Roadmap of BS (IT) Session 2022-2026

Semester 1			
Sr.No	**Course Code**	**Title**	**Credit Hrs**
1	CIT-301	Introduction to Information & Communication Technologies	3(2-1)
2		Programming Logics	2(2-0)
3	ENG-322	English Composition & Comprehension	3(3-0)
4	MTH-323	Calculus & Analytical Geometry	3(3-0)
5	ISL-321	Islamic Studies	2(2-0)
6	ISL-322	Ethics (For Non-Muslims)	2(2-0)
7		Basic Math-1 (For Pre-Medical students only)	3(3-0)
8		Applied Physics	3(3-0)
Total			**21(20-1)**
Semester 2			
Sr.No	**Course Code**	**Title**	**Credit Hrs**
1	CSI-301	Programming Fundamental	4(3-1)
		Technical and Business Writing	3(3-0)
2		Linear Algebra	3(3-0)
3	CSI-405	Discrete Structures	3(3-0)
4	PST-321	Pakistan Studies	2(2-0)
5	CSI-503	Database Systems	4(3-1)
		Basic Math-2 (For Pre-Medical students only)	3(3-0)
Total			**22(20-2)**
Semester 3			
Sr.No	**Course Code**	**Title**	**Credit Hrs**
1	CSI-302	Object Oriented Programming	4(3-1)
2	CSI-512	Computer Networks	4(3-1)
3	CIT-406	Web Technologies	3(2-1)
4	STA-321	Probability & Statistics	3(3-0)
5		Communication and Presentation Skills	3(3-0)
Total			**17(14-3)**
Semester 4			
Sr.No	**Course Code**	**Title**	**Credit Hrs**
1	CSI-402	Operating Systems	4(3-1)

2	CSI-401	Data Structure & Algorithms	4(3-1)
3	CIT-408	Visual Programming	3(2-1)
4	CSI-619	Information Security	3(3-0)
5	SWE-401	Introduction to Software Engineering	3(3-0)
Total			**17(14-3)**

Semester-5			
Sr.No	**C. Code**	**Course Title**	**Cr. Hr**
1	CIT-505	System and Network Administration	3(2-1)
2	CIT-502	Information Technology Infrastructure	3(3-0)
3	CIT-504	Database Administration and Management	4(3-1)
4		University Elective-1	3
5		IT Elective-1	3
Total			**16(14-2)**

Semester-6			
Sr.No	**C. Code**	**Course Title**	**Cr. Hr**
1	CIT-601	Virtual Systems and Services	4(3-1)
2	SWE-501	Software Requirement Engineering	3(3-0)
3		Formal Methods/Operation Research/Enterprise Systems	3(3-0)
4		University Elective-2	3
5		IT Elective-2	3
6		IT Elective-3	3
Total			**19 (18-1)**

Semester-7			
Sr.No	**C. Code**	**Course Title**	**Cr. Hr**
1	CIT-603	Modeling and Simulation	3(2-1)
2		IT Elective-4	3
3		IT Elective-5	3
4		IT Project Management	3(3-0)
5		University Elective-3	3
6		Final Year Project (Proposal Defense Seminar)	1(0-1)
Total			**16(14-2)**

Semester-8			
Sr.No	**C. Code**	**Course Title**	**Cr. Hr**
1	CIT-631	Final Year Project	5(0-5)
2	CIT-604	Cyber Security	3(3-0)
3	CSI-407	Professional Practices	3(3-0)
Total			**11(6-5)**

Total Credit Hours: 139

Semester 1			
Sr.No	**Course Code**	**Title**	**Credit Hrs**
1	CIT-301	Introduction to Information & Communication Technologies	3(2-1)
2		Programming Logics	2(2-0)
3	ENG-322	English Composition & Comprehension	3(3-0)
4	MTH-323	Calculus & Analytical Geometry	3(3-0)
5	ISL-321	Islamic Studies	2(2-0)
6	ISL-322	Ethics (For Non-Muslims)	2(2-0)
7		Basic Math-1 (For Pre-Medical students only)	3(3-0)
8		Applied Physics	3(3-0)
Total			**21(20-1)**

Course out Line

Course Name:

Introduction to Information and Communication Technologies Course Structure: Lectures: 2 / Labs: 3
Credit Hours: 3

Prerequisites: None (first semester course)

Objectives: This course focuses on a breadth-first coverage of the use of computing and communication technologies to solve real life problems; including computing environments, general application software like word processing, visual presentation applications, tabular data manipulation, DBMS, WWW, Email management systems, Virus, Anti-Virus and Spam Protection; Introduction to the basic computing hardware (main building blocks), operating systems, data networks; software engineering and communication technology along with social and ethical issues. An introduction of the program of study in computing for which this course is being taught (CS, IT, SE etc.). The course attempts to provide every student a set of productivity tools that they will be able to use for the rest of their lives.

Course Outline:

Number Systems, Binary numbers, Boolean logic, History computer system, basic machine organization, Von Neumann Architecture, Algorithm definition, design, and implementation, Programming paradigms and languages, Graphical programming, Overview of Software Engineering and Information Communication Technology, Operating system, Compiler, DBMS, Computer networks and internet, WWW, web mail applications, Computer graphics, AI, Viruses and Anti-Viruses, Use of office productivity tools, such as word processors, spreadsheets, presentation applications, etc., Social, Ethical, Professional and Legal Issues, and overview of the complete program of studies in computing and its structure.

Suggested Text Book:

1. Introduction to Computers by Peter Norton, 6th Edition, McGraw-Hill SiE, ISBN 0-07-059374-4.
Reference Material: 1. Computers: Information Technology in Perspective, 9/e by Larry Long and Nancy Long, Prentice Hall, 2002/ISBN: 0130929891.

Link

https://onlinestudy4u.files.wordpress.com/2012/10/introduction-to-computers-by-peter-norton-6th-ed.pdf

2. An Invitation to Computer Science, Schneider and Gersting, Brooks/Cole Thomson Learning, 2000.

3. Information System Today by Leonard Jessup, Joseph Valacich.

4. Computers Today by Suresh K. Basandra.

5. Computer Science: An overview of Computer Science, Sherer.

Programming Logics:

English Composition & Comprehension

Calculus & Analytical Geometry

Islamic Studies

Ethics (For Non-Muslims)

Basic Math-1 (For Pre-Medical students only)

Applied Physics

Semester 2			
Sr.No	Course Code	Title	Credit Hrs
1	CSI-301	Programming Fundamental	4(3-1)
		Technical and Business Writing	3(3-0)
2		Linear Algebra	3(3-0)
3	CSI-405	Discrete Structures	3(3-0)
4	PST-321	Pakistan Studies	2(2-0)
5	CSI-503	Database Systems	4(3-1)
		Basic Math-2 (For Pre-Medical students only)	3(3-0)
Total			**22(20-2)**

Programming Fundamentals:
Course Name: **Programming Fundamentals**
Credit Hours: 4 (3+1)
Prerequisites**: None**
Course Outline:
This course covers overview of Computer Programming, Principles of

Structured and Modular Programming, Overview of Structured Programming Languages, Algorithms and Problem Solving, Program Development: Analyzing Problem, Designing Algorithm/Solution, Testing Designed Solution, Translating Algorithms into Programs, Fundamental Programming Constructs, Data Types. Basics of Input and Output, Selection and Decision (If, If-Else, Nested If-Else, Switch Statement and Condition Operator), Repetition (While and For Loop, Do-While Loops), Break Statement, Continue Statement, Control Structures, Functions, Arrays, Pointers, Records, Files (Input-Output), Testing & Debugging.

Reference Materials:

1. *C How to Program* by Paul Deitel and Harvey Deitel, Prentice Hall; 7 edition (March 4, 2012). ISBN-10: 013299044X
2. *Programming in C* by Stephen G. Kochan, Addison-Wesley Professional; 4 edition (September 25, 2013). ISBN-10: 0321776410
3. *Java How to Program* by Paul Deitel and Harvey Deitel, Prentice Hall; 9th edition (March, 2011)
4. *C++ How to Program* by Paul Deitel and Harvey Deitel, Prentice Hall; 9th edition (February, 2013)

Discrete Structures:

Course Name: **Discrete Structures**
Credit Hours: 3
Prerequisites: None

Course Outline:

Mathematical reasoning: introduction to logic, propositional and predicate calculus; negation disjunction and conjunction; implication and equivalence; truth tables; predicates; quantifiers; natural deduction; rules of Inference; methods of proofs; use in program proving; resolution principle; Set theory: Paradoxes in set theory; inductive definition of sets and proof by induction; Relations, representation of relations by graphs; properties of relations, equivalence relations and partitions; Partial orderings; Linear and wellordered sets; Functions: mappings, injection and surjection, composition of functions; inverse functions; special functions; Peano postulates; Recursive

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function theory; Elementary combinatorics; counting techniques; recurrence relation; generating functions.
Graph Theory: elements of graph theory, Planar Graphs, Graph Colouring, Euler graph, Hamiltonian path, trees and their applications.

Reference Materials:

1. *Discrete Mathematical Structure with Application to Computer Science*, J. P. Temblay and B Manohar, McGraw-Hill, 2nd Edition.
2. *Discrete Mathematics,* 7th edition, Richard Johnson Baugh, 2008, Prentice Hall Publishers.

3. *Discrete Mathematics and Its Applications,* 6th edition, Kenneth H. Rosen, 2006, McGraw-Hill Book Co.

4. *Discrete Mathematical Structures, 4th edition*, Kolman, Busby & Ross, 2000, Prentice-Hall Publishers.

5. *Discrete and Combinatorial Mathematics: An Applied Introduction,* Ralph P. Grimaldi, Addison-Wesley Pub. Co., 1985.

6. *Logic and Discrete Mathematics: A Computer Science Perspective* by Winifred Grassman, Jean-Paul Tremblay, Winifred Grassman, Prentice Hall, 1995

Database Systems

Course Name: **Database Systems**

Credit Hours: 4 (3+1)

Prerequisites: **Programming Fundamentals**

Course Outline:

Basic Database Concepts, Database Architecture, DB Design Life Cycle, Schema Architecture, Conceptual, Logical and Physical Database Modelling and Design, , Entity Relationship Diagram (ERD), Enhanced ERD, Relational Data Model, Mapping ERD to Relational Model, Functional Dependencies and Normalization, Relational Algebra, Structured Query Language (SQL), Transaction Processing, Concurrency Control And Recovery Techniques, Query Optimization Concepts.

Reference Materials:

1. *Database Systems A Practical Approach to Design, Implementation, and Management*, Thomas Connolly and Carolyn Begg, Prentice Hall; 7th edition (March 10, 2011)

2. *Modern Database Management* by Fred McFadden, Jeffrey Hoofer, Mary Prescott, Prentice Hall; 11th Edition (July 26, 2012). ISBN-10: 0132662256

3. *Fundamentals of Database Systems* by R. Elmasri and S. Navathe. 6th Edition, Addison-Wesley (2010). ISBN-10: 0136086209.

4. *Database Design and Relational Theory: Normal Forms and All That Jazz* by C. J. Date, O'Reilly Media; 1st Edition (April 24, 2012). ISBN-10: 1449328016.

5. *Modern Database Management* by Fred McFadden, Jeffrey Hoofer, Mary Prescott, Prentice Hall; 11th Edition (July 26, 2012). ISBN-10: 0132662256

Technical and Business Writing

Linear Algebra

Pakistan Studies

Basic Math-2 (For Pre-Medical students only)

Semester 3			
Sr.No	**Course Code**	**Title**	**Credit Hrs**
1	CSI-302	Object Oriented Programming	4(3-1)
2	CSI-512	Computer Networks	4(3-1)
3	CIT-406	Web Technologies	3(2-1)
4	STA-321	Probability & Statistics	3(3-0)
5		Communication and Presentation Skills	3(3-0)
Total			**17(14-3)**

Object Oriented Programming:

Course Name: **Object Oriented Programming**

Credit Hours: **3**

Prerequisites: **Programming Fundamentals**

Course Outline:

Evolution of Object Oriented Programming (OOP), Object Oriented concepts and principles, problem solving in Object Oriented paradigm, OOP design process, classes, functions/methods, objects and encapsulation; constructors and destructors, operator and function/method overloading, association, aggregation, composition, generalization, inheritance and its types, derived classes, function/method overriding, abstract and concrete classes, virtual functions, polymorphism, exception handling.

Reference Materials:

1. *Java: How to Programme,* Harvey M. Deitel and Paul J. Deitel, Prentice Hall; 8 edition (March 27, 2009). ISBN-10: 0136053068
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2. *C++: How to Programme*, Prentice Hall; 8 edition (March 25, 2011). ISBN-10: 0132662361
3. *Object Oriented Programming in C++* by Robert Lafore, Sams Publishing; 4 edition (December 29, 2001). ISBN-10: 0672323087
4. J*ava Programming: From the Ground Up* by Ralph Bravaco and Shai Simonson, McGraw-Hill Higher Education New York, 2010, ISBN 978–0–07–352335–4
5. *Beginning Java by Ivor Horton*, John Wiley & Sons, Inc, 7th Edition, 2011, ISBN: 978-0-470-40414-0

Course Name: **Computer Networks**

Credit Hours: 3

Prerequisites: None

Course Outline:

Data Communication concepts, Analogue and digital Transmission, Noise, Media, Encoding, Asynchronous and Synchronous transmission. Network

system architectures (OSI, TCP/IP), Error Control, Flow Control, Data Link Protocols, Bridging. Local Area Networks and MAC Layer protocols, Multiplexing, Switched and IP Networks, Inter-networking, Routing. Transport layer protocols TCP, UDP and SCTP. Application Layer Protocols. Wireless LANs.

Lab exercises using tools such as Wireshark, OpNet, Packet tracer etc.

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Reference Materials:

1. *Data Communications and Networking*, by Behrouz A. Forouzan, McGraw-Hill Science; 5th edition (February 17, 2012). ISBN-10: 0073376221
2. *Data and Computer Communications* by William Stallings, Prentice Hall; 9th Edition (August 13, 2010). ISBN-10: 0131392050
3. *Computer Networks* by Andrew S. Tanenbaum and David J. Wetherall, Prentice Hall; 5th Edition (October 7, 2010). ISBN-10: 0132126958
4. *Computer Networks and Internets* by Douglas E. Comer, Prentice Hall; 5th Edition (April 28, 2008). ISBN-10: 0136066984

Course Name: **Web Technologies**
Credit Hours: 3*
Prerequisites: Database Systems
Course Outline:
Introduction to Web Applications, TCP/IP Application Services. Web Servers: Basic Operation, Virtual hosting, Chunked transfers, Caching support, Extensibility. SGML, HTML5, CSS3. XML Languages and Applications: Core XML, XHTML, XHTM MP. Web Service: SOAP, REST, WML, XSL. Web Services: Operations, Processing HTTP Requests, Processing HTTP Responses, Cooki Coordination, Privacy and P3P, Complex HTTP Interactions, Dynamic Content Delivery. Server Configuration. Server Security. Web Browsers Architecture and Processes. Active Browser Pages: JavaScript, DHTML, AJAX. JSON, Approaches to Web Application Development. Programing in any Scripting language. Search Technologies. Search Engine Optimization. XML Query Language, Semantic Web, Future Web Application Framework.
Reference Materials:
1. *Web Application Architecture: Principles, protocols and practices* by Leon Shklar and Richard Rosen, Wiley; 2nd Edition (May 5, 2009). ISBN-10: 047051860X
2. *Web Technologies: A Computer Science Perspective* by Jeffrey C. Jackson, Prentice Hall; 1st Edition (August 27, 2006). ISBN-10: 0131856030

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3. *Web Technologies* by Uttam Kumar Roy, Oxford University Press, USA (June 13, 2011). ISBN-10: 0198066228

Probability & Statistics

Communication and Presentation Skills

Semester 4			
Sr.No	**Course Code**	**Title**	**Credit Hrs**
1	CSI-402	Operating Systems	4(3-1)
2	CSI-401	Data Structure & Algorithms	4(3-1)
3	CIT-408	Visual Programming	3(2-1)
4	CSI-619	Information Security	3(3-0)
5	SWE-401	Introduction to Software Engineering	3(3-0)
Total			**17(14-3)**

Course Name: Operating Systems
Credit Hours: 4 (3+1)
Prerequisites: Programming Fundamentals
Course Outline:
History and Goals, Evolution of multi-user systems. Introduction to the techniques used to implement operating systems and related kinds of systems software. Among the topics covered will be process management (creation, synchronization, and communication); Multi-Threading, processor scheduling; deadlock prevention, avoidance, and recovery; main-memory management; virtual memory management (swapping, paging, segmentation and page-replacement algorithms); control of disks and other input/output devices; file-system structure and implementation; and protection and security. Lab assignments involving different single and multithreaded OS algorithms.
Reference Materials:
1. Operating System Concepts, 9th Edition, Silberschatz A., Peterson, J. L., & Galvin P. C. 2012.
2. Modern Operating Systems, 3rd Edition, Tanenmaum A. S., 2008.

. **Data Structure and Algorithms**
Course Name: **Data Structure and Algorithms**
Credit Hours: 4 (3+1)
Prerequisites**: Discrete Structures**
Course Outline:

Introduction to Data Structures and Algorithms. Complexity Analysis. Arrays. Sorting Algorithms: Insertion Sort, Selection Sort, Bubble Sort, Shell Sort, Heap Sort, Quick Sort, Merge Sort, Radix Sort, Bucket Sort. Linked Lists: Singly Linked Lists, Doubly Linked Lists, Circular List. Stacks, Queues, and Priority Queue. Recursion: Function call and Recursion Implementation, Tail Recursion, Non-tail Recursion, Indirect Recursion, Nested Recursion, Backtracking. Trees: Binary Trees, Binary Heap, Binary Search. Tree Traversal, Insertion, Deletion, and Balancing a Tree. Heap. B-Tree, B+Tree, Spanning Tree, Splay Trees. Graphs: Representation, Treversal, Shortest Path, and Cycle Detection; Isomorphic Graphs. Graph Traversal Algorithms. Hashing. Memory Management and Garbage Collection.

Reference Materials:

1. *Data Structures & Problem Solving Using Java* by Mark Allen Weiss, Addison-Wesley, 4th Edition (October 7, 2009). ISBN-10: 0321541405 (or Latest Edition)

2. *Algorithms*, Robert Sedgewick, Princeton University Publisher: Addison-Wesley Professional (latest Edition)

3. *Data Structures: Abstraction and Design Using Java* by Koffman and Wolfgang, Wiley; 2nd Edition (January 26, 2010). ISBN-10: 0470128704 128

4. *Data Structures and Algorithms in C++* by Adam Drozdek, Course Technology; 4th Edition (August 27, 2012). ISBN-10: 1133608426

5. *Data Structures Using C++* by D. S. Malik, Course Technology; 2nd Edition (July 31, 2009). ISBN-10: 0324782012

6. *Data Structures and Other Objects Using C++* by Michael Main and Walter Savitch, Prentice Hall; 4th Edition (March 6, 2010). ISBN-10:

Course Name: **Introduction to Software Engineering**
Credit Hours: 3
Prerequisites: Data Structures and Algorithms

Course Outline:

Overview of SE, Practice & Myths; the Software Processes, Generic Process Models: Framework Activity, Task Set, Process Patterns, Process Improvement, CMM Prescriptive, Process Models: Waterfall Model, Incremental Process Model, Evolutionary Process Model; Specialized Process Models: Component Based Development, the Formal Methods Models, Agile Development; Business Information Systems: Components, Types, and Evaluating methods. SDLC: Phases, System Planning, Preliminary Investigation, SWOT Analysis. The Importance of Strategic Planning; Evaluation of Systems Requests, Requirements Engineering. Difference between Structured Analysis and Object Oriented Analysis, Difference between FDD Diagrams & UML Diagrams; Data & Process Modelling; Diagrams: Data Flow, Context, Conventions, Detailed Level DFD's; Levelling and Balancing. Logical Versus Physical Models. The Design

Process; Architecture Design Elements, Interface Design Elements, Component-Level Design Elements, Deployments Design Elements; System Architecture, Architectural Styles. User Interface Design. WebApps Interface Design; Software Quality Assurance. Validation Testing, System Testing; Internal and External View of Testing. Project Management. Risk Management; Maintenance and Reengineering.

Reference Materials:

1. *Software Engineering* 8E by Ian Sommerville, Addison Wesley; 8th Edition (2006). ISBN-10: 0321313798

2. *Systems Analysis and Design* by Gary B. Shelly, Thomas J. Cashman and Harry J. Rosenblatt, Course Technology; 7th Edition (2007). ISBN-10: 1423912225

3. *Software Engineering: A Practitioner's Approach by Roger S. Pressman*, McGraw-Hill Science/Engineering/Math; 7th Edition (2009). ISBN-10:

Visual Programming

Credit Hours:	3(2-1)	**Prerequisites:**	Object Oriented Programming

Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	**Domain**	**BT Level***
	C	1
1. Use the different elements of a visual programming language as building blocks to develop correct, coherent programs.	C	3
	C	4
2. Program using the fundamental software development process, including design, coding, documentation, testing, and debugging.		
3. Analyze problems, develop conceptual designs that solve those problems, and transform those designs to Visual Programs.		

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

Course Content:

Visual Programming Basics; Introduction to Events; Fundamentals of Event-driven Programming, message handling, user interfaces, graphics device interface, painting and drawing, windows management, input devices, resources, string and menu resource, dialogs and windows controls, common controls, dynamic link libraries, threads and synchronization, network programming, Building Class Libraries at the Command Line, Class Libraries, Using References, Assemblies, Private Assembly Deployment, Shared Assembly Deployment, Configuration Overview, Configuration Files, Programmatic Access to Configuration, Using SDK Tools for Signing and Deployment, Metadata, Reflection, Late Binding, Directories, Files, Serialization, Attributes, Memory Management and Garbage Collection, Threading and Synchronization, Asynchronous Delegates, Application Domains, Marshal by Value, Marshal by Reference, Authentication and Authorization, Configuring Security, Code Access Security, Code Groups, Evidence, Permissions, Role-Based Security, Principals and Identities, Using Data Readers, Using Data Sets, Interacting with XML Data, Tracing Event Logs, Using the Boolean Switch and Trace Switch Classes, Print Debugging Information with the Debug Class, Instrumenting Release Builds with the Trace Class, Using Listeners, and Implementing Custom Listeners.

Teaching Methodology:

Lecturing, Written Assignments, Project, Report Writing

Course Assessment:

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

Reference Materials:

1. Visual C#: How to Program, Deitel and Deitel, 6/e Edition, Prentice Hall / Pearson Education, 2017.
2. Programming in C# .NET, J.C. Bradley, A.C. Millspaugh, McGraw-Hill, 2014
3. Microsoft Visual C# 2013 Step by Step (Step by Step Developer), Sharp, J., 1st Edition (2013), Microsoft Press.

Course Name: Information Security
Credit Hours: 3
Prerequisites: Data Communication and Computer Networks

Course Outline:

Basic notions of confidentiality, integrity, availability; authentication models; protection models; security kernels; Encryption, Hashing and Digital
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Signatures; audit; intrusion detection and response; database security, hostbased
and network-based security issues operational security issues;
physical security issues; personnel security; policy formation and

enforcement; access controls; information flow; legal and social issues; identification and authentication in local and distributed systems; classification and trust modeling; risk assessment

Reference Materials:

1. *Computer Security: Art and Science*, Matthew Bishop
2. *Cryptography and Network Security* by William Stalling 6th Edition, 2012
3. *Principles of Information Security* 3rd E by Michael E. Whitman and Herbert J. Mattord

Semester-5			
Sr.No	C. Code	Course Title	Cr. Hr
1	CIT-505	System and Network Administration	3(2-1)
2	CIT-502	Information Technology Infrastructure	3(3-0)
3	CIT-504	Database Administration and Management	4(3-1)
4		University Elective-1	3
5		IT Elective-1	3
Total			**16(14-2)**

Course Name: Systems and Network Administration
Credit Hours: 3
Prerequisites: Computer Communication and Networks, Operating Systems

Course Outline:

Introduction To System Administration. SA Components. Server Environment (Microsoft and Linux). Reliable Products, Server Hardware Costing, Maintenance Contracts and Spare Parts, Maintaining Data Integrity, Client Server OS Configuration, Providing Remote Console Access. Comparative Analysis of OS: Important Attributes, Key Features, Pros and Cons. Linux Installation and Verification, Configuring Local Services and Managing Basic System Issues. Administer Users and Groups. Software Management. Managing Network Services and Network Monitoring Tools. Boot
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Management and Process Management. IP Tables and Filtering. Securing Network Traffic. Advanced File Systems and Logs. Bash Shell Scripting. Configuring Servers (FTP, NFS, Samba, DHCP, DNS and Apache).

Reference Materials:

1. *The Practice of System and Network Administration*, Second Edition by Thomas Limoncelli, Christina Hogan and Strata Chalup, Addison-Wesley Professional; 2nd Edition (2007). ISBN-10: 0321492668
2. *Red Hat Enterprise Linux 6 Bible: Administering Enterprise Linux Systems*

by William vonHagen, 2011
3. *Studyguide for Practice of System and Network Administration* by Thomas A. Limoncelli, Cram101; 2nd Edition (2011). ISBN-10: 1428851755
4. *Networking Systems Design and Development* by Lee Chao, CRC Press; 1st Edition (December 21, 2009). ISBN-10: 142009159X (TB2)
5. *Windows Administration* Latest Edition, Microsoft Press
6. *Linux Administration* Guide Latest Edition

Course Name: Database Administration & Management
Credit Hours: 3
Prerequisites: Database Systems
Course Outline:
Installation of DBMS; SQL* Plus; DBA Tools. DBMS Physical Structure & Architectural Components: Server, Instance, SGA, Shared Pool, Library Cache, Data Dictionary Cache, Large Pool, Processes. Startup and Shutdown Database. Managing Instances. Managing Files. Creating Database and Data dictionary. Managing Tablespaces. Operations with Tablespaces. Data File Management, Segments, Block. Managing Undo Data, Undo Data Statistics: Managing Tables and Users. Indexes Management, Maintaining Data Integrity, Constraints. Managing Privileges. Server Side Configuration. Client Side Configuration. Usage and Configuration of Oracle Shared Server. Backup and Recovery. Sizing Shared
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Pool, Sizing Buffer Cache, I/O Issues. Tuning Rollback Segments. Tuning Shared Servers, Types of Locks, Block Efficiency, Storage hierarchy, Avoiding Dynamic allocation, Statistics, PCTFREE and PCTUSED, Monitoring Index Usage.
Reference Materials:
1. *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
2. *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
3. *Online Material* URL http://www.oracle.com/technetwork/index.html (this should be avoided)

Course Name: Information Technology Infrastructure
Credit Hours: 3
Prerequisites: Computer Communication and Networks
Course Outline:
Definition of IT Infrastructure, Non-functional Attributes, Availability Concepts, Sources of Unavailability, Availability Patterns. Performance. Security Concepts. Data centres. Servers: Availability, Performance, Security.

Networking: Building Blocks, Availability, Performance, Security. Storage: Availability, Performance, Security. Virtualization: Availability, Performance, Security. Operating Systems: Building Blocks, Implementing Various OSs, OS availability, OS Performance, OS Security. End User Devises: Building Blocks, Device Availability, Performance, Security. IT Infrastructure Management. Service Delivery Processes. Service Support Processes. Ethics, Trends, organizational and technical issues related to IT infrastructure.

Reference Materials:

1. *IT Infrastructure Architecture: Infrastructure building blocks and concepts* by Sjaak Laan, Lulu.com (November 5, 2011). ISBN-10: 1447881281
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

Semester-6			
Sr.No	C. Code	Course Title	Cr. Hr
1	CIT-601	Virtual Systems and Services	4(3-1)
2	SWE-501	Software Requirement Engineering	3(3-0)
3		Formal Methods/Operation Research/Enterprise Systems	3(3-0)
4		University Elective-2	3
5		IT Elective-2	3
6		IT Elective-3	3
Total			**19 (18-1)**

Virtual Systems and Services:

Credit Hours: 4(3-1)   **Prerequisites:**   Programming Fundamentals

Course Content:

This course will investigate the current state of virtualization in computing systems. Virtualization at both the hardware and software levels will be examined, with emphasis on the hypervisor configurations of systems such as Vmware, Zen and Hyper-V. The features and limitations of virtual environments will be considered, along with several case studies used to demonstrate the configuration and management of such systems. Para-virtualized software components will be analyzed and their pros and cons discussed. Processor and peripheral support for virtualization will also be examined, with a focus on emerging hardware features and the future of virtualization.

Reference Materials:

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

Human Computer Interaction

Credit Hours:	3 (3,0)	**Prerequisites:**	Software Engineering

Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	**Domain**	**BT Level***
	C	2
	C	3
1. Explain context of HCI and different measures for evaluation.	C	4
	C	5
2. Apply the principles of good design for people from the perspective of age and disabilities.		
3. Analyze techniques for user centered design for a medium sized software.		
4. Evaluate the usability of a medium size software user interface.		

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

Course Content:

Contexts for HCI, Psychology of usable things, Processes for User-Centered Design, Metrics and Measures for Evaluation, Usability heuristics and principles of Usability testing, Physical capabilities, Cognitive and social models for interaction design, Principles of good interaction design, Accessibility, Principles of GUI, Visual design elements, Data gathering, Task analysis, Prototyping, Help and user documentation,

Internationalization, Usability inspection methods, Usability testing methods, New Interaction Technologies, Usability in practice, Visual Design and Typography, Icon Design, Ubiquitous, Augmented and Virtual Reality.

Teaching Methodology:
Lecturing, Written Assignments, Project, Report Writing
Course Assessment:
Sessional Exam, Home Assignments, Quizzes, Project, Presentations, Final Exam
Reference Materials:

1. Designing the User Interface: Strategies for Effective Human-Computer Interaction, Ben Shneiderman and Catherine Plaisant, 6th Ed, Pearson Inc, 2016.
2. Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design, Benyon, D. 3rd Ed., Pearson. 2013
3. About Face: The Essentials of Interaction Design, Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, 4th Ed, Wiley, 2014

Course Name: **Software Requirements Engineering**
Credit Hours: 3
Prerequisites: **Introduction to Software Engineering**
Course Outline:
Definition of Requirements Engineering and role in system development, Fundamental concepts and activities of Requirements Engineering, Information elicitation techniques, Modeling scenarios.
Fundamentals of goal-oriented Requirements Engineering, Modelling behavioural goals, Modelling quality goals, Goal modelling heuristics, Object modelling for Requirements Engineering, Object modelling notations, Object modelling heuristics, Identifying objects from goals, Modelling Use Cases and state machines, Deriving operational requirements from goals, Requirements Specification, Requirements verification and validation.
Management of inconsistency and conflict, Techniques for requirements evaluation, selection and prioritization; Requirements management; Requirements traceability
Reference Materials:
1. *Requirements Engineering: Processes and Techniques,* Gerald Kotonya and Sommerville, John-Wiley Sons, 1998 (or Latest Edition).
2. *Software Requirements*, Karl E. Wiegers, Microsoft Press, 2003(or Latest Edition).
3. *Software Requirements Specification*, David Tuffley, CreateSpace Independent Publishing Platform, 2010 (or Latest Edition).
4. *System Requirements Engineering,* Loucopoulos and Karakostas, McGraw-Hill, 1995 (or Latest Edition).

Operation Research:

Course Name: **Operations Research**
Credit Hours: 3
Prerequisites: **Probability and Statistics**

Course Outline:

Introduction to mathematical modeling. Linear program models, simplex method for solving LP models, sensitivity analysis, other solution techniques for LP models, specialized LP models (transport, assignment, etc.). Network based models, shortest path, min weight spanning tree, max flow, PERT/CPM. Decision models, dynamic programming, games theory. Probabilistic models, expected return models, Markov chains, stochastic processes, queuing models, stochastic inventory models.

Sample labs and assignments:

Given a scenario, select and develop an appropriate model, solve it for the given parameters, and analyze the sensitivity of the solution to changes in the problem parameters.

Reference Materials:

1. *Operations Research: An Introduction,* Hamdi A. Taha, *(8/e), (*2006) or Latest Edition
2. *Introduction to Operations Research, F.S.* Hillier, and G. J. Leibermann, (8/e), (2005) or Latest Edition

Semester-7			
Sr.No	**C. Code**	**Course Title**	**Cr. Hr**
1	CIT-603	Modeling and Simulation	3(2-1)
2		IT Elective-4	3
3		IT Elective-5	3
4		IT Project Management	3(3-0)
5		University Elective-3	3
6		Final Year Project (Proposal Defense Seminar)	1(0-1)
Total			**16(14-2)**

Simulation and Modeling
Credit Hours: 3 (2-1)   **Prerequisites:**
Course Learning Outcomes (CLOs):

At the end of the course the students will be able to:	**Domain**	**BT Level***

CLO	BT*	PLO
	C	1
1. Explain the model classification at different levels.	C	3
	C	4
	C	4
2. Analyze complex engineering systems and associated issues (using systems thinking and modelling techniques)		
3. Apply advanced theory-based understanding of engineering fundamentals and specialist bodies of knowledge in the selected discipline area to predict the effect of engineering activities.		
4. Analyze the simulation results of a medium sized engineering problem.		

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

Course Content:

Introduction to modelling and simulation, System analysis, Classification of systems, System theory basics, its relation to simulation, Model classification at conceptual, abstract, and simulation models levels, Methodology of model building, Simulation systems and languages, Means for model and experiment description, Principles of simulation system design, Parallel process modeling using Petri nets and finite automata in simulation, Models of queuing systems, Discrete simulation models, Model time, Simulation experiment control, Overview of numerical methods used for continuous simulation. System Dymola/ Modelica, Combined simulation, Special model classes, Models of heterogeneous systems, Cellular automata and simulation, Checking model validity, Verification of models, Analysis of simulation results, simulation results visualization, model optimization, generating, transformation, and testing of pseudorandom numbers with overview of commonly used simulation systems.

Teaching Methodology:

Lecturing, Written Assignments, Project, Report Writing

Course Assessment:

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

Reference Materials:

1. Modeling and Simulation, Bungartz, H.-J., Zimmer, S., Buchholz, M., Pflüger, D., Springer-Verlag, 2014.
2. Simulation Modeling Handbook, A Practical Approach, Christopher A. Chung, CRC Press, 2004.
3. System design, modeling and simulation using Ptolemy II, Claudius Ptolemaeus, , Ver 2.0, Creative Commons Attribution-ShareAlike 3.0 Unported, 2014
4. Applied Simulation Modeling, Andrew F. Seila, Vlatko Ceric, Pandu Tadikamalla, Thomson Learning Inc., 2003.

Course Name: Information Technology Project Management
Credit Hours: 3
Prerequisites: Software Engineering, Technology Management
Course Outline:
Introduction to Project Management. The Project Management and Information Technology Context. The Project Management Process Groups. Project Integration Management. Project Scope Management. Project Time Management. Project Cost Management. Project Quality Management. Project Human Resource Management. Project Communications Management. Project Risk Management. Project Procurement Management. Project Management Tools.
Reference Materials:
1. *Information Technology Project Management* by Kathy Schwalbe, Course Technology; 6th Edition (July 22, 2010). ISBN-10: 1111221758
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2. *A Guide to the Project Management Body of Knowledge*, 3rd Edition (PMBOK Guides), ISBN-13: 978-1930699458
3. *IT Project Management: On Track from Start to Finish* by Joseph Phillips, McGraw-Hill Osborne Media; 3rd Edition (February 25, 2010). ISBN-10: 0071700439
4. *Information Technology Project Management* by Jack T. Marche, Wiley; 3rd Edition (January 6, 2009). ISBN-10: 0470371935
5. *Effective Project Management: Traditional, Agile, Extreme* by Robert K. Wysocki, Wiley; 6th Edition (2011). ISBN-10: 111801619X

Semester-8			
Sr.No	**C. Code**	**Course Title**	**Cr. Hr**
1	CIT-631	Final Year Project	5(0-5)
2	CIT-604	Cyber Security	3(3-0)
3	CSI-407	Professional Practices	3(3-0)
Total			**11(6-5)**

Cyber Security

Credit Hours: 3 (3,0)

Course Content:

Basic security concepts, Information security terminology, Malware classifications, Types of malware. Server side web applications attacks. Cross-site scripting, SQL Injection, Cross-site request forgery, Planning and policy, Network protocols and service models. Transport layer security, Network layer security, Wireless security, Cloud & IoT security.

Reference Materials:

1. Security+ Guide to Network Security Fundamentals by Mark Ciampa, th Edition
2. Corporate Computer Society by Randall J.Boyle, 3rd Edition

Course Name: Professional Practices

Credit Hours: 3
Prerequisites: None

Course Outline:

Computing Profession, Computing Ethics, Philosophy of Ethics. The Structure of Organizations, Finance and Accounting, Anatomy of a Software House, Computer Contracts, Intellectual Property Rights, The Framework of Employee Relations Law and Changing Management Practices, Human Resource Management and IT, Health and Safety at Work, Software Liability, Liability and Practice, Computer Misuse and the Criminal Law, Regulation and Control of Personal Information. Overview of the British Computer Society Code of Conduct, IEEE Code of Ethics, ACM Code of Ethics and Professional Conduct, ACM/IEEE Software Engineering Code of Ethics and Professional Practice. Accountability and Auditing, Social Application of Ethics.

Reference Materials:

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. *Computer Ethics* by Deborah G. Johnson, Pearson; 4th Edition (January 3, 2009). ISBN-10: 0131112414
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.
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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

Course Name: Professional Practices
Credit Hours: 3
Prerequisites: None
Course Outline:
Computing Profession, Computing Ethics, Philosophy of Ethics. The Structure of Organizations, Finance and Accounting, Anatomy of a Software House, Computer Contracts, Intellectual Property Rights, The Framework of Employee Relations Law and Changing Management Practices, Human Resource Management and IT, Health and Safety at Work, Software Liability, Liability and Practice, Computer Misuse and the Criminal Law, Regulation and Control of Personal Information. Overview of the British Computer Society Code of Conduct, IEEE Code of Ethics, ACM Code of Ethics and Professional Conduct, ACM/IEEE Software Engineering Code of Ethics and Professional Practice. Accountability and Auditing, Social Application of Ethics.
Reference Materials:
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. *Computer Ethics* by Deborah G. Johnson, Pearson; 4th Edition (January 3, 2009). ISBN-10: 0131112414
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.
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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