



WOMEN UNIVERSITY MARDAN

DEPARTMENT OF COMPUTER SCIENCE

BS CS COURSE CONTENTS

(2023)

Course Contents of Computing Core

Course Name: *Programming Fundamentals*
Credit Hours: 4 (3-1)
Pre-requisites: None

Course Introduction:

This course provides fundamental concepts of programming to freshmen. The course is a prerequisite to many other courses, therefore, students are strongly advised to cover all contents and try to achieve CLOs to the maximum possible level. The course may be taught as language independent. Further, it is up to the university to choose any language for the practical/Lab purpose but that must be latest and market oriented.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand basic problem solving steps and logic constructs	C2 (Understand)
CLO-2	Apply basic programming concepts	C3 (Apply)
CLO-3	Design and implement algorithms to solve real world problems	C3 (Solve)

Course Outline:

Introduction to problem solving, a brief review of Von-Neumann architecture, Introduction to programming, role of compiler and linker, introduction to algorithms, basic data types and variables, input/output constructs, arithmetic, comparison and logical operators, conditional statements and execution flow for conditional statements, repetitive statements and execution flow for repetitive statements, lists and their memory organization, multi-dimensional lists, introduction to modular programming, function definition and calling, stack rolling and unrolling, string and string operations, pointers/references, static and

dynamic memory allocation, File I/O operations.

Reference Materials (or use any other standard and latest books):

1. Starting out with Programming Logic & Design, 4th Edition, Tony Gaddis,
2. The C Programming Language, 2nd Edition by Brian W. Kernighan, Dennis M. Ritchie
3. Object Oriented Programming in C++ by Robert Lafore
4. C How to Program, 7th Edition by Paul Deitel & Harvey Deitel
5. Problem Solving and Program Design in C++, 7th Edition by Jeri R. Hanly & Elliot B. Koffman

Course Name: *Object Oriented Programming*
Credit Hours: 4 (3-1)
Pre-requisites: Programming Fundamentals

Course Introduction:

The course aims to focus on object-oriented concepts, analysis and software development. The basic concept of OOP is covered in this course.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand principles of object oriented paradigm.	C2 (Understand)
CLO-2	Identify the objects & their relationships to build object oriented solution	C3 (Identify)
CLO-3	Model a solution for a given problem using object oriented principles	C3 (Apply)
CLO-4	Examine an object oriented solution	C4 (Examine)

Course Outline:

Introduction to object oriented design, history and advantages of object oriented design, introduction to object oriented programming concepts, classes, objects, data encapsulation, constructors, destructors, access modifiers, const vs non-const functions, static data members & functions, function overloading, operator overloading, identification of classes and their relationships, composition, aggregation, inheritance, multiple inheritance, polymorphism, abstract classes and interfaces, generic programming concepts, function & class templates, standard template library, object streams, data and object serialization using object streams, exception handling.

Reference Materials: (or use any other standard and latest books)

1. Java: How to Program, 9th Edition by Paul Deitel
 2. Beginning Java 2, 7th Edition by Ivor Horton
 3. An Introduction to Object Oriented Programming with Java, 5th Edition by C. Thomas Wu
 4. Starting Out with C++ from Control Structures to Objects, 9th Edition, Tony Gaddis
 5. C++ How to Program, 10th Edition, Deitel & Deitel.
 6. Object Oriented Programming in C++, 3rd Edition by Robert Lafore
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Course Name: *Data Structures*
Credit Hours: 4 (3-1)
Pre-requisites: Programming Fundamentals

Course Introduction:

The course is designed to teach students structures and schemes, which allow them to write programmer to efficiently manipulate, store, and retrieve data. Students are exposed to the concepts of time and space complexity of computer programs.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Implement various data structures and their algorithms and apply them in implementing simple applications	C3 (Apply)
CLO-2	Analyze simple algorithms and determine their complexities.	C5 (Analyze)
CLO-3	Apply the knowledge of data structure to other application domains.	C3 (Apply)
CLO-4	Design new data structures and algorithms to solve problems.	C6 (Design)

Course Outline:

Abstract data types, complexity analysis, Big Oh notation, Stacks (linked lists and array implementations), Recursion and analyzing recursive algorithms, divide and conquer algorithms, Sorting algorithms (selection, insertion, merge, quick, bubble, heap, shell, radix, bucket), queue, dequeuer, priority queues (linked and array implementations of queues), linked list & its various types, sorted linked list, searching an unsorted array, binary search for sorted arrays, hashing and indexing, open addressing and chaining, trees and tree traversals, binary search trees, heaps, M-way tress, balanced trees, graphs, breadth-first and depth-first traversal, topological order, shortest path, adjacency matrix and adjacency list implementations, memory management and garbage collection.

Reference Materials: (or use any other standard and latest books)

1. Data Structures and Algorithm Analysis in Java by Mark A. Weiss
 2. Data Structures and Abstractions with Java by Frank M. Carrano & Timothy M. Henry
 3. Data Structures and Algorithms in C++ by Adam Drozdek
 4. Data Structures and Algorithm Analysis in C++ by Mark Allen Weiss
Java Software Structures: Designing and Using Data Structures by John Lewis and Joseph Chase
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Course Name: *Computer Organization and Assembly Language*
Credit Hours: 3 (2-1)
Pre-requisites: Digital Logic Design

Course Introduction:

The main objective of this course is to introduce the organization of computer systems and usage of assembly language for optimization and control. Emphasis should be given to expose the low-level logic employed for problem solving while using assembly language as a tool. At the end of the course the students should be capable of writing moderately complex assembly language subroutines and interfacing them to any high level language.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Acquire the basic knowledge of computer organization computer architecture and assembly language	C2 (Understand)
CLO-2	Understand the concepts of basic computer organization, architecture, and assembly language techniques	C2 (Understand)
CLO-3	Solve the problems related to computer organization and assembly language	C3 (Apply)

Course Outline:

Introduction to computer systems: Information is bits + context, programs are translated by other programs into different forms, it pays to understand how compilation systems work, processors read and interpret instructions stored in memory, caches matter, storage devices form a hierarchy, the operating system manages the hardware, systems communicate with other systems using networks; Representing and manipulating information: information storage, integer representations, integer arithmetic, floating point; Machine-level representation of programs: a historical perspective, program encodings, data formats, accessing information, arithmetic and logical operations, control, procedures, array allocation and access, heterogeneous data structures, understanding pointers, using the gdb debugger, out-of-bounds memory references and buffer overflow, x86-64: extending ia32 to 64 bits, machine-level representations of floating-point programs; Processor architecture: the Y86 instruction set architecture, logic design and the Hardware Control Language (HCL), sequential Y86 implementations, general principles of pipelining, pipelined Y86 implementations

Reference Materials: (or use any other standard and latest books)

1. Computer System Architecture, M. Morris Mano, Latest Edition,
 2. Assembly Language Programming for Intel- Computer, Latest Edition
 3. Computer Systems: A Programmer's Perspective, 3/E (CS:APP3e), Randal E. Bryant and David R.O' Hallaron, Carnegie Mellon University
 4. Robert Britton, MIPS Assembly Language Programming, Latest Edition,
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Course Name: *Digital Logic Design*
Credit Hours: 3 (2-1)
Pre-requisites: None

Course Introduction:

The course introduces the concept of digital logic, gates and the digital circuits. Further, it focuses on the design and analysis combinational and sequential circuits. It also serves to familiarize the student with the logic design of basic computer hardware components.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Acquire knowledge related to the concepts, tools and techniques for the design of digital electronic circuits	-
CLO-2	Demonstrate the skills to design and analyze both combinational and sequential circuits using a variety of techniques	-
CLO-3	Apply the acquired knowledge to simulate and implement small-scale digital circuits	-
CLO-4	Understand the relationship between abstract logic characterizations and practical electrical implementations.	-

Course Outline: (or use any other standard and latest books)

Number Systems, Logic Gates, Boolean Algebra, Combination logic circuits and designs, Simplification Methods (K-Map, Quinn Mc-Cluskey method), Flip Flops and Latches, Asynchronous and Synchronous circuits, Counters, Shift Registers, Counters, Triggered devices & its types. Mealy machines and Moore machines. Binary Arithmetic and Arithmetic Circuits, Memory Elements, State Machines. Introduction Programmable Logic Devices (CPLD, FPGA) Lab Assignments using tools such as Verilog HDL/VHDL, MultiSim.

Reference Materials:

1. Digital Fundamentals by Floyd, 11/e.
 2. Fundamental of Digital Logic with Verilog Design, Stephen Brown, 2/e
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Course Name: *Operating Systems*
Credit Hours: 3 (2-1)

Pre-requisites: Data Structures

Course Introduction:

To help students gain a general understanding of the principles and concepts governing the functions of operating systems and acquaint students with the layered approach that makes design, implementation and operation of the complex OS possible.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand the characteristics of different structures of the Operating Systems and identify the core functions of the Operating Systems	C2 (Understand)
CLO-2	Analyze and evaluate the algorithms of the core functions of the Operating Systems and explain the major performance issues with regard to the core functions	C5 (Evaluate)
CLO-3	Demonstrate the knowledge in applying system software and tools available in modern operating systems.	C3 (Demonstrate)

Course Outline:

Operating systems basics, system calls, process concept and scheduling, inter-process communication, multithreaded programming, multithreading models, threading issues, process scheduling algorithms, thread scheduling, multiple-processor scheduling, synchronization, critical section, synchronization hardware, synchronization problems, deadlocks, detecting and recovering from deadlocks, memory management, swapping, contiguous memory allocation, segmentation & paging, virtual memory management, demand paging, thrashing, memory-mapped files, file systems, file concept, directory and disk structure, directory implementation, free space management, disk structure and scheduling, swap space management, system protection, virtual machines, operating system security

Reference Materials: (or use any other standard and latest books)

1. Operating Systems Concepts, 9th edition by Abraham Silberschatz
 2. Modern Operating Systems, 4th edition by Andrew S. Tanenbaum
 3. Operating Systems, Internals and Design Principles, 9th edition by William StallingsWu
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Course Name: *Database System*
Credit Hours: 4 (3-1)
Pre-requisites: None

Course Introduction:

The course aims to introduce basic database concepts, different data models, data storage and retrieval techniques and database design techniques. The course primarily focuses on relational data model and DBMS concepts

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Explain fundamental database concepts.	C2 (Explain)
CLO-2	Design conceptual, logical and physical database schemas using different data models.	C5 (Design)
CLO-3	Identify functional dependencies and resolve database anomalies by normalizing database tables.	C2 (Identify)
CLO-4	Use Structured Query Language (SQL) for database definition and manipulation in any DBMS	C4 (Use)

Course Outline:

Basic database concepts, Database approach vs. file based system, database architecture, three level schema architecture, data independence, relational data model, attributes, schemas, tuples, domains, relation instances, keys of relations, integrity constraints, relational algebra, selection, projection, Cartesian product, types of joins, normalization, functional dependencies, normal forms, entity relationship model, entity sets, attributes, relationship, entity-relationship diagrams, Structured Query Language (SQL), Joins and sub-queries in SQL, Grouping and aggregation in SQL, concurrency control, database backup and recovery, indexes, NoSQL systems.

Reference Materials: (or use any other standard and latest books)

1. Database Systems: A Practical Approach to Design, Implementation, and Management, 6th Edition by Thomas Connolly and Carolyn Begg
 2. Database Systems: The Complete Book, 2nd Edition by Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom
 3. Database System Concepts, 6th Edition by Avi Silberschatz, Henry F. Korth and S. Sudarshan.
 4. Database Management Systems, 3rd Edition by Raghu Ramakrishnan, Johannes Gehrke
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Course Name: *Information Security*
Credit Hours: 3 (2-1)
Pre-requisites: None

Course Introduction:

This course provides a broad overview of the threats to the security of information systems, the responsibilities and basic tools for information security, and the levels of training and expertise needed in organizations to reach and maintain a state of acceptable security. It covers concepts and applications of system and data security. Areas of particular focus include secure network design, implementation and transition issues, and techniques for responding to security breaches.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Explain key concepts of information security such as design principles, cryptography, risk management, and ethics	C2 (Explain)
CLO-2	Discuss legal, ethical, and professional issues in information security	A2 (Discuss)
CLO-3	Apply various security and risk management tools for achieving information security and privacy	C3 (Apply)
CLO-4	Identify appropriate techniques to tackle and solve problems in the discipline of information security	C4 (Identify)

Course Outline:

Information security foundations, security design principles; security mechanisms, symmetric and asymmetric cryptography, encryption, hash functions, digital signatures, key management, authentication and access control; software security, vulnerabilities and protections, malware, database security; network security, firewalls, intrusion detection; security policies, policy formation and enforcement, risk assessment, cybercrime, law and ethics in information security, privacy and anonymity of data.

Reference Materials: (or use any other standard and latest books)

1. Computer Security: Principles and Practice, 3rd edition by William Stallings
 2. Principles of Information Security, 6th edition by M. Whitman and H. Mattord
 3. Computer Security, 3rd edition by Dieter Gollmann
 4. Computer Security Fundamentals, 3rd edition by William Easttom
 5. Official (ISC)2 Guide to the CISSP CBK, 3rd edition
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Course Name: *Computer Networks*
Credit Hours: 3 (2-1)
Pre-requisites: None

Course Introduction:

This course introduces the basic concept of computer network to the students. Network layers, Network models (OSI, TCP/IP) and protocol standards are part of the course.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Describe the key terminologies and technologies of computer networks	C2(Describe)
CLO-2	Explain the services and functions provided by each layer in the Internet protocol stack.	C2 (Explain)
CLO-3	Identify various internetworking devices and protocols and their functions in a networking	C4 (Identify)
CLO-4	Analyze working and performance of key technologies, algorithms and protocols	C4 (Analyze)
CLO-5	Build Computer Network on various Topologies	P3 (Build)

Course Outline:

Introduction and protocols architecture, basic concepts of networking, network topologies, layered architecture, physical layer functionality, data link layer functionality, multiple access techniques, circuit switching and packet switching, LAN technologies, wireless networks, MAC addressing, networking devices, network layer protocols, IPv4 and IPv6, IP addressing, sub netting, CIDR, routing protocols, transport layer protocols, ports and sockets, connection establishment, flow and congestion control, application layer protocols, latest trends in computer networks.

Reference Materials: (or use any other standard and latest books)

1. Computer Networking: A Top-Down Approach Featuring the Internet, 6th edition by James F. Kurose and Keith W. Ross
 2. Computer Networks, 5th Edition by Andrew S. Tanenbaum
 3. Data and Computer Communications, 10th Edition by William Stallings
 4. Data Communication and Computer Networks, 5th Edition by Behrouz A. Forouzan
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Course Name: *Software Engineering*
Credit Hours: 3 (3-0)
Pre-requisites: None

Course Introduction:

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Describe various software engineering processes and activates	C1 (Describe)
CLO-2	Apply the system modeling techniques to model a medium size software systems	C3 (Apply)
CLO-3	Apply software quality assurance and testing principles to medium size software systems	C4 (Apply)
CLO-4	Discuss key principles and common methods for software project management such as scheduling, size estimation, cost estimation and risk analysis	C2 (Discuss)

Course Outline:

Nature of Software, Overview of Software Engineering, Professional software development, Software engineering practice, Software process structure, Software process models, Agile software Development, Agile process models, Agile development techniques, Requirements engineering process, Functional and non-functional requirements, Context models, Interaction models, Structural models, behavioral models, model driven engineering, Architectural design, Design and implementation, UML diagrams, Design patterns, Software testing and quality assurance, Software evolution, Project management and project planning, configuration management, Software Process improvement

Reference Materials: (or use any other standard and latest books)

1. Software Engineering, Sommerville I., 10th Edition, Pearson Inc., 2014
 2. Software Engineering, A Practitioner's Approach, Pressman R. S.& Maxim B. R., 8th Edition, McGraw-Hill, 2015.
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Course Name: *Analysis of Algorithms*
Credit Hours: 3 (3-0)
Pre-requisites: Data Structures

Course Introduction:

Detailed study of the basic notions of the design of algorithms and the underlying data structures. Several measures of complexity are introduced. Emphasis on the structure, complexity, and efficiency of algorithms.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Explain what is meant by “best”, “expected”, and “worst” case behavior of an algorithm	
CLO-2	Identify the characteristics of data and/or other conditions or assumptions that lead to different behaviors.	
CLO-3	Determine informally the time and space complexity of simple algorithms	
CLO-4	List and contrast standard complexity classes	
CLO-5	Use big O, Omega, Theta notation formally to give asymptotic upper bounds on time and space complexity of algorithms	
CLO-6	Use of the strategies(brute-force, greedy, divide-and-conquer, and dynamic programming) to solve an appropriate problem	
CLO-7	Solve problems using graph algorithms, including single-source and all-pairs shortest paths, and at least one minimum spanning tree algorithm	
CLO-8	Trace and/or implement a string-matching algorithm	

Course Outline:

Introduction; role of algorithms in computing, Analysis on nature of input and size of input Asymptotic notations; Big-O, Big Ω , Big Θ , little-o, little- ω , Sorting Algorithm analysis, loop invariants, Recursion and recurrence relations; Algorithm Design Techniques, Brute Force Approach, Divide-and-conquer approach; Merge, Quick Sort, Greedy approach; Dynamic programming; Elements of Dynamic Programming, Search trees; Heaps; Hashing; Graph algorithms, shortest paths, sparse graphs, String matching; Introduction to complexity classes.

Reference Materials: (or use any other standard and latest books)

1. Introduction to Algorithms (3rd edition) by Thomas H. Corman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein
 2. Algorithm Design, (1st edition, 2013/2014), Jon Kleinberg, Eva Tardos,
 3. Algorithms, (4th edition, 2011), Robert Sedgewick, Kevin Wayne
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Course Name: *Artificial Intelligence*
Credit Hours: 3 (2-1)
Pre-requisites: Object Oriented Programming

Course Introduction:

Artificial Intelligence has emerged as one of the most significant and promising areas of computing. This course focuses on the foundations of AI and its basic techniques like Symbolic manipulations, Pattern Matching, Knowledge Representation, Decision Making and Appreciating the differences between Knowledge, Data and Code. AI programming language Python has been proposed for the practical work of this course.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand the fundamental constructs of Python programming language.	C2 (Understand)
CLO-2	Understand key concepts in the field of artificial intelligence	C2 (Understand)
CLO-3	Implement artificial intelligence techniques and case studies	C3 (Apply)

Course Outline:

An Introduction to Artificial Intelligence and its applications towards Knowledge Based Systems; Introduction to Reasoning and Knowledge Representation, Problem Solving by Searching (Informed searching, Uninformed searching, Heuristics, Local searching, Min-max algorithm, Alpha beta pruning, Game-playing); Case Studies: General Problem Solver, Eliza, Student, Macsyma; Learning from examples; ANN and Natural Language Processing; Recent trends in AI and applications of AI algorithms. Python programming language will be used to explore and illustrate various issues and techniques in Artificial Intelligence.

Reference Materials: (or use any other standard and latest books)

1. Russell, S. and Norvig, P. "Artificial Intelligence. A Modern Approach", 3rd ed, Prentice Hall, Inc., 2015.
 2. Norvig, P., "Paradigms of Artificial Intelligence Programming: Case studies in Common Lisp", Morgan Kaufman Publishers, Inc., 1992.
 3. Luger, G.F. and Stubblefield, W.A., "AI algorithms, data structures, and idioms in Prolog, Lisp, and Java", Pearson Addison-Wesley. 2009.
 4. Severance, C.R., 2016. "Python for everybody: Exploring data using Python 3." CreateSpace Independent Publ Platform.
 5. Miller, B.N., Ranum, D.L. and Anderson, J., 2019. "Python programming in context." Jones & Bartlett Pub.
 6. Joshi, P., 2017. "Artificial intelligence with python." Packt Publishing Ltd.
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Course Contents of Domain Core

Course Name: *Parallel and Distributed Computing*
Credit Hours: 3 (2-1)
Pre-requisites: Object Oriented Programming, Operating Systems

Course Introduction:

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Learn about parallel and distributed computers.	-
CLO-2	Write portable programs for parallel or distributed architectures using Message-Passing Interface (MPI) library	-
CLO-3	Analyze complex problems with shared memory openMP.	-programming with

Course Outline:

Asynchronous/synchronous computation/communication, concurrency control, fault tolerance, GPU architecture and programming, heterogeneity, interconnection topologies, load balancing, memory consistency model, memory hierarchies, Message passing interface (MPI), MIMD/SIMD, multithreaded programming, parallel algorithms & architectures, parallel I/O, performance analysis and tuning, power, programming models (data parallel, task parallel, process-centric, shared/distributed memory), scalability and performance studies, scheduling, storage systems, synchronization, and tools (Cuda, Swift, Globus, Condor, Amazon AWS, OpenStack, Cilk, gdb, threads, MPICH, OpenMP, Hadoop, FUSE).

Reference Materials:

1. Distributed Systems: Principles and Paradigms, A. S. Tanenbaum and M. V. Steen, Prentice Hall, 2nd Edition, 2007
 2. Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet, KHwang, J Dongarra and GC. C. Fox, Elsevier, 1st Ed.
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Course Name: *Theory of Automata*

Credit hours: 3 (3-0)

Pre-requisites: None

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Explain and manipulate the different concepts in automata theory and formal languages such as formal proofs, automata, regular expressions, Turing machines etc.	C2 (Understand)
CLO-2	Prove properties of languages, grammars and automata with rigorously formal mathematical methods	C2 (Understand)
CLO-3	Design of automata, RE and CFG	C3 (Apply)
CLO-4	Transform between equivalent NFAs, DFAs and REs	C3 (Apply)
CLO-5	Define Turing machines performing simple tasks	C2 (Understand)
CLO-6	Differentiate and manipulate formal descriptions of languages, automata and grammars with focus on regular and context-free languages, finite automata and regular expressions.	C3 (Apply)

Course Outline:

Finite State Models: Language definitions preliminaries, Regular expressions/Regular languages, Finite automata (FAs), Transition graphs (TGs), NFAs, Kleene's theorem, Transducers (automata with output), Pumping lemma and non-regular language Grammars and PDA: CFGs, Derivations, derivation trees and ambiguity, Simplifying CFLs, Normal form grammars and parsing, Decidability, Context sensitive languages, grammars and linear bounded automata (LBA), Chomsky's hierarchy of grammars Turing Machines Theory: Turing machines, Post machine, Variations on TM, TM encoding, Universal Turing Machine, Defining Computers by TMs.

Reference Materials:

1. Introduction to computer theory, Daniel I. A. Cohen, 2nd Edition
2. Automata, Computability and Complexity: Theory and Applications, by Elaine Rich, 2011
3. An Introduction to Formal Languages and Automata, by Peter Linz, 4th edition, Jones & Bartlett Publishers, 2006.
4. Theory of Automata, Formal Languages and Computation, by S. P. Eugene, Kavier, 2005, New Age Publishers

Course Name: *Compiler Construction*
Credit Hours: 3 (2-1)
Pre-requisite: Theory of Automata

CLO No.	Course Learning Outcomes	Bloom's Taxonomy
CLO-1	Understand the basic techniques used in compiler construction such as lexical analysis, top- down, bottom-up parsing, context-sensitive analysis, and intermediate code generation.	C2 (Comprehension)
CLO-2	Understand the basic data structures used in compiler construction such as abstract syntax trees, symbol tables, three-address code, and stack machines	C2 (Comprehension)
CLO-3	Design and implement a compiler using a software engineering approach	C3 (Apply)
CLO-4	Use generators (e.g. Lex and Yacc)	C3 (Apply)

Course outline:

Introduction to interpreter and compiler. Compiler techniques and methodology; Organization of compilers; Lexical and syntax analysis; Parsing techniques. Types of parsers, top-down parsing, bottom-up parsing, Type checking, Semantic analyser, Object code generation and optimization, detection and recovery from errors.

Reference Material:

1. Compilers: Principles, Techniques, and Tools, A. V. Aho, R. Sethi and J. D. Ullman, Addison-Wesley, 2nd ed., 2006
2. Modern Compiler Design, D. Grune, H. E. Bal, C. J. H. Jacobs, K. G. Langendoen, John Wiley, 2003.
3. Modern Compiler Implementation in C, A. W. Appel, M. Ginsburg, Cambridge University Press, 2004.

Course Name: *Computer Architecture*

Credit hours: 3 (2-1)

Pre-requisites: None

CLO No.	Course Learning Outcomes	Bloom's taxonomy
CLO1	Understand the basic model of a computer including the Datapath, control, memory, and I/O components	C2(Comprehension)
CLO2	Understand the memory hierarchy including caches and virtual memory	C2(Comprehension)
CLO3	Understand computer performance measures and their estimation	C2(Comprehension)
CLO4	Understand pipelined architectures including data-paths and hazards	C2(Comprehension)
CLO5	write a fully functional, stand-alone medium size assembly language program	C3(Application)
CLO6	to program efficiently in an assembly level instruction set, including the use of addressing modes and data types	C3(Application)

Course Outline

Fundamentals of Computer Design including performance measurements & quantitative principles, principles of Instruction Set Design, Operands, addressing modes and encoding, pipelining of Processors: CPU Simulators, Issues and Hurdles, exception handling features, Instruction-Level Parallelism and Dynamic handling of Exceptions, Memory Hierarchy Design, Cache Design, Performance Issues and improvements, Main Memory Performance Issues, Storage Systems, Multiprocessors and Thread Level Parallelism. Case Studies.

Reference Material

1. Computer Architecture: A Quantitative Approach by Hennessy & Patterson, Morgan & Kauffman Series (2006) Latest Edition
2. Computer Organization & Design: The Hardware/Software Interface by Patterson & Hennessy, Morgan & Kauffman Series (2008) Fourth Edition
3. Computer Organization and Architecture Designing for performance by William Stallings, 8th Edition, Prentice Hall Inc. 2016
4. The 8088 and 8086 Microprocessors by Walter A. Triebel, Avtar Singh fourth edition Prentice Hall Inc

Course Name: *Human Computer Interaction and Computer Graphics*

Credit Hours: 3 (2,1)

Prerequisites: None

This course provides basic understanding of the area of Human Computer Interaction and Computer Graphics and introduces students to various methods and techniques that could be used to design and evaluate interactive systems.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand the basics of human and computational abilities and limitations.	C2 (Understand)
CLO-2	Understand basic theories, tools and techniques in HCI.	C2 (Understand)
CLO-3	Understand the fundamental aspects of designing and evaluating interfaces.	C3 (Design)
CLO-4	Apply appropriate HCI techniques to design systems that are usable by people.	C4 (Apply)

Course Outline:

Overview of human computer interaction, Interaction devices (Positioning, Pointing and Drawing Devices, display devices, printers, scanners etc). Human psychology and ergonomics, Interaction Paradigms, Interaction design basics, HCI in the software process, Design rules, Implementation support, Evaluation techniques, Universal design, User support, Cognitive models, Socio-organizational issues and stakeholder requirements, Communication and collaboration models, Task analysis, Dialog notations and design, Models of the system, Modeling rich interaction, Groupware, Ubiquitous computing and augmented realities

Reference Materials:

1. Human-Computer Interaction by Alan Dix, Janet E. Finlay, Gregory D. Abowd, Russell Beale, Prentice Hall; 3rd Edition December 20, 2003. ISBN-10: 0130461091
2. Human-Computer Interaction: Concepts And Design by J. Preece, Y. Rogers, H. Sharp, D. Benyon, S. Holland, T. Carey, Addison Wesley; 1st Edition (April 30, 1994). ISBN10: 0201627698.
3. Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications by Julie A. Jacko, CRC Press; 3 Edition (May 4, 2012. ISBN 10: 1439829438
4. Interaction Design: Beyond Human - Computer Interaction by Yvonne Rogers, Helen Sharp, and Jenny Preece, Wiley; 3rd Edition June 15, 2011). ISBN-10: 0470665769
5. Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Rules by Jeff Johnson, Morgan Kaufmann; 1st Edition June 3, 2010). ISBN -10: 012375030X.

Course Name: *Advance Database Management Systems*

Credit hours: 3 (2,1)

Prerequisite: Database Systems

CLO No.	Course Learning Outcomes	Bloom's Taxonomy
CLO 1	Understanding data models, technologies and approaches for building distributed database systems.	C2 (Understand)
CLO 2	Select and apply appropriate models and methods for a particular scenario.	C3 (Apply)
CLO 3	To implement and maintain an efficient database system using emerging technologies and tools.	C3 (Apply)

Course Outline:

Introduction to object relational and object oriented data models. File organizations concepts, Query processing and optimization (Optimization approaches, Use of constraints, use of different index structures and mechanisms). Transaction processing and Concurrency control techniques (ACID properties, locking approaches, deadlocks). Database Recovery techniques, Database Programming (PL/SQL, T- SQL or similar technology), Database Integrity and security, Database Administration, Physical database design and tuning, Distributed database systems, Emerging trends in database systems, NoSQL, MongoDB.

Reference Material:

1. Thomas Connolly and Carolyn Beg. Database Systems: A Practical Approach to Design, Implementation, and Management, Pearson, Latest Edition.
2. R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004
3. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008.

Course Contents of Mathematics & Supporting Courses

Course Name: *Differential Equations*

Credit Hours: 03

Specific Objectives of the Course:

At the end of the course the students will be able to: Identify, analyze and subsequently solve physical situations whose behavior can be described by ordinary differential equations; Determine solutions to first order separable differential equations; Determine solutions to first order linear differential equations; Determine solutions to first order exact differential equations; Determine solutions to second order linear homogeneous and non-homogeneous differential equations with constant coefficients.

Course Outline:

Ordinary Differential Equations of the First Order: Geometrical Considerations, Separable Equations, Equations Reducible to Separable Form, Exact Differential Equations, Integrating Factors, Linear First-Order Differential Equations, variation of Parameters. Ordinary Linear Differential Equations; Homogeneous Linear Equations of the Second Order, Homogeneous Second-Order Equations with Constant Coefficients, General Solution, Real Roots, Complex Roots, Double Root of the Characteristic Equation, Differential Operators, Cauchy Equation, Homogeneous Linear Equations of Arbitrary Order, Homogeneous Linear Equations of Arbitrary Order with Constant Coefficients, Non-homogeneous Linear Equations. Modelling of Electrical Circuits. Systems of Differential Equations. Series Solutions of Differential Equations. Partial Differential Equations: Method of Separation of variables.

Recommended Books:

1. Advanced Engineering Mathematics Michael, G.1996, Prentice Hall Publishers
 2. Advanced Engineering Mathematics, 7th edition, Erwin, K. 1993, John Wiley & Sons Inc.
 3. A First Course in Differential Equation Zill. Prindle. Weber. Schmidt.1996. Brooks/Cole Publishing.
 4. Differential Equations with Boundary-Value Problems, Dennis. G. Zill, Michael, R. Cullen. 1996, Brooks/Cole Publishing,
 5. Elementary Differential Equations with Applications C. H. Edwards. David, E. 1993. Penney, Prentice Hall.
-

Course Name:	<i>Linear Algebra</i>
Credit Hours:	3 (3-0)
Pre-requisites:	Calculus and Analytical Geometry

Specific objectives of course: linear algebra is the study of vector spaces and linear transformations. The main objective of this course is to help students learn in rigorous manner, the tools and methods essential for studying the solution spaces of problems in mathematics, engineering, the natural sciences, and social sciences and development mathematical skills needed to apply these to the problems arising within their field of study; and to various real world problems.

Course Outline:

System of Linear Equations: Representation in matrix form. Matrices. Operations on matrices. Echelon and reduced echelon form. Inverse of a matrix (by elementary row operations) Solution of linear system. Gauss-Jordan method. Gaussian elimination.

Determinants: Permutations of order two and three and definitions of determinants of the same order. Computing of determinants. Definition of higher order determinants. Properties. Expansion of determinants.

Vector Spaces: Definition and examples, subspaces. Linear combination and spanning set. Linearly Independent sets. Finitely generated vector spaces. Bases and dimension of a vector space. Operations on subspaces, Intersections, sums and direct sums of subspaces. Quotient Spaces

Linear mappings: Definition and examples. Kernel and image of a linear mapping. Rank and nullity Reflections, projections and homotheties. Change of basis. Eigen-values and eigenvectors Theorem of Hamilton-Cayley.

Inner product Spaces: Definition and examples. Properties. Projection. Cauchy inequality. Orthogonal and orthonormal basis. Gram Schmidt Process. Diagonalization.

Recommended Books:

1. Ch. W. Curtis, "*Linear Algebra*", Springer 2004.
 2. T. Apostol, "*Multi Variable Calculus and Linear Algebra*", 2nd ed., John Wiley and sons, 1997
 3. H. Anton, C. Rorres, "*Elementary Linear Algebra: Applications Version*", 10th Edition, John Wiley and sons, 2010.
 4. S. Friedberg, A. Insel, "*Linear Algebra*", 4th Edition, Pearson Education Canada, 2003.
 5. S. I. Grossman, "*Elementary Linear Algebra*", 5th Edition, Cengage Learning, 2004
-

Course Name: *Probability and Statistics*
Credit Hours: 3 (3-0)
Pre-requisites: None

Course Introduction:

To introduce the concepts of data analysis, presentation, counting techniques, probability and decision making.

CLO No. Course Learning Outcomes **Bloom Taxonomy**

Course Outline:

Introduction to Statistics and Data Analysis, Statistical Inference, Samples, Populations, and the Role of Probability. Sampling Procedures. Discrete and Continuous Data. Statistical Modeling. Types of Statistical Studies. Probability: Sample Space, Events, Counting Sample Points, Probability of an Event, Additive Rules, Conditional Probability, Independence, and the Product Rule, Bayes' Rule. Random Variables and Probability Distributions. 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. Discrete Probability Distributions. Continuous Probability Distributions. 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. Single Sample & One- and Two-Sample Estimation Problems. Single Sample & One- and Two-Sample Tests of Hypotheses. The Use of P-Values for Decision Making in Testing Hypotheses (Single Sample & One- and Two-Sample Tests), Linear Regression and Correlation. Least Squares and the Fitted Model, Multiple Linear Regression and Certain, Nonlinear Regression Models, Linear Regression Model Using Matrices, Properties of the Least Squares Estimators.

Reference Materials: (or use any other standard and latest books)

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

Course Name: *Pre-Calculus I*

Credit Hours: 03

Specific Objectives of the Course:

To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions.

Matrices: Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.

Quadratic Equations: Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.

Sequences and Series: Arithmetic progression, geometric progression, harmonic progression.

Binomial Theorem: Introduction to mathematical induction, binomial theorem with rational and irrational indices.

Trigonometry: Fundamentals of trigonometry, trigonometric identities.

Recommended Books:

1. Kolman, Bernard, and Shapiro, Arnold. Introduction to Algebra and Trigonometry. United Kingdom, Elsevier Science, 2014.
2. Flanders, Harley, and Price, Justin J.. Algebra and Trigonometry. United Kingdom, Elsevier Science, 2014.
3. Kaufmann J. E, College Algebra and Trigonometry, 1987, PWS-Kent Company, Boston.
4. Swokowski E. W., Fundamentals of Algebra and Trigonometry (6th edition), 1986, PWS-Kent Company, Boston.

Course Name: *Pre-Calculus II*

Credit Hours: 03

Specific Objectives of the Course:

To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Preliminaries: Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities.

Limits and Continuity: Limit of a function, left- hand and right-hand limits, continuity, continuous functions.

Derivatives and their Applications: Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.

Integration and Definite Integrals: Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

Recommended Books:

1. Anton H, Bevens I, Davis S, Calculus: A New Horizon (8th edition), 2005, John Wiley, New York.
2. Stewart J, Calculus (3rd edition), 1995, Brooks/Cole (suggested text).
3. Swokowski E W, Calculus and Analytic Geometry, 1983, PWS-Kent Company, Boston.
4. Thomas G. B, Finney A. R. Calculus (11th Edition), 2005, Addison-Wesley, Reading, Ma, USA

Course Contents of General Education Courses

Course Name:	<i>Functional English</i>
Credit Hours:	3 (3-0)
Pre-requisites:	None

Course Description:

This course introduces the students with the basic grammatical / structural rules of English Language. It will help the students in improving their basic Language Skills to an optimum level so as to enable them to communicate effectively in English language through proper usage of vocabulary & knowledge of English grammar.

Outcomes:

1. Students will be familiarized with the technical methods of reading / comprehension.
2. They will be exposed to different reading materials, which will help them in improving their vocabulary, grammar and sentence structure etc.
3. The experience of this course will also help them to overcome those problems due to which they are unable to express themselves properly Parts of Speech

Course Contents:

- Vocabulary (Frequently confused / misused words,
- Phrases,
- synonyms,
- antonyms,
- idioms & General vocabulary),
- Practical Use of Grammar (Nouns, Pronouns, Verbs, Adjectives, Adverbs, Prepositions, Conjunctions, Articles, Interjections & Tenses),
- Sentences (Types of sentences, Parts of sentences),
- Direct and Indirect Speech,
- Active & Passive Voice & Conditional Sentences),

Recommended Reading:

1. High School English Grammar & Composition by Wren and Martin.
2. Practical English Grammar by A.J. Thomson & A.V. Martinet. Exercises 1 & 2. 3rd edition. Oxford University Press.
3. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand & Françoise Grellet. Oxford Supplementary Skills. 4th Impression 1993. 4. Reading. Upper Intermediate. Brian Tomilson & Rod Ellis. Oxford Supplementary Skills. 3rd Impression 1992.
4. Précis writing by R. Dhillon.
5. Systems Student Companion English for lower secondary schools by Magdalene Chew & Surinder Kaur.

Course Name:	<i>Expository Writing</i>
Credit Hours:	3 (3-0)
Pre-requisites:	Functional English

Course Description:

This course will introduce students to the basic principles of effective / skillful writing and will develop the understanding of the students on academic and technical writing skills. Students will understand and know how to follow the stages of writing process and will apply these to technical and workplace writing tasks. Students will learn how to incorporate clarity and utility in their writing, learn stylistic methods for effective writing and to be aware of ethical issues in technical writing. Also, Students will read, analyze, and interpret material from technical fields, and will practice research and writing skills appropriate for technical topics.

Outcomes:

1. Students will be familiarized with basic sources and methods of research and documentation on topics including on-line research.
2. They will be able to synthesize and integrate material from primary and secondary sources wedded to their own ideas in research papers.

Course Contents:

- Topic sentence
- Paragraph writing:
- Essay writing:
 - Introduction and Practice: Essay types: descriptive, narrative, discursive, argumentative.
- CV and job application
- Letter and memo writing
- Minutes of meetings
- Summary and précis writing
- Comprehension

Recommended Reading:

1. Boutin, M., & Brinand, S., & Grellet, F. (1993). *Oxford Supplementary Skills*. Fourth Impression. Pages 45-53.
2. Nolasco, R. (1992). *Oxford Supplementary Skills* (3rd ed.). Fourth Impression.
3. Langan, J. (2004). *College Writing Skills*. Mc-Graw-Hill Higher Education.

Course Name:	<i>Technical and Business Writing</i>
Credit Hours:	3 (3-0)
Pre-requisites:	Communication and Presentation Skills

Course Introduction:

Students in the senior level needs good technical writing skills not only for writing project report but also useful for them to communicate their resume and get place in the market. This is a high level course which provide useful knowledge to the students for writing proposals etc. Further, the course aims at augmenting students’ proficiency in technical writing in order to sensitize them to the dynamics, challenges, and needs of the modern world characterized by technologically advanced social, cultural, and corporate settings. It will focus on students’ ability to effectively convey and exchange information in cross-cultural, international, and multinational milieu necessitated by the emergence of global society.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
-	-	-

Course Outline:

Overview of technical reporting, use of library and information gathering, administering questionnaires, reviewing the gathered information; Technical exposition; topical arrangement, exemplification, definition, classification and division, casual analysis, effective exposition, technical narration, description and argumentation, persuasive strategy, Organizing information and generation solution: brainstorming, organizing material, construction of the formal outline, outlining conventions, electronic communication, generation solutions. Polishing style: paragraphs, listening sentence structure, clarity, length and order, pomposity, empty words, pompous vocabulary, document design: document structure, preamble, summaries, abstracts, table of contents, footnotes, glossaries, cross-referencing, plagiarism, citation and bibliography, glossaries, index, appendices, typesetting systems, creating the professional report; elements, mechanical elements and graphical elements. Reports: Proposals, progress reports, Leaflets, brochures, handbooks, magazines articles, research papers, feasibility reports, project reports, technical research reports, manuals and documentation, thesis. Electronic documents, Linear verses hierarchical structure documents.

Reference Materials: (or use any other standard and latest books)

1. Technical Report Writing, by Pauley and Riordan, Houghton Mifflin Company, 8th Edition.
 2. Effective Technical Communication by Ashraf Rizvi, Tata McGraw-Hill.
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Course Name: Civics and Community Engagement**Credit Hours: 2(2-0)****Learning Outcomes:**

- Understand, critically think about, and reflect upon the history of democracy and civic engagement in the Pakistan.
- Identify and utilize - civic/community engagement skills such as: (advocacy, organizing, communications) and knowledge- (working in groups and teams, leadership, diversity, how systems work)
- Create civic sense and establish importance of civic and community engagement.
- Identify and explain the values and ethics for community engagement.
- Carry out a civic engagement activity incorporating some of their new knowledge and skills of civic engagement and reflect on their learning about the community, the issue addressed, and about themselves.

Course Contents-

Divided into categories for in-depth comprehension-

Category A: General

- The historical background of civic and community engagement
- Conceptual understanding of Human Rights and Minority Rights
- Dimensions of Citizens engagement in Community: Political, Social, Economic
- Rights and duties of Citizens in Community
- Organizations (National & International) and Groups
- Role of non-governmental organizations and their contributions
- NGOs: Nature and Scope
- International Commission for Red Cross (ICRC)
- Amnesty International
- Asia Watch

Category B: Pakistan's context

- Role of Citizens in Governance of Pakistan
- Democratic Accountability and Civic Engagement
- Enhancement of leadership skills among women and youth of Pakistan through civic community engagement programs

Recommended Books

1. Hoefler, R. (2012). Advocacy
2. for Practice. 3rd Edition. Chicago, IL: Lyceum Books, Inc. (ISBN-13: 978-1935871828)
3. Putnam, R. and Feldstein, L (2003). Better Together. New York, NY: Simon and Schuster. (ISBN-13: 978-0743235471)
4. Civic Engagement—What Is It and Why Is It Important? Kerry J. Kennedy
5. Universal Human Rights in Theory and Practice by Jack Donnelly
6. Adamantia Pollis and Peter Schwab, Human Rights Cultural and Ideological Perspectives. Preager Publishers, Preager Publishers, London, 1980.
7. Promoting and Protecting Minority Rights- A Guide for Advocates by United Nations.

8. Human Rights in International Law, Council of Europe press, 1992.
 9. United Nations, Human Rights Status of International Instruments, United Nations, Baltimore, New York, 1987.
-

Course Name: Principles of Marketing
Credit Hours: 3(3-0)

COURSE OBJECTIVE

This course objects at to make understand the marketplace and the consumers. Apprehend the elements in marketing mix and their application in marketing decisions. Outline the functions of marketing communication. Discuss social responsibility and ethics in marketing Understand the importance of customer relationship in marketing and the creation of customer value.

Introduction To Marketing

- Marketing and the Society
- Importance and scope of marketing
- Definition of marketing
- Nature and concept of marketing

Marketing Environments

- The Marketing environment
- Macro environment
- Micro environment
- Environmental scanning and monitoring

Marketing & Strategy

- Strategic planning
- Strategic marketing planning
- Forecasting marketing demand

Marketing Decisions

- Information required for marketing decisions
- Reasons for obtaining information
- Marketing research

Consumer Behavior

- Information for purchase decisions

- Consumer decision process
- Influence of social and psychological factors
- Market implications

Market Segmentation And Targeting

- Factors for Segmentation
- Selecting the target market
- Developing the positioning and target market strategies

Products And Services

- Definition of product and services
- Classification of consumer goods
- Classification of business goods

Product Development And Life Cycle

- Product development process and commercialization
- Product life cycle stages and its implications.

Pricing

- Overview of pricing
- Importance of pricing
- Break even analysis
- Factor effecting pricing decisions.

Distribution

- Importance of distribution channels
- Selecting a channel of distribution
- Retail functions in distribution
- Recent trends in wholesaling and retailing.

Promotion

- Importance and types of promotion
- Channels of communication
- Objectives, budgeting and promotional mix
- Legal environments of promotion.

Advertisement And Publicity

- Scope of advertisement and publicity
- Characteristic of advertisement and publicity.
- Development, planning and implementation of advertising plan.
- Evaluating the success and failure of promotional plan.

Introduction To E-Business

- Introduction and Different trends.
- Rules of doing e-business
- E-business application in the market

Recommended Books:

1. Philip Kotler, Principles of Marketing (17 Edition), Pearson.
 2. David Jobber, Principles of Marketing (Latest Edition)
 3. Jerome McCarthy & William, D. Pareanth, Basics Marketing, (Latest Edition).
 4. David L. Kurtz& Louis E. Boone, Contemporary Business (latest edition)
 5. Philip Kotler & Gary Armstrong, Principles of marketing (latest edition)
 6. Stephen P. Robbins and Mary Coulter, Management (13thEdition).
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Course Name: *Islamic Studies*

Credit Hours: 2 (2-0)

Objectives of the Course

This course is aimed at:

To provide Basic information about Islamic Studies

To enhance understanding of the students regarding Islamic Civilization

To improve Students skill to perform prayers and other worships

To enhance the skill of the students for understanding of issues related to faith and religious life

Course Content

Introduction to Qur'anic Studies

Basic Concepts of Quran

History of Quran

Uloom-ul-Quran

Study of Selected Text of Holy Quran

Verses of Surah Al-Baqara Related to Faith (Verse No-284-286)

Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)

Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)

Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)

Verses of Surah Al-Inam Related to Ahkam (Verse No-152-154)

Study of Selected Text of Holy Quran

Verses of Surah Al-Ahzab Related to Adab al-Nabi (Verse No.6, 21, 40, 56, 57, 58.)

Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment

Verses of Surah Al-Saf Related to Tafakkur, Tadabbur (Verse No-1,14)

Seerat of Holy Prophet (S.A.W)-I

Life of Muhammad Bin Abdullah (Before Prophet Hood)

Life of Holy Prophet (S.A.W) in Makkah

Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W)-II

Life of Holy Prophet (S.A.W) in Madina

Important Events of Life Holy Prophet in Madina

Important Lessons Derived from the life of Holy Prophet in Madina

Introduction to Sunnah

Basic Concepts of Hadith

History of Hadith

Kinds of Hadith

Uloom-ul-Hadith

Sunnah & Hadith

Legal Position of Sunnah

Selected Study from Text of Hadith

First Twenty Ahadith (Narrations of the Holy Prophet Muhammad peace be upon him) from the book “Al-Arbaeen Nawawi” by Imam Abu Zakaria Yahya bin Sharf Al-Deen Al-Nawawi

Introduction to Islamic Law & Jurisprudence

Basic Concepts of Islamic Law & Jurisprudence
History & Importance of Islamic Law & Jurisprudence
Sources of Islamic Law & Jurisprudence
Nature of Differences in Islamic Law
Islam and Sectarianism

Islamic Culture & Civilization

Basic Concepts of Islamic Culture & Civilization
Historical Development of Islamic Culture & Civilization
Characteristics of Islamic Culture & Civilization
Islamic Culture & Civilization and Contemporary Issues

Islam & Science

Basic Concepts of Islam & Science
Contributions of Muslims in the Development of Science
Quran & Science

Islamic Economic System

Basic Concepts of Islamic Economic System
Means of Distribution of wealth in Islamic Economics
Islamic Concept of Riba
Islamic Ways of Trade & Commerce

Political System of Islam

Basic Concepts of Islamic Political System
Islamic Concept of Sovereignty
Basic Institutions of Govt. in Islam

Islamic History

Period of Khilaft-e-Rashida
Period of Umayyad’s
Period of Abbasids

Social System of Islam

Basic Concepts of Social System of Islam
Elements of Family
Ethical Values of Islam

Reference Books:

1. Hameedullah Muhammad, “Emergence of Islam” , IRI, Islamabad
2. Hameedullah Muhammad, “Muslim Conduct of State”
3. Hameedullah Muhammad, ‘Introduction to Islam

4. Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.
5. Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993).
6. Mir Waliullah, "Muslim Jurisprudence and the Quranic Law of Crimes" Islamic Book Service (1982).
7. H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)
8. Dr. Muhammad Zia-ul-Haq, "Introduction to AL Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)
9. Imam Yahya bin Sharf Al-Deen Al-Nawawi, "Arbaeen Nawawi" Maktaba Khuddam Al-Quran, 36-K, Model Town, Lahore (2nd Edition: 2008).

Course Name: *Application of Information and Communication Technologies*

Credit Hours: 3 (2-1)

Pre-requisites: None

Course Introduction:

This is an introductory course in Computer Science designed for beginners. Apart from leading the participants through a whirlwind history of computing, the course also develops a feel for web programming through a series of lectures that help the students develop their own web page. Main objective of the course is to build an appreciation for the fundamental concepts in computing and to become familiar with popular PC productivity software.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand basics of computing technology	C1(Knowledge)
CLO-2	Do number systems conversions and arithmetic	C2(Understand)
CLO-3	Have knowledge of types of software	C2(Understand)
CLO-4	Have knowledge of computing related technologies	C3 (Apply)

Course Outline:

Brief history of Computer, Four Stages of History, Computer Elements, Processor, Memory, Hardware, Software, Application Software its uses and Limitations, System Software its Importance and its Types, Types of Computer (Super, Mainframe, Mini and Micro Computer), Introduction to CBIS (Computer Based Information System), Methods of Input and Processing. Organizing Computer Facility, Centralized Computing Facility, Distributed Computing Facility, Decentralized Computing Facility, Input Devices. Keyboard and its Types, Terminal (Dump, Smart, Intelligent), Dedicated Data Entry, SDA (Source Data Automation), Pointing Devices, Voice Input, Output Devices. Soft- Hard Copies, Monitors and its Types, Printers and its Types, Plotters, Computer Virus and its Forms, Storage Units, Primary and Secondary Memories, RAM and its Type Cache, Hard Disks, Working of Hard Disk, Diskettes, RAID, Optical Disk Storages

(DVD, CD ROM), Magnetic Types, Backup System, Data Communications, Data Communication Model, Data Transmission, Digital and Analog Transmission, Modems, Asynchronous and Synchronous Transmission, Simplex. Half Duplex, Full Duplex Transmission, Communications, Medias (Cables, Wireless), Protocols, Network Topologies (Star, Bus, Ring), LAN, LAN, Internet, A Brief History, Birthplace of ARPA Net, Web Link, Browser, Internet Services provider and Online Services Providers, Function and Features of Browser, Search Engines, Some Common Services available on Internet.

Reference Materials:

1. Charles S. Parker, Understanding Computers: Today and Tomorrow, CourseTechnology, 25 Thomson Place, Boston, Massachusetts 02210, USA
2. Livesley, Robert Kenneth. An introduction to automatic digital computers. Cambridge University Press, 2017.
3. Zawacki-Richter, Olaf, and Colin Latchem. "Exploring four decades of research in Computers & Education." Computers & Education 122 (2018): 136-152.
4. Sinha, Pradeep K., and Priti Sinha. Computer fundamentals. BPB publications, 2010.
5. Goel, Anita. Computer fundamentals. Pearson Education India, 2010.

Course Name:	<i>Ideology and Constitution of Pakistan</i>
Credit Hours:	2 (2-0)
Pre-requisites:	None

Learning Objectives

- To develop critical thinking for understanding Constitutional development in Pakistan;
- To develop understanding of the legal and constitutional structure of the state;
- To develop comprehension of the interconnectivity between the Constitutional provisions and political practice;
- To develop the understanding of students regarding ideological basis of Pakistan as well as role of ideology in building national character.

Contents of the Course

Course is divided into two sections to cover the maximum portion of the course.

Section A: Ideological understanding and development of Pakistan

1. Basis of Ideology of Pakistan and Two Nations Theory
2. Ideology of Pakistan: Vision of Quaide e Azam and Allama Iqbal
3. Role of ideology in building national character
4. Democratic system of Pakistan (Issues)
5. Major causes of the Imposition of martial Law (1958, 1969, 1977&1999).

Section B: Constitutional Development of Pakistan

6. Pakistan’s Constitutional Development from 1947 onward.
7. An Overview of the Constitution of Pakistan (Features of 1973 Constitution).

8. Basic Concepts—Federalism and the 1973 Constitution.
9. Islam and the Constitution of Pakistan -1973.
10. Constitutional Amendments and Reforms- 1973.

Recommended Books:

Students are advised to take notes during lectures. Certain books have been recommended for reference and quality of analysis.

- Constitution of Pakistan
 - The Constitutional History of Pakistan—1947-2012, Malik Muhammad Owais Khalid, 2012
 - Constitutional History and Political Development, Hamid Khan, 2005
 - Constitutional Development in Pakistan, G.W. Chaudhary
 - Constitution Making in Pakistan 1947-85, Dr. Baz Muhammad
 - Allen Gledhill, Pakistan: The Development of its Laws and Constitution
 - “Military, State and Society in Pakistan” by Hasan Askari Rizvi, 2000.
 - Kazmi, Raza, Pakistan Studies, Karachi Oxford University Press.
 - Qureshi, I. H., A Short History of Pakistan, University of Karachi Press.
 - Qureshi, I. H., Struggle for Pakistan, University of Karachi Press.
 - Sayeed, K. B., Pakistan Formative Phase, National Book Service
 - Ziring, Lawrence, Pakistan in Twentieth Century: A Political History, London; Oxford University Press
 - Government and politics in Pakistan by Mushtaq Ahmad
 - Ideology and Dynamics of Politics in Pakistan by Muhammad Asif Malik
-

Course Name: Introduction to Psychology

Credit hours: 2 (2,0)

AIMS AND OBJECTIVES

To ensure that the students are aware of the nature, origin, history and scope of Psychology as a modern discipline and its relationship with other sciences and to have a working knowledge of the application and the practice of psychology in real life.

Introduction to Psychology:

- Nature and Application of Psychology with special reference to Pakistan.
- Historical Background and Schools of Psychology (A Brief Survey)

Methods of Psychology:

- Observation
- Case History Method
- Experimental Method

- Survey Method
- Interviewing Techniques

Biological Basis of Behavior:

- Neuron: Structure and Functions
- Central Nervous System and Peripheral Nervous System
- Endocrine Glands

Sensation, Perception, and Attention

Sensation:

- Characteristics and Major Functions of Different Sensations
- Vision: Structure and functions of the Eye.
- Audition: Structure and functions of the Ear

Perception:

- Nature of Perception
- Factors of Perception: Subjective, Objective and Social
- Kinds of Perception
 - Spatial Perception (Perception of Depth and Distance)
 - Temporal Perception
 - Auditory Perception

Attention:

- Factors
 - Subjective
 - Objective
- Span of Attention
- Fluctuation of Attention
- Distraction of Attention (Causes and Control)

SUGGESTED READINGS:

- Atkinson R. C., & Smith E. E. (2000). *Introduction to psychology* (13th ed.). Harcourt Brace College Publishers.
- Fernald, L. D., & Fernald, P. S. (2005). *Introduction to psychology*. USA: WMC Brown

Publishers.

- Glassman, W. E. (2000). *Approaches to psychology*. Open University Press.
- Hayes, N. (2000). *Foundation of psychology* (3rd ed.). Thomson Learning.
- Lahey, B. B. (2004). *Psychology: An introduction* (8th ed.). McGraw-Hill Companies, Inc.
- Leahey, T. H. (1992). *A history of psychology: Main currents in psychological thought*. New Jersey: Prentice-Hall International, Inc.
- Myers, D. G. (1992). *Psychology* (3rd ed.). New York: Wadsworth Publishers.
- Ormord, J. E. (1995). *Educational psychology: Developing learners*. PrenticeHall, Inc

Course Name: *Professional Practices*
Credit Hours: 2 (2-0)
Pre-requisites: None

Course Introduction:

A Computing graduate as professional has some responsibilities with respect to the society. This course develops student understanding about historical, social, economic, ethical, and professional issues related to the discipline of Computing. It identifies key sources for information and opinion about professionalism and ethics. Students analyze, evaluate, and assess ethical and professional computing case studies.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
-	-	-

Course Outline:

Historical, social, and economic context of Computing (software engineering, Computer Science, Information Technology); Definitions of Computing (software engineering, Computer Science, Information Technology) subject areas and professional activities; professional societies; professional ethics; professional competency and life-long learning; uses, misuses, and risks of software; information security and privacy; business practices and the economics of software; intellectual property and software law (cyber law); social responsibilities, software related contracts, Software house organization. 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: (or use any other standard and latest books)

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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Course Name: *Applied Physics*
Credit Hours: 3 (2-1)
Pre-requisites: None

Course Introduction:

The course introduces students with the basic concept of Physics and electronics. Students are also taught Physics laws and other associate topics to prepare them for the advanced level courses in this area. The focus of the course on electric force and its applications and related problems, conservation of charge, charge quantization, Electric fields due to point charge and lines of force and many other useful topics.

CLO No. Course Learning Outcomes

Bloom Taxonomy

Course Outline:

Electric force and its applications and related problems, conservation of charge, charge quantization, Electric fields due to point charge and lines of force. Ring of charge, Disk of charge, A point charge in an electric field, Dipole in a n electric field, The flux of vector field, The flux of electric field, Gauss' Law, Application of Gauss' Law, Spherically symmetric charge distribution, A charge isolated conductor, Electric potential energy, Electric potentials, Calculating the potential from the field and related problem Potential due to point and continuous charge distribution, Potential due to dipole, equipotential surfaces, Calculating the field from the potential
, Electric current, Current density, Resistance, Resistivity and conductivity, Ohm's law and its applications, The Hall effect, The magnetic force on a current, The Biot- Savart law, Line of B, Two parallel conductors, Amperes' s Law, Solenoid, Toroids, Faraday's experiments, Faraday's Law of Induction, Lenz's law, Motional emf, Induced electric field, Induced electric fields, The basic equation of electromagnetism, Induced Magnetic field, The displacement current, Reflection and Refraction of light waves, Total internal reflection, Two source interference, Double Slit interference, related problems, Interference from thin films, Diffraction and the wave theory, related problems, Single-Slit Diffraction, related problems, Polarization of electromagnetic waves, Polarizing sheets, related problems.

Reference Materials: (or use any other standard and latest books)

1. Fundamentals of Physics (Extended), 10th edition, Resnick and Walker
2. Narciso Garcia, Arthur Damask, Steven Schwarz., "Physics for Computer Science Students", Springer Verlag, 1998.

Course Name: *Discrete Structure*
Credit Hours: 3 (3-0)
Pre-requisites: None

Course Introduction:

Introduces the foundations of discrete mathematics as they apply to Computer Science, focusing on providing a solid theoretical foundation for further work. Further, this course aims to develop understanding and appreciation of the finite nature inherent in most Computer Science problems and structures through study of combinatorial reasoning, abstract algebra, iterative procedures, predicate calculus, tree and graph structures. In this course more emphasis shall be given to statistical and probabilistic formulation with respect to computing aspects.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand the key concepts of Discrete Structures such as Sets, Permutations, Relations, Graphs and Trees etc.	C2 (Understand)
CLO-2	Apply formal logic proofs and/or informal, but rigorous, logical reasoning to real problems, such as predicting the behavior of software or solving problems such as puzzles.	C3 (Apply)
CLO-3	Apply discrete structures into other computing problems such as formal specification, verification, databases, artificial intelligence, and cryptography.	C3 (Apply)
CLO-4	Differentiate various discrete structures and their relevance within the context of computer science, in the areas of data structures and algorithms, in particular	C4 (Differentiate)

Course Outline:

Mathematical reasoning, propositional and predicate logic, rules of inference, proof by induction, proof by contraposition, proof by contradiction, proof by implication, set theory, relations, equivalence relations and partitions, partial orderings, recurrence relations, functions, mappings, function composition, inverse functions, recursive functions, Number Theory, sequences, series, counting, inclusion and exclusion principle, pigeonhole principle, permutations and combinations. Algorithms, Searching and Sorting Algorithms, elements of graph theory, planar graphs, graph coloring, Graph Algorithms, euler graph, Hamiltonian path, rooted trees, traversals.

Reference Materials: (or use any other standard and latest books)

1. Discrete Mathematics and Its Applications, 7th edition by Kenneth H. Rosen
2. Discrete Mathematics with Applications, 4th Edition by Susanna S. Epp
3. Discrete Mathematics, 7th edition by Richard Johnson Baugh
4. Discrete Mathematical Structures, 4th edition by Kolman, Busby & Ross
5. Discrete and Combinatorial Mathematics: An Applied Introduction by Ralph P. Grimaldi
6. Logic and Discrete Mathematics: A Computer Science Perspective by Winifred Grassman

Course Name: *Calculus and Analytic Geometry*
Credit Hours: 3 (3-0)
Pre-requisites: None

Course Introduction:

To provide foundation and basic ground for calculus and analytical geometry background.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
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Course Outline:

Limits and Continuity; Introduction to functions, Introduction to limits, Techniques of finding limits, Indeterminate forms of limits, Continuous and discontinuous functions and their applications, Differential calculus; Concept and idea of differentiation, Geometrical and Physical meaning of derivatives, Rules of differentiation, Techniques of differentiation, Rates of change, Tangents and Normals lines, Chain rule, implicit differentiation, linear approximation, Applications of differentiation; Extreme value functions, Mean value theorems, Maxima and Minima of a function for single-variable, Concavity, Integral calculus; Concept and idea of Integration, Indefinite Integrals, Techniques of integration, Riemann sums and Definite Integrals, Applications of definite integrals, Improper integral, Applications of Integration; Area under the curve, Analytical Geometry; Straight lines in R^3 , Equations for planes.

Reference Materials: (or use any other standard and latest books)

1. Calculus and Analytic Geometry by Kenneth W. Thomas.
2. Calculus by Stewart, James.
3. Calculus by Earl William Swokowski; Michael Olinick; Dennis Pence; Jeffery A. Cole

List of Computing Electives

S.No	Course	Credit Hours
1.	E-Commerce Technologies & Applications	3(3+0)
2.	Digital Marketing	3(2+1)
3.	Cyber Security	3(3+0)
4.	Web Technologies	3(2+1)
5.	Data Science	3(2+1)
6.	Information Architecture	3(3+0)
7.	Data Mining	3(3+0)
8.	Web Content Management Systems	3(2+1)
9.	Internet of Things (IoT)	3(3+0)
10.	Artificial Neural Networks and Deep Learning	3(2+1)
11.	Programming for Artificial Intelligence	3(2+1)
12.	Natural Language Processing	3(3+0)
13.	Wireless and Mobile Networks	3(3+0)
14.	Fundamentals of Data Warehousing	3(3+0)
15.	Software Requirement Engineering	3(2+1)
16.	Web Engineering	3(2+1)
17.	R Programming	3(2+1)
18.	Usability Engineering	3(3+0)
19.	Research Methodology	3(3+0)
20.	Software Architecture and Design	3(3+0)
21.	Machine Learning	3(2+1)
22.	Digital Image Processing	3(3+0)
23.	Network Security	3(3+0)
24.	Telecommunication Systems	3(3+0)
25.	Information Retrieval	3(3+0)
26.	Wearable Technology	3(3+0)
27.	Mobile Application Development	3(2+1)
28.	Programming in Python	3(2+1)
29.	Object Oriented Analysis and Design	3(3+0)
30.	Object Oriented Programming in Java	3(2+1)
31.	Emerging Computer Networks	3(3+0)

Note* The University may offer other subjects than the electives list.