**Teaching Methodology:**

Lecturing, 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[TB]
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

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ITEC-4544 Cloud Computing			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	

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

<b>Course Content:</b>
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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: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 [TB]
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

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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](https://www.vmware.com/pdf/virtualization_considerations.pdf)

7. [https://www.researchgate.net/publication/270581440\\_Cloud\\_Federation\\_characterization\\_and\\_conceptual\\_model](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

### ITEC-4546 Internet of Everything

**Credit Hours:** 3(3.0)      **Prerequisites:** CS-3134

#### 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]

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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 Life Cycle, 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:**

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

**IIEC-4441 Data Warehousing**

<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	Database Systems
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**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 warehouse models	C	1
2. Understand the basic principles of designing the Data ware house	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. Introduction to Data Warehousing: Brief History, Characteristics, Architecture, Data Staging and ETL, Multidimensional 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: Ch. 3]

4. User Requirement Analysis: Interviews, Glossary-based Requirement Analysis,
5. Additional Requirements. [TB: Ch. 4]
6. Conceptual Modeling: Dimensional Fact Model, Events and Aggregation, Temporal Aspects, Overlapping Fact Schemata, Formalizing the Dimensional Fact Model. [TB: Ch. 6]
7. Conceptual Design: ER Schema-based Design, Relational Schema-based Design, XML Schema-based Design, Mixed-approach Design. Requirement-driven Approach Design. [TB: Ch. 6]
8. Workload and Data Volume [TB1: Ch. 7]
9. Logical Modeling: MOLAP and HOLAP Systems. ROIAP Systems, Views, Temporal Scenarios. [TB1: Ch. 8]
10. Logical Design: From Fact Schemata to Star Schemata. View Materialization, View Fragmentation. [TB1: Ch. 9]
11. Data-staging Design: Population Reconciled Databases, Cleansing Data, Populating Dimensional Tables, Populating Fact Tables, Populating Materialized View 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
<b>Teaching Methodology:</b>
Lectures, Semester Project, Assignments, Presentations
<b>Course Assessment:</b>
Sessional Exam, Assignments, Quizzes, Project, Presentations. Final Exam
<b>Reference Materials:</b>
1. Data Warehouse Design: Modern Principles and Methodologies by Matteo Golfarelli and Stefano Rizzi, McGraw-Hill Osborne Media; 1st Edition (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 Paulraj Ponniah, Wiley; 2nd Edition (2010). ISBN-10: 0470462078
5. • 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

ITEC-4747 Semantic Web			
Credit Hours:	3 (3,0)	Prerequisites:	
<b>Course Learning Outcomes (CLOs):</b>			
Having successfully completed this course, the student will be able to:		Do-main	BT Level*

1- Understand the concept structure of the Semantic Web technology and how this technology revolutionizes the World Wide Web and its uses.	3
2- Understand the concepts of metadata, semantics of knowledge and resource, ontology, and their descriptions in XML-based syntax and web ontology language (OWL).	3
3- Describe logic semantics and inference with OWL.	3
4- Understand Semantic Web query languages (SPARQL).	2
5- Use ontology engineering approaches in semantic applications.	3
6- Program semantic applications with Java and Jena API.	3

**Course Content:**

- 1- Semantic Web – Introduction and Vision , Structured Web Documents
- 2- XML, RDF, RDF-S, Web Ontology Language
- 3- WL, Ontology Engineering (Protégé) ,Discovering Information
- 4- Querying (SPARQL) Semantic Web Applications (E-learning, Web services)
- 5- Description Logic Reasoning (Fact++); Rules (SWRL) Building Semantic Web Applications (Apache Jena Framework)
- 6- Building Semantic Web Applications
- 7- State-of-the-art in Semantic Web community (Linked data and applications)

**Teaching Methodology:**

Lecturing, Written Assignments, Project,

**Course Assessment:**

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

**Reference Materials:**

- 1.A Semantic Web Primer third edition Grigoris Antoniou, Paul Groth, Frank van Harmelen. Rinke Hoekstra[TB] ISBN:0262018284 9780262018289
2. The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management by Michael C. Daconta Leo J. Obrst and Kevin T. Smith
3. Explorer's Guide to the Semantic Web by Thomas B. Passin

**ITEC-3442 Knowledge Management**

<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None
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**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	C	2

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contemporary debates on knowledge productivity, strategic capability and organizational learning.		
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, 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- Knowledge Capture and Codification: Tacit Knowledge Capture at the Individual, Group, and Organizational Levels, Explicit 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 Manage-

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<p>ment 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]</p> <p>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]</p> <p>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]</p> <p>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]</p> <p>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]</p>
<b>Teaching Methodology:</b>
Lectures, Written Assignments, Presentations
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam
<b>Reference Materials:</b>
<ol style="list-style-type: none"> <li>1. Essentials of Knowledge Management: Concepts, Theories and Practices by M. A. Pasha &amp; S. Pasha, Innovators Knowledge Services (2012). ISBN:978-969-9791-04-8</li> <li>2. Knowledge Management In Theory And Practice by KimizDalkir, The MIT Press; 3rd Edition (March 4, 2011). ISBN-10: 0262015080</li> <li>3. The Knowledge Management Toolkit: Orchestrating IT, Strategy, and Knowledge Platforms by AmritTiwana, Prentice Hall; 2<sup>nd</sup> Edition (August 29, 2002). ISBN-10: 013009224X</li> <li>4. Principles of Knowledge Management: Theory, Practice and Cases by ElieGeisler and NilminiWickramasinghe, M.E.Sharpe (January 15, 2009). ISBN-10: 0765613220</li> <li>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</li> </ol>

ITEC-3541 Network Design and Management			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None

Course Learning Outcomes (CLOs):			
At the end of the course the students will be able to:		<b>Domain</b>	<b>BT Level*</b>
4. Describe the importance of network design top down approach.		C	2
5. Explain the matrices necessary to accomplish best network design.		C	2

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6. <b>Identify</b> various internetworking devices and protocols, and their functions in a network.	C	3
7. <b>Analyze</b> working and performance of key technologies in network design.	C	3
8. <b>Build</b> Computer Network on the base of network design best practices	P	3
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

### Course Content:

1. Analyzing Business Goals and Constraints: Using a Top-Down Network Design Methodology, Analyzing Business Goals, Analyzing Business Constraints. Analyzing Technical Goals and Tradeoffs: Scalability, Availability, Network Performance, Security, Manageability, Usability, Adaptability, Affordability, Making Network Design Tradeoffs. [TB1: Ch. 1, 2]
2. Characterizing the Existing Internetwork: Characterizing the Network Infrastructure. Checking the Health of the Existing Internetwork. Characterizing Network Traffic: Characterizing Traffic Flow, Characterizing Traffic Load, Characterizing Traffic Behavior. Characterizing Quality of Service Requirements. [TB1: Ch. 3, 4]
3. Designing a Network Topology: Hierarchical Network Design, Redundant Network Design Topologies, Modular Network Design, Designing a Campus Network Design Topology, Virtual LANs, Wireless LANs, Redundancy and Load Sharing in Wired LANs, Server Redundancy, Workstation-to-Router Redundancy, Designing the Enterprise Edge Topology. Secure Network Design Topologies. [TB1: Ch. 5]
4. Designing Models for Addressing and Numbering: Guidelines for Assigning Network Layer Addresses, Designing a Model for Naming. [TB1: Ch. 6]
5. Selecting Switching and Routing Protocols: Making Decisions as Part of the Top Down Network Design Process, Selecting Switching Protocols. Selecting Routing Protocols. IP Routing. [TB1: Ch. 7]
6. Developing Network Security Strategies: Network Security Design, Security Mechanisms. Modularizing Security Design, [TB1: Ch. 8]
7. Developing Network Management Strategies: Network Management Design, Network Management Architectures. Selecting Network Management Tools and Protocols. [TB1: Ch. 9]
8. Physical Network Design: Selecting Technologies and Devices for Campus Networks: LAN Cabling Plant Design, LAN Technologies, Selecting Internetworking Devices for a Campus Network Design, Example of a Campus Network Design. [TB1: Ch. 10]
9. Selecting Technologies and Devices for Enterprise Networks: Remote-Access Technologies. Selecting Remote-Access Devices for an Enterprise, WAN Technologies, Example of a WAN Design. [TB1: Ch. 11]
10. Testing Network Design: Using Industry Tests. Building and Testing a Prototype Network System, Writing and Implementing a Test Plan for Network Design, Tools for Testing a Network Design. [TB1: Ch. 12]
11. Optimizing Network Design: Optimizing Bandwidth Usage with IP Multicast Technologies, Reducing Serialization Delay, Optimizing Network Performance to Meet Quality of Service Requirements, Cisco IOS Features for Optimizing Network Performance. Documenting Network Design: Responding to a Customer's Request for Proposal. Contents of a Network Design Document [TB1: Ch. 13, 14].

### Teaching Methodology:

Lectures, Written Assignments, Semester Project, Presentations
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>
<ol style="list-style-type: none"> <li>1. Top-Down Network Design by Priscilla Oppenheimer. Cisco Press; 3rd Edition (September 3, 2010). ISBN-10: 1587202832 (TB1)</li> <li>2. Networking Systems Design and Development by Lee Chao. CRC Press; 1st Edition (December 21, 2009). ISBN-10: 142009159X (TB2)</li> <li>3. Networks: Design and Management by Steven Karris, Orchard Publications (August 2002). ISBN-10: 0970951140</li> <li>4. Network Design: Management and Technical Perspectives by Teresa C. Piliouras and Kornel Terplan, CRC Press (August 19, 1998). ISBN-10: 0849334047</li> </ol>

ITEC-3441 Business Intelligence and Analytics			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	<b>Domain</b>	<b>BT Level*</b>
1. Enhance students' understanding regarding the evolution, need and benefits of business intelligence.	C	2
2. Students will also learn about various technical aspects of BI and understand the processes involving in planning, designing, building and maintaining BI environment.	C	2
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content
<ol style="list-style-type: none"> <li>1. Business Intelligence - An Introduction, Value Drivers, Performance Metrics and Key Performance Indicators, Use Cases for BI. [TB: Ch. 1, 2]</li> <li>2. BI Success Factors. Strategic Versus Tactical Planning. BI Strategy and Plan. [TB: Ch. 3,4]</li> <li>3. BI Environment, BI and Analytics Platform and Strategy, Organizational BI Framework, Services &amp; Systems Evaluation. [TB: Ch. 5]</li> <li>4. Business Process and Information Flow: Information Need &amp; Flow, Information Processing &amp; Information Flow, Information Flow Model. Modeling Frameworks. [TB: Ch. 6]</li> <li>5. Data Requirements Analysis: Business Uses of Information, Metrics: Facts, Qualifiers, and Models, Defining Business Rules, Data Requirement Analysis, Assessing Suitability. [TB: Ch. 7]</li> <li>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: Ch. 8, 9]</li> </ol>

7. Data Profiling: Data Sources, Data Profiling Activities, Data Model Inference, Attribute Analysis, Relationship Analysis, Management Issues. [TB: 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: 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: 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: Ch. 13]
11. Deriving Insight from Data: Customer Profiles, Behavior, and Lifetime Value; Demographics, Psychographics, Geographic; Geographic Data. Behavior Analysis. [TB: Ch. 15, 16]
12. Knowledge Discovery & Delivery: Business Drivers, KD Virtuous Cycle. Direct Versus Unidirectional Knowledge Discovery, Data Mining Activities, Data Mining Techniques. [TB: 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, Scorecards and Dashboards, Geographical Visualizations. Integrated Analysis. [TB: 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, Semester Project, Lab Assignments, Presentations

**Course Assessment:**

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

**Reference Materials:**

1. Business Intelligence by David Loshi, Morgan Kaufmann; 2nd Edition (October 31, 2012). ISBN-10: 0123858895 [TB]
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 Stacia Misner. Microsoft Press (December 22, 2008). ISBN-10: 073562660X

ITEC-442 Data Mining			
<b>Credit Hours:</b>	3(3.0)	<b>Prerequisites:</b>	

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 Hierarchical 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, HITSC 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]
13- 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
14- 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  
15- 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  
Reference Material:
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: 0764599445C

**ITEC-4461 Enterprise Resource Planning**

<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None
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**Course Learning Outcomes (CLOs):**

At the end of the course the students will be able to:	Domain	BT Level*
1. Learn ERP technologies	C	2
2. How to implement ERP processes to business	C	2
3. Auditing ERP	C	2

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

**Course Content:**

1. Introduction to Enterprise Resource Planning Systems. [TB. Ch. 1]
2. ERP Technology. [TB. Ch. 2]
3. ERP and Business Process Reengineering. [TB. Ch. 3]

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4. Systems Diagramming and the Process Map. [TB. Ch. 41]
5. ERP Life Cycle: Planning and Package Selection. [TB. Ch. 5]
6. ERP Life Cycle: Implementation and Operation and Maintenance. [TB. Ch. 6]
7. ERP Sales, CRM and Knowledge Management. [TB. Ch. 7]
8. ERP Financials. [TB. Ch. 8]
9. Human Capital Management, Self-Service and Outsourcing. [TB. Ch. 9]
10. Case studies
<b>Teaching Methodology:</b>
Lectures, Labs, Labs Assignments, Semester Project, Presentations.
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>
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 AartiBatra, I K International Publishing House (February 15, 2010). ISBN-10: 9380578148

ITEC-3542 Network Programming			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	Programming Fundamentals

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	<b>Domain</b>	<b>BT Level*</b>
1: Identify and describe the purpose of each component of the TCP/IP protocol suite	C	4
2: Learn to develop large and complex client-server applications using TCP/IP	C	5
3: Learn socket programming in Linux and Windows environment developing client/server applications using C language	C	4
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
1. Introduction and TCP/IP: A Simple Daytime Client, Protocol Independence, Roadmap to Client/Server [CH.1]
2. BSD Networking, Unix standard, 64-bit Architectures. [Ch. 1]
3. Transport Layer details: UDP, TCP, SCTP, connections, port numbers, buffers etc [Ch. 2]
4. Sockets Introduction and Elementary TCP Sockets : Socket Address Structure, Arguments and Functions [Ch.3]

5. TCP/IP client server Application [Ch. 3]
6. I/O Multiplexing: The SELECT and POLL function with all aspects. [Ch. 6]
7. Socket Options: getsockopt and setsockopt functions, default [Ch. 7]
8. Socket states, generic, IPv4, IPv6, ICMPv6 socket options etc. [Ch. 7]
9. Elementary UDP Sockets: sendto and recvfrom functions. UDP echo server and client. summary of UDP. [Ch. 8]
10. Elementary Name and Address Conversions. [Ch. 9]
11. IPv4 and IPv6 Interoperability. [Ch. 10]
12. Daemon Processes and advanced I/O functions. [Ch. 12, 13]
13. Non-blocking I/O and ioctl operations. [Ch. 15,16]
14. Routing Sockets, Broadcasting, Multicasting. [Ch. 17,18, 19]
15. Threads and Raw Sockets [Ch. 23, 25]
16. Data link Access & Streams [Ch. 26, 33]
<b>Teaching Methodology:</b>
Lectures, Labs, Labs Assignments, Semester Project, Presentations.
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>
1- UNIX Network Programming Volume I by Richard Steven. Prentice Hall; 2nd Edition (September 4, 1998).ISBN-10: 0130810819
2- Windows System Programming by Johnson M. Hart, Addison-Wesley Professional: 4th Edition (February 26, 2010). ISBN-10: 0321657748
3- The Linux Programming Interface: A Linux and UNIX System Programming Hand-book by Michael Kerrisk, No Starch Press: 1st Edition (October 28, 2010). ISBN-10: 1593272200
4- Linux Kernel Development by Robert Love, Addison-Wesley Professional: 3rd Edition (July 2, 2010). ISBN-10: 0672329468
5- System Software: An Introduction to Systems Programming by Leland L. Beck. Addison Wesley, (3rd Edition) (1996). ASIN: B0084YEEWO

<b>ITEC-4444 Information Systems and Audit</b>			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	CMP-3450 (Database Systems)
<b>Course Learning Outcomes (CLOs):</b>			
At the end of the course the students will be able to:		<b>Domain</b>	<b>BT Level*</b>
CLO-1: Understand the concepts and standards related to the discipline of Information System Audit.		C	1
CLO-2: Analyze and Audit Information Systems		C	4
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain			

<b>Course Content:</b>
1. Introduction to Auditing, Assurance and Internal Control: Different Types of Audit, Audit Risks, IT Audit, Role of Audit Committee, Internal Audit Control. [TBI:1]
2. IT Governance and Management: IT Governance Practices for Executives and Boards of Directors, IT Strategic Planning. Policies, Processes, Procedures, and Standards, Risk Man-

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- agement. IT Management Practices. [TB2: Ch. 2]
3. Organization Structure and Responsibilities, Business Continuity Planning, Auditing IT Governance. [TB2: Ch. 2]
  4. The Audit Process: Audit Management, ISACA Auditing Standards, Risk Analysis, [TB2: Ch. 3]
  5. Internal Controls, Performing an Audit, Control Self-Assessment, Implementation of Audit Recommendations [TB2: Ch. 3]
  6. IT Life Cycle Management: Business Realization, Project Management, The Software Development Life Cycle (SDLC). [TB2: Ch. 4]
  7. Infrastructure Development and Implementation, Maintaining Information Systems, Business Processes, Application Controls. [TB2: Ch. 4]
  8. Auditing the Software Development Life Cycle. Auditing Business Controls, Auditing Application Controls. [TB2: Ch. 4]
  9. IT Service Delivery and Infrastructure, Information Systems Operations, Information Systems Hardware, Information Systems Architecture and Software. [TB2: Ch. 5]
  10. Disaster Recovery Planning, Auditing IS Infrastructure and Operations. [TB2: Ch. 5]
  11. Information Asset Protection: Information Security Management, Logical Access Controls. [TB2: Ch. 6]
  12. Network Security Controls, Environmental Controls, Physical Security Controls, Auditing Asset Protection [TB2: Ch. 6]
  13. Over view of Popular Methodologies, Framework and Guidelines [TB2: Appendix B]
  14. Overview of Computer-Assisted Audit Tools and Techniques: Application Controls, Testing Computer Application Controls, Computer- Aided Audit Tools and Techniques for Testing Controls. [TB1: Ch. 7]

**Teaching Methodology:**

Lecturing, Written Assignments, Project, Report Writing

**Course Assessment:**

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

**Reference Materials:**

1. Auditing Information Systems: Enhancing Performance of the Enterprise, Abraham Nyirongo, Trafford, 2015.
2. Information Systems Control and Audit, Ron Weber, Dorling Kindsley Pearson Education, 2014
3. CISA® Certified Information Systems Auditor All-in-One Exam Guide, Peter Gregory, 3rd Edition, McGraw-Hill Education, 2016
4. . Information Systems Auditing and Assurance by James A. Hall and Tommie Singleton. South-Western College Pub; 2nd Edition (July 27, 2004). ISBN-10: 0324191995
5. CISA® Certified Information Systems Auditor All-in-One Exam Guide By: Peter Gregory, McGraw-Hill Osborne Media; 2nd Edition (August 9, 2011). ISBN-10: 0071769102
6. Information Technology Control and Audit, Third Edition by Sandra Senft and Frederick Gallegos, Auerbach Publications; 3rd Edition (2008). ISBN-10: 1420065505
7. Managing the Audit Function: A Corporate Audit Department Procedures Guide by Michael P. Cangemi and Tommie W. Singleton, Wiley; 3rd Edition (2003). ISBN-10:0471281190
8. COBIT 4.1 by IT Governance Institute, ISACA (2007). ISBN-10: 1933284722

### ITEC-4569 Routing And Switching

<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	Computer Network
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#### Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	Domain	BT Level*
1. Understand the switching details and mechanism	C	1
2. Understanding of the architecture and operating principle of router	C	2
3. Operations of wireless LANs, WANs	C	2
4. Solutions and effectiveness of routing protocols and configurations	A	3

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

#### Course Content:

1. Ethernet Basic: Ethernet Layer 1, Ethernet Layer 2, Switching and Bridging Logic, SPAN and RSPAN. [TB: Ch. 1]
2. Virtual LANs and VLAN Trunking: VLANs, VLAN Trunking Protocols, VLAN Trunking: ISL and 802.1Q, Configuring PPPoE. [TB: Ch. 2]
3. Spanning Tree Protocol: 802.1d Spanning Tree Protocol, Optimizing Spanning Tree. Protecting STP, Troubleshooting Complex Layer 2 Issues. [TB: Ch. 3]
4. IP Addressing: IP Addressing & Subnetting, CIDR, Private Addressing, and NAT. [TB: Ch. 4]
5. IP Services: ARP, Proxy ARP, Reverse ARP, BOOTP, and DGCP; HSRP, VRRP, and GLBP; Syslog, Web Cache Communication Protocol, Implementing and Using: IP-SLA, NetFlow, Router IP Traffic Export, FTP, Embedded Event Manager, Remote Monitoring, TFTP Server, Secure Copy Protocol, HTTP and HTTPS Access, Telnet Access, SSH Access. [TB: Ch. 5]
6. IP Forwarding (Routing): IP Forwarding, Multi-layer Switching, Policy Routing, Optimized Edge Routing and Performance Routing. [TB: Ch. 6]
7. EIGRP: Basic States, EIGRP Convergence, EIGRP Configuration, [TB: Ch. 7]
8. OSPF: OSPF Database Exchange, OSPF Design and LSAs, OSPF Configurations, Virtual Link Configuration, Configuring OSPF Authentication, OSPF Stub Router Configuration. [TB: Ch. 8]
9. IGP Routing: Routing Map, Prefix Lists, and Administrative Distance; Router Redistribution, Router Summarization, Default Routes, Troubleshooting Complex Layer 3 Issues. [TB: Ch. 9]
10. Fundamentals of BGP Operations: Building BGP Neighbor Relationships, Building the BGP Table, Building the IP Routing Table. [TB: Ch. 10]
11. BGP Routing Policies: Routing Filtering and Routers Summarization, BGP Path Attributes and the BGP Decision Processes, Configuring BGP Policies. [TB: Ch. 11]
12. Wide Area Network: Point-to-Point Protocol, Frame Relay Concepts, Frame Relay Configuration. [TB: Ch. 15]

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13. IP Multicasting: Need of Multicasting, Multicasting IP Addresses, Managing Distribution of Multicast Traffic with IGMP, LAN Multicast Optimizations. [TB: Ch. 16]
14. IP Multicast Routing: Basic, Dense-Mode Routing Protocols, LAN- Specific Issues with PIM-DM and PIM-SM, Sparse-Mode Routing Protocols. [TB: Ch. 17]
<b>Teaching Methodology:</b>
Lectures, Written Assignments, Semester Project.
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Final Exam
<b>Reference Materials:</b>
1. CCIE Routing and Switching Certification Guide (4th Edition) by Wendell Odom, Rus Healy and Denise Donohue, Cisco Press; 4th Edition
2. Packet Guide to Routing and Switching by Bruce Hartpence. O'Reilly Media (September 3, 2011). ISBN-10: 1449306551
3. CCIE Routing and Switching v4.0 Quick Reference by Brad Ellis, Jacob Uecker and Steven Means, Cisco Press (October 4, 2010). ASIN: B00452V45O

### ITEC-4365 Business Process Management

<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	None
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#### Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	Domain	BT Level*
4. Understand the key Terms and concepts in Business Process Management.	C	2
5. Learn about the major methodologies and techniques for implementing BPM.	C	2
6. Learn what a BPM management and process-centric organization is and how it works.	C	2
7. Understand the metrics and measurements critical to managing processes	C	3
8. 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: 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: 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

<p>Process Data, Modeling Organization, Modeling Operation, Business Process Flexibility, Architecture of Process Execution Environments. [TB: Ch. 3]</p> <p>4. Process Orchestrations: Control Flow Patterns, Petri Nets, Event-driven Process Chains, Workflow Nets, Graph-Based Workflow Language, Business Process Model and Notation. [TB: Ch. 4]</p> <p>5. Process Choreographies: Motivation and Terminology, Development Phases, Process Choreography Design, Process Choreography Implementation, Service Interaction Patterns, Choreography Modeling in BPMN. [TB: Ch. 5]</p> <p>6. Properties of Business Processes: Data Dependencies, Object Lifecycle Conformance, Structural Soundness, Soundness, Relaxed Soundness, Weak Soundness, Lazy Soundness, Soundness Criteria Overview. [TB: Ch. 6]</p> <p>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: Ch. 7]</p> <p>8. Business Process Management Methodology: Dependencies between Processes, Methodology Overview, Phases in Detail. [TB: Ch. 7]</p>
<b>Teaching Methodology:</b>
Lectures, Written Assignments, Presentations
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Presentations, Final Exam
<b>Reference Materials:</b>
<p>1. Business Process Management: Concepts, Languages, Architectures by Mathias Weske, Springer; 2nd Edition (May 3, 2012). ISBN-10: 3642286151. [TB]</p> <p>2. Business Process Management Common Body Of Knowledge by Yvonne LedererAntonucci, et. al., CreateSpace Independent Publishing Platform (March 8, 2009). ISBN-10: 1442105666</p> <p>3. Process Management: A Guide for the Design of Business Processes by Jörg Becker, Martin Kugeler and Michael Rosemann, Springer; 2<sup>nd</sup> Edition (January 21, 2011). ISBN-10: 3642151892</p> <p>4. Business Process Management, Second Edition: Practical Guidelines to Successful Implementations by John Jeston and Johan Nelis, Butterworth-Heinemann; 2<sup>nd</sup> Edition (March 24, 2008). ISBN-10: 0750686561</p> <p>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</p> <p>6. Business Process Management: Practical Guidelines to Successful Implementations by John Jeston &amp; Johan Nelis, Butterworth-Heinemann; 2nd Edition (March 24, 2008). ISBN-10: 0750686561</p> <p>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</p> <p>8. Workflow Modeling: Tools for Process Improvement and Application Development by Alec Sharp and Patrick McDermott, Artech House; 2<sup>nd</sup> Edition (October 31, 2008). ISBN-10: 1596931922</p> <p>9. Process Analysis and Improvement: Tools and Techniques by Seppanen, Marvic S., Kumar, Sameer &amp; Chandra, Charu (2005). McGraw-Hill</p> <p>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; 2<sup>nd</sup> Edition (July 27, 2007). ISBN-10: 0123741521</p>

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ITFC 3810 Artificial Intelligence			
<b>Credit Hours:</b>	3(3,0)	<b>Prerequisites:</b>	

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

<b>Teaching Methodology:</b>
Lectures, Written Assignments, Semester Project, Lab Assignments, Presentations
<b>Course Assessment:</b>
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
<b>Reference Materials:</b>
<ol style="list-style-type: none"> <li>1. Artificial Intelligence: A Modern Approach, by Russell and Norvig, Prentice Hall. 2nd Edition. ISBN-10: 0137903952[TB]</li> <li>2. Artificial Intelligence: A Systems Approach by M. Tim Jones, Jones and Bartlett Publishers, Inc; 1st Edition (December 26, 2008). ISBN-10: 0763773379</li> <li>3. Artificial Intelligence in the 21st Century by Stephen Lucci , Danny Kopec, Mercury Learning and Information (May 18, 2012). ISBN-10: 1936420236</li> </ol>

URCC-5110 Citizenship Education and Community Engagement			
<b>Credit Hours:</b>	Non Credited	<b>Prerequisites:</b>	

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	<b>Domain</b>	<b>BT Level*</b>
1. Introduction to citizen Education	C	1
2. Introduction to community engagement	C	2
* BT= Bloom's Taxonomy, C=Cognitive domain, P=Psychomotor domain, A= Affective domain		

Course Content:
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1. Introduction to Citizenship Education and Community Engagement: Orientation
2. Introduction to Active Citizenship: Overview of the ideas, Concepts, Philosophy and Skills
3. Identity, Culture and Social Harmony: Concepts and Development of Identity
4. Components of Culture and Social Harmony, Cultural & Religious Diversity
5. Multi-cultural society and inter-cultural dialogue: bridging the differences, promoting harmony
6. Significance of diversity and its impact, Importance and domains of inter-cultural harmony
7. Active Citizen: Locally active, globally connected
8. Importance of active citizenship at national and global level
9. Understanding community, Identification of resources (human, natural and others)
10. Human rights, Constitutionalism and citizens' responsibilities: Introduction to human rights
11. Universalism vs relativism, Human rights in constitution of Pakistan
12. Public duties and responsibilities
13. Social Issues in Pakistan: Introduction to the concept of social problem, Causes and solutions
14. Social Issues in Pakistan (Poverty, Equal and Equitable access of resources, unemployment)
15. Social Issues in Pakistan (Agricultural problems, terrorism & militancy, governance issues)
16. Social action and project: Introduction and planning of social action project
17. Identification of problem, Ethical considerations related to project
18. Assessment of existing resources

**Teaching Methodology:**

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

**Course Assessment:**

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

**Reference Materials:**

1. Kennedy, J. K. Brunold, A. (2016). *Regional context and citizenship education in asia and europe*. New York: Routledge Falmer.
2. Macionis, J. J. Gerber, M. L. (2010). *Sociology*. New York: Pearson Education.
3. British, Council. (2017). *Active citizen's social action projects guide*. Scotland: British Council

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