DEPARTMENT OF COMPUTER SCIENCE

UNIVERSITY OF CHITRAL

Scheme of Studies Bachelor of Science in Computer Science

1ST MEETING OF THE BOARD OF STUDIES

12TH OCTOBER, 2021

ANNEXURE – A

Scheme of Studies Bachelor of Science in Computer Science

Name of Degree: Bachelor of Science in Computer Science

Eligibility Criteria: The minimum requirements for admission is at least 45% marks in FSc/FCS/equivalent Examination.

Duration: The minimum duration for completion of BSCS degree is four and maximum is seven years' subject to approval of extension from the competent authority.

Degree Completion Requirements:

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

a. Must have studied and passed the prescribed courses, totaling at least 136 credit hours.
b. Must have earned CGPA (Cumulative Grade Point Average) of at least 2.0 on a scale of 4.0.

BSCS Curriculum Design

The structure of BSCS Program is proposed to meet the needs of students through theory and practical computing experience. The students are expected to learn theoretical and practical understanding of the respective field of Computing.

The proposed structure is dynamic and provides basis for various options including Breadth-Based, Depth-Based, and Integrated Breadth & Depth-Based specializations. Student may choose a particular option, which is most appropriate to their planned future career. The following are some relevant details:

The following table gives the distribution of credit hours in different domains of knowledge.

Table 1 Areas Covered in BSCS Program

Course Group	**Credit hours**
Computing Core	39
Computer Science Core	24
Computer Science Supporting	09
Mathematics & Science Foundation	12
General Education	19
University Electives	12
Computer Science Electives	21
Total	136

Table 1.1 Computing Core Courses

Course Code	Course Title	Credit hours
CS 111	Programming Fundamentals	4(3-1)
CS 112	Discrete Structures	3(3-0)
CS 121	Object Oriented Programming	4(3-1)
CS 231	Data Structures & Algorithms	4(3-1)
CS 242	Database Systems	4(3-1)
CS 351	Operating Systems	4(3-1)
CS 354	Computer Networks	4(3-1)
CS 361	Software Engineering	3(3-0)
CS 364	Information Security	3(3-0)
Proj-489	Final Year Project	6(0-6)
Total		39 (27-12)

Table 1.2 Computer Science Core Courses

Course Code	Course Title	Credit hours
CS 232	Digital Logic & Design	4(3-1)
CS 241	Computer Organization & Assembly Language	4(3-1)
CS 352	Theory of Automata	3(3-0)
CS 353	Design & Analysis of Algorithms	3(3-0)
CS 362	Compiler Construction	3(3-0)
CS 463	Parallel & Distributed Computing	3(3-0)
CS 472	Artificial Intelligence	4(3-1)
Total		24 (21-3)

Table 1.3 Computer Science Supporting Courses

Course Code	Course Title	Credit hours
CS 235	Multivariate Calculus	3(3-0)
CS 343	Differential Equations	3(3-0)
CS 481	Theory of Programming Languages	3(3-0)
Total		9-0

Table 1.4 Mathematics and Science Foundation Courses

Course Code	Course Title	Credit hours
CS 114	Calculus & Analytical Geometry	3(3-0)
CS 122	Linear Algebra	3(3-0)
CS 125	Applied Physics	3(3-0)
CS 233	Probability & Statistics	3(3-0)
	Total	12-0

Table 1.5 General Education Courses

Course Code	Course Title	Credit hours
CS 113	Introduction to Information & Communication Technologies	3(2-1)
CS 115	English Composition & Comprehension	3(3-0)
CS 116	Islamic Studies/ Ethics	2(2-0)
CS 123	Technical & Business Writing	3(3-0)
CS 124	Pakistan Studies	2(2-0)
CS 234	Communication & Presentation Skills	3(3-0)
CS 471	Professional Practices	3(3-0)
Total		18-1

Table 1.6 University Elective Courses

Course Code	Course Title	Credit hours
CS 126	Fundamentals to Geography	3(3-0)
CS 127	Entrepreneurship	3 (3+0)
CS 247	Introduction to Economics	3(3+0)
CS 248	Organizational Behavior	3(3+0)
CS 355	Introduction to Philosophy	3(3+0)
CS 356	Introduction to Sociology	3(3+0)
CS 367	Introduction to Management	3(3+0)
CS 368	Principle of Marketing	3(3+0)
Total (At least 12 credit hours from the above)		12-0

Table 1.7 Computer Science Elective Courses

Course Code	Course Title	Credit hours
CS 244	Microprocessor and Assembly Language	3(3+0)
CS 245	Data Communication Networks	3(3+0)
CS 246	Web Technologies	3 (2+1)
CS 365	Visual Programing	3(2+1)
CS 366	Mobile Applications Development	3(2+1)
CS 473	Distributed Data Base Systems	3(2+1)
CS 474	Cryptography	3(3+0)
CS 475	Web Development	3(2+1)
CS 476	Advance Programing	3(2+1)
CS 477	Software Project Management	3(3+0)
CS 478	Introduction to Data Mining	3(2+1)
CS 483	Introduction to Data Science	3(2+1)
CS 484	Networks Security	3(3+0)
CS 485	Cyber Security	3(3+0)
CS 486	Digital Marketing	3(3+0)
Total (Any Seven of the above)		21

1st Semester (18 Credit Hours)		
Course Code	Course Name	Credit Hours
CS 111	Programming Fundamentals	4 (3+1)
CS 112	Discrete Structures	3(3+0)
CS 113	Introduction to Information & Communication Technologies	3 (2+1)
CS 114	Calculus & Analytical Geometry	3(3+0)
CS 115	English Composition & Comprehension	3(3+0)
CS 116	Islamic Studies	2(2+0)
Total Credit Hours		18(16+2)

2nd Semester (18 Credit Hour)		
Course Code	Course Name	Credit Hours
CS 121	Object Oriented Programming	4 (3+1)
CS 122	Linear Algebra	3(3+0)
CS 123	Technical & Business Writing	3(3+0)
CS 124	Pakistan Studies	2(2+0)
CS 125	Applied Physics	3 (3+0)
Any one of the following Courses		
CS 126	Fundamentals of Geography	3 (3+0)
CS 127	Entrepreneurship	3 (3+0)
Total Credit Hours		18(17-1)

3rd Semester (17 Credit Hour)		
Course Code	Course Name	Credit Hours
CS 231	Data Structures & Algorithms	4 (3+1)
CS 232	Digital Logic & Design	4 (3+1)
CS 233	Probability & Statistics	3 (3+0)
CS 234	Communication & Presentation Skills	3 (3+0)
CS 235	Multivariate Calculus	3 (3+0)
Total Credit Hours		17 (15+2)

4th Semester (17 Credit Hour)		
Course Code	Course Name	Credit Hours
CS 241	Computer Organization & Assembly Language	4 (3+1)
CS 242	Database Systems	4 (3+1)
CS 243	Differential Equations	3(3+0)
Any one of the following Courses		
CS 244	Microprocessor and Assembly Language	3(3+0)
CS 245	Data Communication Networks	3(3+0)
CS 246	Web Technologies	3(2+1)
Any one of the following Courses		
CS 247	Introduction to Economics	3(3+0)
CS 248	Organizational Behaviour	3(3+0)
Total Credit Hours		17(15+2)

5th Semester (17 Credit Hour)		
Course Code	Course Name	Credit Hours
CS 351	Operating Systems	4 (3+1)
CS 352	Theory of Automata	3(3+0)
CS 353	Design & Analysis of Algorithms	3(3+0)
CS 354	Computer Networks	4 (3+1)
Any one of the following Courses		
CS 355	Introduction to Philosophy	3(3+0)
CS 356	Introduction to Sociology	3(3+0)
Total Credit Hours		17(15+2)

6th Semester (18 Credit Hour)		
Course Code	Course Name	Credit Hours
CS 361	Software Engineering	3(3+0)
CS 362	Compiler Construction	3 (3+0)
CS 363	Parallel & Distributed Computing	3(3+0)
CS 364	Information Security	3(3+0)
Any one of the following Courses		
CS 365	Visual Programing	3(2+1)
CS 366	Mobile Applications Development	3(2+1)
Any one of the following Courses		
CS 367	Introduction to Management	3(3+0)
CS 368	Principle of Marketing	3(3+0)
Total Credit Hours		18(18+0)

7th Semester (16 Credit Hour)		
Course Code	Course Name	Credit Hours
CS 471	Professional Practices	3(3+0)
CS 472	Artificial Intelligence	4 (3+1)
Any Three courses from the following		
CS 473	Distributed Data Base Systems	3(2+1)
CS 474	Cryptography	3(3+0)
CS 475	Web Development	3(2+1)
CS 476	Advance Programing	3(2+1)
CS 477	Software Project Management	3(3+0)
CS 478	Introduction to Data Mining	3(2+1)
Total Credit Hours		16(12+4)

8th Semester (15 Credit Hour)		
Course Code	Course Name	Credit Hours
CS 481	Theory of Programming Languages	3(3+0)
Any two courses from the following		
CS 483	Introduction to Data Science	3(2+1)
CS 484	Networks Security	3(3+0)
CS 485	Cyber Security	3(3+0)
CS 486	Digital Marketing	3(3+0)
Proj-489	Final Year Project	6(0+6)
Total Credit Hours		15(09+6)

Course Code: CS 111	**Course Name:** Programming Fundamentals	**Credit Hours:** 4 (3+1)	**Prerequisites:** None
Course Learning Outcomes:			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Understand basic problem solving steps and logic constructs		Cognitive	2
Apply basic programing concepts		Cognitive	3
Design and implement algorithms to solve real world problems		Cognitive	3

Course Content:

Week-1: Introduction to Programming Languages, History of C++, Basic elements of C++, C++ character set, C++ words, Reserve words, User define words/identifier, Rules for identifier

Week-2: Basic Data Types **(**Int**,** Float**,** Char**),** Modifiers **(**Long, Signed, Unsigned, Double, Long Double, Short**),** Numbers **(**Integer Numbers**,** Real Numbers**),** Types of identifiers **(**Constant identifier**,** Variable identifier), Statements

Week-3: General Structure of C++ Program**,** Input Statement, Output Statement**,** String/message**,** Char/Char identifier**,** Assignment Statement**,** Operators**,** Arithmetic Operators**,** Relational Operators**,** Logical Operators**,** Expression**,** Initialization Statement**,** Increment Operator (Prefix & Postfix forms), getche () function, getch () function, Escape sequences

Week-4: Comments in C++ Program**,** Pre-processor Directives**,** Difference between Declaration & Definition**,** Arithmetic Assignment Expression**,** Priority of Operators**,** Conversion of Mathematical formula into C++ expression

Week-5: Control structures/Decision Control structure, Transfer of control Statements (TOCS), Repetitive Control structure/statements (Loops), Conditional TOCS, Single alternative if statement and Nested if statement, Double alternative if statement (if-else statement) and Nested if-else statement

Week-6: Conditional operator/Ternary Operator (? :)**,** Switch statement/Multiple Branching statement and Nested Switch statement**,** Manipulators **(**endl manipulator**,** setw manipulator**),** Continue statement**,** Break statement, goto statement

Week-7: Loop**,** Types of Loop**,** Fixed loop (count control loop)**,** Non-fixed loop (event control loop), Fixed loop/for loop**,** Variations in for loop**,** Defining variable in for loop**,** Multiple initializations in for loop**,** Multiple inc/dec expressions in for loop**,** Initialization outside for loop, Inc/dec expression inside for loop**,** No testing (infinite loop), Output statement inside for loop, Nested for loop

Week-8: Non-fixed loop (event control loop)**,** While-loop (Pre-tested loop)**,** Do-while loop (Post-tested loop), Nested while & do-while loop

Week-9: Arrays**,** One-dimensional array**,** Two-dimensional array

Week-10: Sorting and searching**,** Bubble sort**,** Linear search**,** Strings (array of characters)

Week-11: Function**,** Types of Function**,** Built-in function**,** User-defined function, Parts of user defined function

Week-12: Function with values and no return**,** Function with values and return**,** passing values from a function, Passing arguments to a function

Week-13: Pointers Basic Concepts**,** Structure**,** specifying structure**,** Defining structure variable**,** Accessing structure members **Week-14:**String and string operations, pointers/references, static and dynamic memory allocation **Week-15-16:** File I/O operations
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. Starting out with Programming Logic & Degins, 4th Edition, Tony Gaddis, 2. C How to Program, 7th Edition by Paul Deitel & Harvey Deitel 3. The C Programming Language, 2nd Edition by Brian W. Kernighan, Dennis M. Ritchie 4. Object Oriented Programming in C++ by Robert Lafore 5. Introduction to Computation and Programming Using Python: With Application to Understanding Data, 2nd Edition by Guttag, John 6. Practice of Computing Using Python, 3rd Edition by William Punch & Richard Enbody 7. Starting out with Python, 4th Edition, Tony Gaddis. 8. 8. Problem Solving and Program Design in C++, 7th Edition by Jeri R. Hanly & Elliot B. Koffman

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 112	Discrete Structures	3(3+0)	None
Course Learning Outcomes:			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Understand the key concepts of Discrete Structures such as Sets, Permutations, Relations, Graphs, and Trees etc.		Cognitive	2
Apply formal logic proofs and/or informal, but rigorous, logical reasoning to real problems, such as predicting the behaviour of software or solving problems such as puzzles.		Cognitive	3
Apply discrete structures into other computing problems such as formal specification, verification, databases, artificial intelligence, and cryptography.		Cognitive	3
Differentiate various discrete structures and their relevance within the context of computer science, in the areas of data structures and algorithms, in particular.		Cognitive	4

Course Content:

Mathematical reasoning

Week-1: Objectives of the course, Mathematical reasoning
Week-2: Propositional and predicate logic,
Week-3: Rules of inference, proof by induction, proof by contraposition
Week-4: Proof by contradiction, proof by implication

Set theory

Week-5: Relations, equivalence relations and partitions
Week-6: Partial orderings, recurrence relations
Week-7: Functions, mappings, function composition
Week-8: Inverse functions, recursive functions

Number Theory

Week-9: Sequences, series
Week-10: Counting, inclusion and exclusion principle, pigeonhole principle
Week-11: Permutations
Week-12: Combinations

Graph theory

Week-13: Elements of graph theory
Week-14: Planar graphs, graph coloring, euler graph
Week-15: Hamiltonian path, rooted trees
Week-16: Traversals

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Presentations

Course Assessment:

Home Assignments, Quizzes, Presentations, Midterm Exam, Final Exam

Reference Materials:

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 Code: CS 113	**Course Name:** Introduction to Information & Communication Technologies	**Credit Hours:** 3 (2+1)	**Prerequisites:** **None**
Course Learning Outcomes:			
At the end of the course the students will be able to:		**Domain**	Bloom's Taxonomy Level

Course Content:

Week-1: Computer, Introduction /Block Diagram**,** Brief History/Generations**,** Components, Applications

Week-2: Types of Computer, Classification according to Logic used, Classification according to size (Super Computers, Mainframe Computers, Mini Computer, Micro Computers, Hardware Vs Software

Week-3: Parts of a Computer, The System Unit**,** The Processors**,** Memory**,** Disk Systems, Display cards, The Monitors**,** Keyboard**,** Storage Devices**,** Printers

Week-4: Types of software, Systems Software (Operating Systems (Windows, MS-DOS, LINUX)**,** Translators (Compilers, Interpreters)**,** Utility Programs)**,** Applications software **(**General Purpose, Word Processors, Spreadsheets, Data Bases, (Accounting Packages), Communication software, Graphical designing packages, Special Purpose Application Software

Week-5: Operating systems, Introduction to Windows, Familiarization with Windows Icons**,** My Computer, Recycle Bin, Control panel, Start Button, Other Sub Menus, Task Bar**,** Shut down Processes

Week-6: MS Windows: Use of start Menu**,** Customize the desktop**,** Use of Windows Help, use of Windows accessories, Word pad**,** Calculator, Paint, managing files and folders using My Computer, managing files and Folders using Windows Explorer, Managing Recycle bin operations**,** Internet Explorer (Send/receive E-Mail, Browsing Internet)

Week-7: MS-Word, Open and save files in specified path or new folder**,** Selection of text by different methods and applying different operations, Copying Moving & Deleting, Formatting text (Bold, Underline, Font, Color (Font, Fill)

Week-8: MS-Word, Use of Undo and Redo**,** Use of text alignment, indenting and managing space. Also, use of bullets and Numbering**,** Use of Page setup including page margin, Size, paper source & Layout and Printing a Page, Insert (Picture, Header & Footer etc)

Week-9: MS-Excel, Inserting and deleting cells, rows and columns**,** Managing worksheets, Formatting and Customizing data, Text Alignment, Border, Patterns and Drawing

Week-10: MS-Excel, Use of formulas and functions (formatting numbers, decimal places, columns and row setup etc), Use of page setup and printing configurations

Week-11: MS-PowerPoint, create a New Presentation (Blank, Design Template), New Slide**,** Formatting and Customizing data**,** Animation Schemes, Action Buttons, Action Settings etc

Week-12: The need of Programming**,** Programming Languages, Machine Language, Low-Level Languages, High-Level Languages

Week-13: Binary, Octal, Decimal and Hexadecimal**,** Conversion from one number system to other**,** Binary to Decimal**,** Binary to Octal **Week-14:** Malicious Software Types of Malicious Software, Protection from Malicious Software **Week-15:** Data Transmission Modes**,** Transmission Media, Types of Networks, Local Area Network**,** Wide Area Network **Week-16:** Introduction to Software Engineering**,** Software Process, Elements of Software Design Life Cycle (SDLC)
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: Bruce J. McLaren, Understanding and Using the Internet, West Publishing Company, 610 Opperman Drive, P. 0. Box 64526, St. Paul, MN 55164 Computer Applications for Business, 2nd Edition, DDC Publishing, 275 Madison Avenue, New York Nita Hewitt Rutkosky, Microsoft Office Professional, Paradigm Publishing Company, 875 Montreal Way,St Paul, MN 55102

Course Code: CS 114	**Course Name:** Calculus & Analytical Geometry	**Credit Hours:** 3(3+0)	**Prerequisites: None**
Course Learning Outcomes:			
At the end of the course the students will be able to:		**Domain**	Bloom's Taxonomy Level
Course Content: **Week-1:** Limits and Continuity; Introduction to functions, **Week-2 & 3:** Introduction to limits, Techniques of finding limits, Indeterminate forms of limits **Week-4:** Continuous and discontinuous functions and their applications, **Week-5:** Differential calculus; Concept and idea of differentiation **Week-6:** Geometrical and Physical meaning of derivatives **Week-7:** Rules of differentiation **Week-8:** Techniques of differentiation **Week-9:** Rates of change, Tangents and Normals lines, Chain rule **Week-10:** implicit differentiation, linear approximation, Applications of differentiation **Week-11:** Extreme value functions, Mean value theorems, Maxima and Minima of a function for single-variable, Concavity **Week-12:** Integral calculus; Concept and idea of Integration, Indefinite Integrals			

Week-13: Techniques of integration, Riemann sums and Definite Integrals **Week-14:** Applications of definite integrals, Improper integral **Week-15:** Applications of Integration; Area under the curve **Week-16:** Analytical Geometry; Straight lines in R3, Equations for planes.
Teaching Methodology: Lectures, Written Assignments, Presentations
Course Assessment: Home Assignments, Quizzes, Presentations, Midterm Exam, Final Exam
Reference Materials: 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 4. Calculus by Thomas/Finney 9th Edition 5. Advance Engineering Mathematics by Erwin Kreyszig 8th Edition

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 115	English Composition & Comprehension	3(3+0)	**None**
Course Learning Outcomes:			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
To introduce and enhance the basic grammatical concepts of the English Language. Students in this course will learn to improve their basic and fundamental writing, reading and speaking skills.			
To enable them to use the English language correctly in their Business Administration field for which English language competency is a prerequisite.			
Course Content: **Week-1-2:** Introduction to Part of Speech **Week-3-4:** Open and Closed Classes of Words **Week-5:** Nouns and Determiners: Regular and Irregular Nouns **Week-6:** Classes of Irregular Nouns, Foreign Plurals **Week-7:** Count and Non-Count Nouns, Use of Determiners with Noun **Week-8:** Use of Definite Article **Week-9:** Verbs: Regular and Irregular Verbs **Week-10:** Lexical and Auxiliary verbs **Week-11:** Uses of Model Auxiliary Verbs **Week-12:** Adjectives and Adverbs: Difference; Inflection and Derivation **Week-13:** Types of Adjectives and Adverbs;			

Week-14: Order of Adjectives; Degrees of Adjectives **Week-15:** Prepositions and Conjunctions **Week-16:** Basic Sentence and Its Composition
Teaching Methodology: Lectures, Written Assignments, Presentations
Course Assessment: Home Assignments, Quizzes, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. College Writing Skills with Readings, by John Langan, McGraw-Hill, 5th Edition. 2. A Textbook of English Prose and Structure by Arif Khattak, et al, GIKI Institute, 2000 3. English Grammar in Use by Raymond Murphy. Cambridge University Press' 4. A University Grammar of English by Randolph Quirck and Sidney Greenbaum. ELBS 5. Practical English Usage by Michael Swan. ELBS

Course Code: CS 116	**Course Name:** Islamic Studies	**Credit Hours:** 2(2+0)	**Prerequisites:** **None**
Course Learning Outcomes:			
At the end of the course the students will be able to: This course is aimed at: 1 To provide Basic information about Islamic Studies 2 To enhance understanding of the students regarding Islamic Civilization 3 To improve Students skill to perform prayers and other worships 4 To enhance the skill of the students for understanding of issues related to faith and religious life.		Domain	Bloom's Taxonomy Level
Introduction to Quranic Studies 1) Basic Concepts of Quran 2) History of Quran 3) Uloom-ul-Quran **Study of Selected Text of Holly Quran** 1) Verses of Surah Al-Baqara Related to Faith(Verse No-284-286) 2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)			

3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)

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

1) Life of Muhammad Bin Abdullah (Before Prophet Hood)
2) Life of Holy Prophet (S.A.W) in Makkah
3) Important Events of Life of Holy Prophet in Makkah

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

1) Life of Holy Prophet (S.A.W) in Madina
2) Important Events of Life of Holy Prophet in Madina

Introduction to Sunnah

1) Basic Concepts of Hadith
2) History of Hadith
3) Kinds of Hadith
4) Sunnah & Hadith
5) Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction to Islamic Law & Jurisprudence

1) Basic Concepts of Islamic Law & Jurisprudence
2) History & Importance of Islamic Law & Jurisprudence
3) Sources of Islamic Law & Jurisprudence

Islamic Culture & Civilization

1) Basic Concepts of Islamic Culture & Civilization
2) Characteristics of Islamic Culture & Civilization

Islam & Science

1) Basic Concepts of Islam & Science
2) Contributions of Muslims in the Development of Science
3) Quran & Science

Islamic Economic System

1) Basic Concepts of Islamic Economic System
2) Islamic Concept of Riba

Political System of Islam

1) Basic Concepts of Islamic Political System
2) Islamic Concept of Sovereignty
3) Basic Institutions of Govt. in Islam

Teaching Methodology:
Lectures, Written Assignments, Presentations

Course Assessment: Home Assignments, Quizzes, Presentations, Midterm Exam, Final Exam
Reference Materials: 1) Hameed ullah Muhammad, "Emergence of Islam" , IRI, Islamabad 2) Hameed ullah Muhammad, "Muslim Conduct of State" 3) Hameed ullah Muhammad, 'Introduction to Islam 1) Mulana Muhammad Yousaf Islahi," 5) Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan. 6) Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993) 7) Mir Waliullah, "Muslim Jurisprudence and the Quranic Law of Crimes" Islamic Book Service (1982) 8) H. S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989) 9) Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)

Course Code: CS 121	**Course Name:** Object Oriented Programming	**Credit Hours:** 4 (3+1)	**Prerequisites:** Programming Fundamentals
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
1. Understand principles of object oriented paradigm		Cognitive	2
2. Identify the objects & their relationships to build object oriented solution		Cognitive	3
3. Model a solution for a given problem using object oriented principles		Cognitive	3
4. Examine an object oriented solution		Cognitive	4
Course Content: **Week-1:** Introduction to object oriented design, history and advantages of object oriented design **Week-2:** Introduction to object oriented programming concepts **Week-3:** Classes, objects **Week-4:** Data encapsulation, constructors, destructors **Week-5:** Access modifiers **Week-6:** const vs non-const functions, static data members & functions **Week-7:** Function overloading, operator overloading			

Week-8: Identification of classes and their relationships
Week-9: Composition, aggregation
Week-10: Inheritance, multiple inheritance
Week-11: Polymorphism
Week-12: Abstract classes and interfaces, generic programming concepts
Week-13: Function & class templates
Week-14: Standard template library, object streams
Week-15: Data and object serialization using object streams
Week-16: Exception handling

Teaching Methodology:
Lectures, Written Assignments, Practical labs, Semester Project, Presentations

Course Assessment:
Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam

Reference Materials:

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

Course Code: CS 122	**Course Name:** Linear Algebra	**Credit Hours:** 3(3+0)	**Prerequisites:** None
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level

Course Content:
Week-1: Algebra of linear transformations
Week-2: Matrices
Week-3: Determinants and Rank
Week-5-7: Systems of equations, Characteristic equations
Week-8-9: Vector spaces
Week-10: Orthogonal transformations
Week-11: linear dependence
Week-12: linear Independence and bases
Week-13: Eigenvalues and eigenvectors
Week-14-16: Inner product space and quadratic forms

Teaching Methodology: Lectures, Written Assignments, Presentations
Course Assessment: Home Assignments, Quizzes, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. Elementary Linear Algebra by Howard Anton 2. Linear Algebra and its Applications by Gibert Strang

Course Code: CS 123	**Course Name:** Technical & Business Writing	**Credit Hours:** 3(3+0)	**Prerequisites:**
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Include inculcating writing especially technical and Business skills in the students, equipping them with competencies of preparing precise resume, proposals and reports as future business executives and acquiring policies, plans, programmes policy makers and planners			

Course Content:

Week-1: Definition of Technical writing**,** Purpose and scope of Technical writing**,** Features of Technical Writing

Week-2: Introduction to Paragraph**,** Paragraph Writing, Principle and Examples**,** Practice and Exercise

Week-3: Letter Writing**,** Types of Letters, Classification of Letters, Rules for Personal Letters

Week-4: Official Letters**,** Social Letters or Letter Application, Business Letters**,** Components of Business Letters

Week-5: Comprehension, Principle and Examples**,** Precise Writing**,** Practice and Exercise

Week-6: Expansion of Passage, Method of Expansion, Point and Principles, Practice and exercise

Week-7: Introduction to Essay, Types of Essays, Method for Good Essays

Week-8: Outline for Essay, Collection of Materials for Essay, Characteristics of a Good Essay, Principle and Examples

Week-9: Listening Skill**,** Aim of Listening, Active and Passive Listening, Practice and Exercise

Week-10: Reading Skill**,** Aim of Reading, Principle Reading**,** Active and Passive Reading

Week-11: Effective Speaking, Arrangement of Materials, Method and Principles

Week-12: Successful Writing, Use of Materials for writing, Principles and Method, Practice and Exercise

Week-13: Preparing for Test and Exam, Use of Text Book's Materials, Use of Lecture Materials, Use of Dictionary

Week-14: Strategies for Preparation, Topics, Sub-topics, Main Ideas in Reading, Practice and Exercise **Week-15:** Developing a positive corporate images, understanding of the readers, Proof reading of the written materials, Practice and exercise. **Week-16:** Revision and Practice
Teaching Methodology: Lectures, Written Assignments, Presentations
Course Assessment: Home Assignments, Quizzes, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. English for Modern Business.Ketteley and Thompson 2. Write Better, Speak Better. Readers Digest. 3. Effective Business Communication, 7th Edition, by Herta Murphy 4. Technical Writing Situations And Strategies, bye Michael H. Markel, 2nd Edition.

Course Code: CS 124	**Course Name:** Pakistan Studies	**Credit Hours:** 2(2+0)	**Prerequisites:** None
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
To understand the spirit of freedom struggle in the creation of Pakistan.			
To study the process of governance and national development in the early years of creation of Pakistan			
To examine the external and internal challenges the country faced after its independence.			
Course Content: **Week-1:** Introduction, Advent of Islam in South Asia, Muslim Cultural Heritage in Indo-Pakistan **Week-2:** Hindu Muslim relations throughout Muslim period, Efforts for the revival of Islam in the Sub-continent **Week-3:** Ideology of Pakistan, Aims and objects of Pakistan's formation, Ideology of Pakistan – its importance, Basis of Pakistan's Ideology, Pakistan Ideology in Iqbal and Quaid-e-Azam's writings **Week-4:** Evolution of Muslim Society in the Sub-continent, Emergence of Muslim Society in South Asia, Muslim Society – its emergence progress in South Asia, Decline of Muslim society, scholars, and institutions			

Week-5: National Reformation movements, Efforts for reformation – role of Shah Ahmad Sirhindi, Shah Waliullah and his followers, Role of Educational Institutions, Darul Uloom Deoband; Aligarh University; Nadwatul-Uloom; Jamia Islamia, Delhi; Anjuman Himayat-iIslam and other Institutions such as Sindh Madrassa and Islamia College, Peshawar

Week-6: Political Struggle for Pakistan Movement, Constitutional reforms and Muslims, Separate elections for Muslims, Khilafat movement

Week-7: Pakistan Movement, Evolution of Muslim nationality (1857-1930), Independence of India; its problems and Muslims, Iqbal's address at Allahabad (1930), Ch. Rehmat ali and Pakistan National Movement, Elections (1937) and the attitude of Congress Government towards Muslims

Week-8: Pakistan Resolution, Elections (1945-46); Constitutional problems and transfer of power.

Week-9: Struggle for Pakistan, Role of the Muslims living in minority provinces, Role of the Muslims living in majority provinces (Punjab, Sind, N.W.F.P., Baluchistan)

Week-10: Contribution of different classes in Pakistan Movement

Week-11: Role of religious scholars (Ulema), Role of men of letters and journalists, Role of youth and students, Role of women

Week-12: Emergence of Pakistan, Plan of India's Division and the emergence of Pakistan, Division of Provinces and Referendum, Important events (during the partition)

Week-13: Efforts for the implementation of Islamic System in Pakistan, Importance of Islamization, Objective resolution (1949), Islamic articles in Pakistan's Constitution of 1956, 1962, 1973, Implementation of Shariah; efforts and contributions, Tehreek-e-Nizam-e-Mustafa, 1970 , Steps taken towards the goal after 1970, Study of Islamic Institution such as Zakat, Shariah, Courts and the Council for Islamic Ideology, Our goals; formation of Islamic Society

Week-14: Pakistan – Land and Peoples, Geography: Location: Geographical importance; study of Rural and Urban areas, Natural resources and their use, Agriculture and Industry, Population, Manpower and Education, Economic and Social Welfare

Week-15: Pakistan and Islamic World, Unity of the Islamic World (Philosophy and Practice)

Week-16: Liberation Movements for Islamic States and Pakistan's role, Pakistan's relation with Iran, Saudi Arabia and Afghanistan, Pakistan's efforts for the unity of the Islamic World

Teaching Methodology:

Lectures, Written Assignments, Presentations

Course Assessment:

Home Assignments, Quizzes, Presentations, Midterm Exam, Final Exam

Reference Materials:

1. I.H. Qureshi The Struggle for Pakistan, Karachi, 1965
2. A Short History of Pakistan Book IV, Alien Rule and Rise of Muslim Nationalism, Karachi, 1967
3. Rafiq, Muhammad Sh Tehrik wa Tarikh –e- Pakistan, Lahore, 1977
4. TehriK Azadi Hindh Awar Muslaman By Abu Alla Maududi vol 1&2

Course Code: CS 125	**Course Name:** Applied Physics	**Credit Hours:** 3 (3+0)	**Prerequisites:** None
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level

Course Content:

Week-1: Electric force and its applications and related problem

Week-2: Conservation of charge, charge quantization, Electric fields due to point charge and lines of force. Ring of charge, Disk of charge

Week-3: A point charge in an electric field, Dipole in a n electric field, The flux of vector field, The flux of electric field

Week-4: Gauss' Law, Application of Gauss' Law, Spherically symmetric charge distribution, A charge isolated conductor

Week-5: Electric potential energy, Electric potentials, Calculating the potential from the field and related problem Potential due to point and continuous charge distribution

Week-6: Potential due to dipole, equipotential surfaces, Calculating the field from the potential

Week-7: Electric current, Current density, Resistance, Resistivity and conductivity, Ohm's law and its applications, The Hall effect

Week-8: The magnetic force on a current, The Biot- Savart law, Line of B, Two parallel conductors, Amperes' s Law, Solenoid, Toroids,

Week-9: Faraday's experiments, Faraday's Law of Induction, Lenz's law

Week-10: Motional emf, Induced electric field, Induced electric fields

Week-11: The basic equation of electromagnetism, Induced Magnetic field, The displacement current, Reflection and Refraction of light waves

Week-12: Total internal reflection, Two source interference

Week-13: Double Slit interference, related problems, Interference from thin films,

Week-14: Diffraction and the wave theory, related problems

Week-15: Single-Slit Diffraction, related problems

Week-16: Polarization of electromagnetic waves, Polarizing sheets, related problems.

Teaching Methodology:

Lectures, Written Assignments, Semester Project, Presentations

Course Assessment:

Home Assignments, Quizzes, Presentations, Midterm Exam, Final Exam

Reference Materials:

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 Code: CS 126	**Course Name:** Fundamentals of Geography	**Credit Hours:** 3 (3+0)	**Prerequisites:**
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
To expose students with the founding principles of Geography and geographical knowledge.			

Course Content:

Week-1: Introduction, Definitions, scope and branches of Geography
Week-2: Themes and tools of Geography
Week-3: The Universe, Solar System & associated topic
Week-4: Latitudes, longitudes, their importance &Rotation & Revolution of the earth with impact
Week-5 Celestial position of the Earth. Time, its kinds & International Date Line(IDL
Week-06: Lithosphere(Internal structure of the earth)
Week -07: Rocks, types and importance. Earthquake & Volcanism
Week-08: Atmosphere: structure, composition, heat budget of the earth
Week -09 Mid Term Examinations
Week-10: Atmospheric Pressure, Humidity & Rainfall
Week-11: Hydrosphere(Oceanography): Major Oceans, Relief of the Ocean lfoor,temperature of Ocean
Week-12: Salinity of Oceans, Ocean deposits, Movement of Ocean Water(Waves, Tides & Currents,
Week-13: Population and its Worldwide growth & special emphasis on Pakistan
Week-14: Population Distribution of the World continent wise
Week-15: Major Economic activities
Week-16: Pollution, its types & controlling measures
Week-17: Revision
Week-18: Final Term Examinations

Teaching Methodology:

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

Course Assessment:

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

Reference Materials:

1. Arbogast, A. F. (2007) Discovering Physical Geography, John Wiley and Sons, London
2. Christopherson, R. W. (2009) Geo systems: An introduction to Physical
3. Geography, Pearson Prentice Hall, New Jersey
4. De Blij, H. J and Muller, P. O. (1996) Physical Geography of the Global
5. Environment, USA, John Wiley and sons Inc., New Jersey
6. Guinness, J. P. & Nagle, G. (2011) Geography, Hodder Education, London
7. King, C. (1980) Physical Geography, Basil Blackwell, Oxford
8. Miller, G. T. (2008) Living in the Environment, Principles, connections and Solutions, Wadsworth, USA

Course Code: CS 127	**Course Name:** Entrepreneurship	**Credit Hours:** 3 (3+0)	**Prerequisites:**
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Develop an idea for a new venture			
Research its potential and understand the risks associated;			
Undertake marketing, positioning, and customer development			
Prepare an analysis of the financial requirements and build a financial strategy for the new venture, including incremental appreciation of the equity base;			
Plan for the execution and management of all the relevant functional areas of new venture including operations, supply chain, information systems, and human resources etc.			
Identify and prepare legal documents, IP policy, contracts, etc			
Develop a comprehensive business plan for their venture			

Course Content:

Week-1: Entrepreneurship: An Evolving Concept, Entrepreneurship –A Perspective, Emerging Trends: The Internet and E-Commerce, Entrepreneurial Opportunities, The Evolution of Entrepreneurship, The Myths & Approaches to Entrepreneurship

Week-2: Understanding Strategic Issues in Business Plan Development, Comparative Analysis Entrepreneurship in Other Countries, Strategic Objectives, Competitor Analysis

Week-3: Understanding Strategic Issues in Business Plan Development, STP Strategies, Marketing Mix Strategies

Week-4: Understanding The Entrepreneurial Perspective in Individuals, The Entrepreneurial Perspective, The Dark Side of Entrepreneurship, Entrepreneurial Motivation Entrepreneurial Perspective in Organizations – Corporate Entrepreneurship Social Entrepreneurship and The Ethical Challenges of Entrepreneurship

Week-5: Innovation: The Creative Pursuit of Ideas, Opportunity Identification: The search for New Ideas, Entrepreneurial Imagination and Creativity, The role of Creative Thinking, Arenas in Which People Are Creative, Innovation and the Entrepreneur, The Innovation Process

Week-6: Pathways to Entrepreneurial Ventures, The Pathways to New Ventures for Entrepreneurs, Creating New Ventures, Acquiring an Established Entrepreneurial Venture, Franchising: The Hybrid

Week-7: Legal Challenges for Entrepreneurial Ventures, Legal Challenges for The Entrepreneurial Venture, Intellectual Property Protection: Patents, Copyrights, And Trademarks, Identifying Legal Structures for Entrepreneurial Ventures, Sole Proprietorships, Partnerships, Corporations, Specific Forms of Partnerships and Corporations, Understanding Bankruptcy

Week-8: Sources of Capital for Entrepreneurial Ventures, The Entrepreneur ‟S Search for Capital, Debt Versus Equity, The Venture Capital Market, Informal Risk Capital: "Angel" Financing

Week-9: Assessment of Entrepreneurial Plan, The Challenge of New- Venture Start-Ups, Pitfalls in Selecting New Ventures, Critical Factors for New-Venture Development, Why New Ventures Fail, The Evaluation Process

Week-10: Marketing Challenges for Entrepreneurial Ventures, The Marketing Concept for Entrepreneurs, Marketing Research, Inhibitors to Marketing Research, Internet Marketing, Developing The Marketing Concept, Developing A Marketing Plan, Pricing Strategies

Week-11: Financial Preparation for Entrepreneurial Ventures, The Importance of Financial Information for Entrepreneurs, Understanding The Key Financial Statements, Preparing Financial Budgets, Pro Forma Statements, Capital Budgeting, Break-Even Analysis, Ratio Analysis

Week-12: Developing an Effective Business Plan, What Is A Business Plan?, Pitfalls To Avoid In Planning, Benefits Of A Business Plan, Developing A Well- Conceived Business Plan, Elements Of A Business Plan, Updating The Business Plan, Presentation Of The Business Plan: The "Pitch"

Week-13: Strategic Entrepreneurial Growth, The Nature Of Strategic Planning In Emerging Firms, Strategic Planning, The Lack Of Strategic Planning, The Value Of Strategic Planning, Managing Entrepreneurial Growth, Venture Development Stages, The Entrepreneurial Company In The Twenty-First Century , Building The Adaptive Firm, The Transition From An Entrepreneurial Style To A Managerial Approach, Understanding The Growth Stage, Unique Managerial Concerns of Growing Ventures, The International Environment: Global Opportunities, Achieving Entrepreneurial Leadership In The New Millennium

Week-14: Valuation Of Entrepreneurial Ventures, The Importance Of Business Valuation, Underlying Issues When Acquiring A Venture, Due Diligence, Analyzing The Business, Establishing A Firm‟S Value, Term Sheets In Venture Valuation, Additional Factors In The Valuation Process

Week-15: Harvesting The Entrepreneurial Venture, Harvesting The Venture: A Focus on the Future, The Management Succession Strategy, Key Factors In Succession

Week-16: Projects/ Presentations

Teaching Methodology:

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

Course Assessment:

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

Reference Materials:

1. Entrepreneurship – Theory Process Practice, Donald F. Koratko 8th Edition (South Western - Cengage Learning)

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 231	Data Structures & Algorithms	4 (3+1)	
Course Learning Outcomes			

At the end of the course the students will be able to:	Domain	Bloom's Taxonomy Level
Implement various data structures and their algorithms, and apply them in implementing simple applications.	Cognitive	2,3
Analyse simple algorithms and determine their complexities.	Cognitive	4,5
Apply the knowledge of data structures to other application domains	Cognitive	3
Design new data structures and algorithms to solve problems	Cognitive	6

Course Content:

Week -1: Introduction to Data, Field, Data item, Records, Data Vs Information, Definition of Data Structure, Linear Data Structure, Non Linear Data Structure, Logical & Physical Data Structure

Week-2: Introduction to Algorithms, Algorithmic Notations**,** Control Structure of Algorithms (Sequential Flow**,** Conditional Flow**,** Iterative/Repetitive Flow)

Week-3: Introduction to the Basic Operations of Data Structure **(**Insertion**,** Deletion**,** Traversing, Searching, Sorting, Merging**)**

Week-4: Introduction to Arrays**,** Types of Arrays **(**One Dimensional Array**,** Two Dimensional Array), Algorithm for traversing one Dimensional Array**,** Algorithms for insertion & deletion in one Dimensional Array, Accessing One Dimensional array by Dope Vector method**,** Representation of One Dimensional array in computer memory

Week-5: Introduction to Two Dimensional Array, Accessing two Dimensional array by Dope Vector method, Representation of One Dimensional array in computer memory (Row-by row method, Column-by-column method)

Week-6: Introduction to Recursion**,** Program for Factorial using recursion function in C++**,** Program for Fibonacci sequence using recursion function in C++

Week-7: Introduction to Searching**,** Types of Searching (Linear Search, Binary Search), Algorithm for Linear Search**,** Algorithm for Binary Search

Week-8: Introduction to Sorting, Bubble Sort, Selection Sort, Insertion Sort, Algorithms for Bubble, Selection & Insertion Sort

Week-9: Introduction to Stack**,** Operations on Stack **(**Push Algorithm**,** Pop Algorithm)

Week-10: Introduction to Queue**,** Operations on Queue (Push Algorithm**,** Pop Algorithm**,** Introduction to De-queue

Week-11: Introduction to One Way Linked List**,** Operations on One Way Linked List (Insertion Algorithm**,** Deletion Algorithm)

Week-12: Introduction to Two Way Linked List**,** Operations on Two Way Linked List **(**Insertion Algorithm**,** Deletion Algorithm)

Week-13: Introduction to Trees**,** Terminologies used in tree**,** Similar and Copies trees**,** Binary Trees

Week-14: Types of Binary trees **(**Strictly binary tree, Complete binary tree)**,** Operations on Binary Tree**,** Insertion in Binary Tree, Deletion from Binary Tree

Week-15: Traversing of General Tree**,** Level by Level**,** Pre Order**,** Post Order**,** Traversing of Binary Tree**,** Pre Order**,** In Order**,** Post Order**,** Notations and Expressions and it's inter conversion

Week-16: Introduction to Graphs**,** Graph Terminologies**,** Graph Types, Link representation of graph
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. Data Structure By Seymour Lipschutz, Schaum's Outline Series 2. Data Structure and Algorithms by Alfred V. Aho, John E. Hofcroft, Jeffery D. Ullman

Course Code: CS 232	**Course Name:** Digital Logic & Design	**Credit Hours:** 4 (3+1)	**Prerequisites:** Applied Physics
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Acquire knowledge related to the concepts, tools and techniques for the design of digital electronic circuits			
Demonstrate the skills to design and analyze both combinational and sequential circuits using a variety of techniques			
Apply the acquired knowledge to simulate and implement small-scale digital circuits			
Understand the relationship between abstract logic characterizations and practical electrical implementations.			
Week-1: Number Systems **Week-2:** Logic Gates **Week-3:** Boolean Algebra **Week-4:** Combination logic circuits and designs **Week-5:** Simplification Methods (K-Map, Quinn Mc-Cluskey method) **Week-6:** Flip Flops and Latches **Week-7:** Asynchronous and Synchronous circuits **Week-8:** Counters			

Week-9: Shift Registers
Week-10: Triggered devices & its types
Week-11: Binary Arithmetic and Arithmetic Circuits
Week-12: Memory Elements
Week-13: State Machines
Week-14: Introduction Programmable Logic Devices (CPLD, FPGA)
Week-16: Lab Assignments using tools such as Verilog HDL/VHDL, MultiSim

Teaching Methodology:
Lectures, Written Assignments, Practical labs, Semester Project, Presentations

Course Assessment:
Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam

Reference Materials:

1. Digital Fundamentals by Floyd, 11/e.
2. Fundamental of Digital Logic with Verilog Design, Stephen Brown, 2/e
3. Digital Computer Electronics By Malvino
4. Computer Logic Design By M. Morris Mano

Course Code: CS 233	**Course Name:** Probability & Statistics	**Credit Hours:** 3 (3+0)	**Prerequisites:**
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level

Course Content:
Week 1 Introduction to statistics, basic terminologies related to statistics, types of data/variables.
Week 2-3 Scale of measurements, Diagrammatical and Graphical representation of data, Numerical representation of data (Mean, Variance, Standard deviation)
Week 4-5 Introduction to probability theory, set theory and operations with application, sample space, counting techniques.
Week 6-7 Probability of an event, Rule of probability (Additive, complement, multiplicative/product),
Week 8 Conditional probability and its application, Rule of independence.
Week 9 Mid Term Examination
Week 10-11 Random variables, Mathematical Expectations, Mean and Variance of Random Variables
Week 12-13 Introduction to probability distributions, discrete and continuous probability

functions, mean and variance of probability functions. **Week 14-15** Discrete probability distributions (Bernoulli, Binomial, Poisson, and Hypergeometric distribution) **Week 16-17** Continuous probability distribution (Uniform and Normal distribution) **Week 18** Final Term Examination
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. Introduction to statistical theory, part-1 by Prof. Sher Muhammad Chaudhary. (9th Edition) 2. Elementary statistics; 8th Edition by Prof. Allan G. Bluman 3. Probability and statistics foe 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 4. 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 Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 234	Communication & Presentation Skills	3 (3+0)	
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
This course is comprised of two parts: part-1 and part-2. Part-1 focuses on listening and speaking: the former gives students an exposure to the accent, and stress and intonation patterns of different native and non-native speakers, while the latter is a practice of what they listen to. Both are equally important in bringing about an improvement in learners 'language proficiency in an academic or/and non-academic settings. Through audio-visual aids, pen and paper exercises, and interactive sessions in the class, students improve their listening and speaking skills and build their vocabulary. By the end of the course, students will be able to listen, comprehend, and speak more proficiently. They will also be able to communicate effectively and efficiently with their peers and teachers. Part-2 builds on Part-I and moves from Listening and Speaking to Speaking and Reading. This part focuses on speaking activities and reading exercises.			

It introduces students to various written texts, which they must comprehend, interpret, and discuss with their peers in the classroom. students will be able to listen, speak and read rationally and effectively.		

Course Content:
Listening and Speaking
Week-1: Listening for Gist, Specific Information, Global Meaning
Week-2-3: Asking for Information and Directions
Week-4-5: Making Statements
Week-6-7: Giving Instructions, Descriptions, Reasons
Week-8: Discussion Skills
Week-9: Narration

Speaking and Reading
Week-10: Questions and Answers
Week-11-12: Understanding Reading, Discussions, and Decisions
Week-13-14: Stories and Scenes
Week-15-16: Presentations

Teaching Methodology:
Lectures, Written Assignments, Practical labs, Semester Project, Presentations

Course Assessment:
Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam

Reference Materials:

1. Helgesen, Marc & Steven Brown. Active Listening Building Skills for Understanding. Cambridge: Cambridge University Press, 1994.
2. Klippel, Friederike. Keep Talking. Cambridge: Cambridge University Press, 1984.
3. Gough, Chris. English Vocabulary Organizer. Stamford: Thomson Corporation, 2002.
4. Wallwork, Adrican. Discussions: A-Z. Cambridge: Cambridge University Press, 1997.
5. Ford, Martyn & Dave King. For Real! English in Everyday Situations. London: Mary Glasgow Magazines, 2003.
6. Gammidge, Mick. Speaking Extra. Cambridge: Cambridge University Press, 2005.
7. Klippel, Friederike. Keep Talking. Cambridge: Cambridge University Press, 2008.
8. Dainty, Peter. Newspaper Articles to Get Teenagers Talking. Glasgow: Mary Glasgow Magazines, 2006.
9. Greenall, Simon & Michael Swan. Effective Reading. Cambridge: Cambridge University Press, 2002.

Course Code: CS 235	**Course Name:** Multivariate Calculus	**Credit Hours:** 3 (3+0)	**Prerequisites:**
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Understand the basic concepts and know the basic techniques of differential and integral calculus of functions of several variables;			
Apply the theory to calculate the gradients, directional derivatives, arc length of curves, area of surfaces, and volume of solids;			
Solve problems involving maxima and minima, line integral and surface integral, and vector calculus;			

Course Content:

Week-1: Functions of Several Variables and Partial Differentiation
Week-2-3: Multiple Integrals
Week-4: Line and Surface Integrals
Week-5: Green's and Stoke's Theorem
Week-6-7: Fourier Series: periodic functions
Week-8: Functions of any period P-2L
Week-9: Even & odd functions
Week-10: Half Range expansions
Week-11-12: Fourier Transform
Week-13-14: Laplace Transform
Week-15-16: Z-Transform.

Teaching Methodology:

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

Course Assessment:

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

Reference Materials:

1. Multivariable Calculus, 6th edition James, Stewart 2007 Cengage Learning publishers
2. Calculus and Analytical Geometry, 6th edition. Swokowski, Olinick and Pence.1994, Thomson Learning EMEA, Ltd
3. Multivariable Calculus, 5th edition Howard, A. Albert, H. 1995, John Wiley

Course Code: CS 241	**Course Name:** Computer Organization & Assembly Language	**Credit Hours:** 4 (3+1)	**Prerequisites:** Programming Fundamentals
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Acquire the basic knowledge of computer organization, computer architecture and assembly language			
Understand the concepts of basic computer organization, architecture, and assembly language techniques			
Solve the problems related to computer organization and assembly language			

Course Content:

Week-1: Introduction to computer systems: Information is bits + context
Week-2: programs are translated by other programs into different forms, it pays to understand how compilation systems work
Week-3: processors read and interpret instructions stored in memory
Week-4: caches matter, storage devices form a hierarchy, the operating system manages the hardware
Week-5: systems communicate with other systems using networks
Week-6: Representing and manipulating information: information storage, integer representations, integer arithmetic, floating point
Week-7: Machine-level representation of programs: a historical perspective, program encodings, data formats, accessing information
Week-8: arithmetic and logical operations, control, procedures
Week-9: array allocation and access, heterogeneous data structures
Week-10: understanding pointers, life in the real world: using the gdb debugger, out-of-bounds memory references and buffer overflow
Week-11: x86-64: extending ia32 to 64 bits
Week-12: machine-level representInformatations of floating-point programs
Week-13: Processor architecture: the Y86 instruction set architecture
Week-14: logic design and the Hardware Control Language (HCL)
Week-15: sequential Y86 implementations
Week-16: general principles of pipelining, pipelined Y86 implementations

Teaching Methodology:

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

Course Assessment:

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

Reference Materials:

1. Computer Systems: A Programmer's Perspective, 3/E (CS:APP3e), Randal E. Bryant and David R.O' Hallaron, Carnegie Mellon University
2. Robert Britton, MIPS Assembly Language Programming, Latest Edition,

3. Computer System Architecture, M. Morris Mano, Latest Edition,
4. Assembly Language Programming for Intel- Computer, Latest Edition

Course Code: CS 242	**Course Name:** Database Systems	**Credit Hours:** 4 (3+1)	**Prerequisites:**
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Explain fundamental database concepts.		Cognitive	2
Design conceptual, logical and physical database schemas using different data models.		Cognitive	5
Identify functional dependencies and resolve database anomalies by normalizing database tables.		Cognitive	2
Use Structured Query Language (SQL) for database definition and manipulation in any DBMS		Cognitive	4

Course Content:
Week-1: Basic database concepts, Database approach vs file based system
Week-2: Database architecture
Week-3: Three level schema architecture
Week-4: Data independence, relational data model, attributes, schemas, tuples
Week-5: Domains, relation instances, keys of relations, integrity constraints
Week-6: Relational algebra, selection, projection, Cartesian product, types of joins
Week-7: Normalization, functional dependencies
Week-8: Normal forms
Week-9: Entity relationship model, entity sets, attributes
Week-10: Relationship, entity-relationship diagrams
Week-11: Structured Query Language (SQL)
Week-12: Joins and sub-queries in SQL
Week-13: Grouping and aggregation in SQL
Week-14: Concurrency control
Week-15: database backup and recovery, indexes
Week-16: NoSQL systems

Teaching Methodology:
Lectures, Written Assignments, Practical labs, Semester Project, Presentations

Course Assessment:
Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam

Reference Materials:
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

Course Code: CS 243	**Course Name:** Differential Equations	**Credit Hours:** 3(3+0)	**Prerequisites:**
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
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 Content:

Week-1: Ordinary Differential Equations of the First Order: Geometrical Considerations, Isoclines
Week-2: Separable Equations
Week-3: Equations Reducible to Separable Form
Week-4: Exact Differential Equations
Week-5: Integrating Factors, Linear First-Order Differential Equations, variation of Parameters
Week-6: Ordinary Linear Differential Equations
Week-7: Homogeneous Linear Equations of the Second Order
Week-8: Homogeneous Second-Order Equations with Constant Coefficients
Week-9: General Solution, Real Roots, Complex Roots, Double Root of the Characteristic Equation
Week-10: Differential Operators, Cauchy Equation
Week-11: Homogeneous Linear Equations of Arbitrary Order, Homogeneous Linear Equations of Arbitrary Order with Constant Coefficients
Week-12: Non- homogeneous Linear Equations. Modelling of Electrical Circuits
Week-13: Systems of Differential Equations. Series Solutions of Differential Equations

Week-14-16: Partial Differential Equations: Method of Separation of variables, wave, Heat & Laplace equations and their solutions by Fourier series method
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: 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 Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 246	Web Technologies	3(2+1)	OOP
Course Learning Outcomes			
At the end of the course the students will be able to: Know the fundamentals of web application architecture and web programming. Apply a structured approach to identifying needs, interests, and functionality of a website. Design dynamic websites that meet specified needs and interests. Write well-structured, easily maintained, standards-compliant, accessible HTML code. Write well-structured, easily maintained, standards-compliant CSS code to present HTML pages in different ways. Use JavaScript for client-side scripting and add dynamic content to pages. Use PHP to implement server-side script for creating dynamic web pages and access databases.		Domain	Bloom's Taxonomy Level

Design and implement an interactive web site(s) with regard to issues of usability, accessibility, and internationalization. Further study web technologies, both those that exist today and those that will be developed in the future. Work in collaborative environment by working in group assignments.		

Course Content:

Introduction to Internet, WWW vs Internet, Web Browser, Web Servers, Search Engine, Introduction to HTML, HTML vs HTML5, Basic structure of HTML document, HTML tags (Headings, Paragraph, Image, List, Hyperlink, Tables, Forms, Audio, Video, Div, Span tags, etc), Introduction to CSS, CSS Box Model, CSS Selectors, Background Properties, Color Properties, Link Properties, Positions, Media Queries in CSS, Basics of JavaScript, Datatypes in JS, Variables, Function, Loops, DOM, alert(), confirm() and prompt() in JS, JavaScripts Events, onload(), onclick(), ondblclick(), onscroll(), onblur(), onfocus(), etc, Server side scripting, Installing and Configuring Apache and PHP, Variables and Constant in PHP, Output statement in PHP, PHP Datatypes, Function, Loops, Arrays in PHP, Superglobals variables in PHP($_GET, $_POST, $_FILES, $_COOKIE, $_SESSION, $_SERVER), Passing Variables Between Pages (URL, Sessions, Cookies, and Forms), Creating and Using database in PHP, AJAX, JSON.

Teaching Methodology:

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

Course Assessment:

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

Reference Materials:

1. Duckett, J. (2014). Web Design with HTML, CSS, JavaScript and jQuery Set (Latest ed.). Wiley Publishing.
2. Nixon, R. (2015). PHP: 20 Lessons to Successful Web Development (Latest ed.). McGraw-Hill Education Group.
3. Nixon, R. (2012). Learning PHP, MySQL, JavaScript, and CSS: A step-by-step guide to creating dynamic websites (Latest ed.). O'Reilly Media, Inc.

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 247	Introduction to Economics	3(3+0)	
Course Learning Outcomes			

At the end of the course the students will be able to:	Domain	Bloom's Taxonomy Level
This aims at providing the students with a solid knowledge in Economic Principles		
Familiarizes him/her with the institutions and policies that influence economic activity both at the micro and Macro levels in the country		

Course Content:

Nature & scope of Economics:

Week-1: Definition-Smith, Marshall and Robins, Scope and Importance of Economics

Theory of Consumer's Behavior

Week-2 Utility analysis, Law of Diminishing Marginal Utility, Indifference Curves Analysis, Definition of ICs, Budget line and consumer's Equilibrium

Theory of Demand and Supply

Week-3 Law of demand, Elasticity of Demand, Law of supply, Elasticity of supply

Market and Price Determination

Week-4 Market Definition, Types, Market structure, perfect composition, imperfect competition (Monopoly, monopolistic competition, oligopoly

Production

Week-5 Production function definition, Factors of production, relationship of MP, AP & TP with each other

Week-6 Theory of Firm/Price

Revenue, Total revenue, average and marginal revenue

Week-7 Cost of Production- type and curve,

National Income

Week-8 Meaning and definition of National Income, GNP, NNP, GDP, PI, DPI, Circular Flow & Measurement, NI, Circular flow of NI in two sectors economy

Money

Week-9 Barter System, Difficulties, Money, Definition and Types

Inflation

Week-10 Definition and Types, Causes and Solution, Inflation in Pakistan

Banks

Week-11 Bank, Definition and Types, Commercial Bank, Function, Central Bank, Definition and Functions

International Trade (Brief Treatment)

Week-12 Merits and Demerits of International Trade, Importance of IT

Balance of Payment

Week-13 Balance of Trade and Balance of Payments (BOF)**,** Disequilibrium in BOP or Adverse BOP & its correction

Public Finance

Week-14 Public revenue, sources, Public Expenditure, Hands, Sources of Revenue & Expenditure of modern govt

Taxation

Week-15 Definition of Tax, Types of Taxes, Direct and Indirect Taxes

Week-16 Presentation & Quizzes
Teaching Methodology: Lectures, Written Assignments, Presentations
Course Assessment: Home Assignments, Quizzes, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. Samulson-Economics, 1998 Edition Mac Graw Hill. Newyorll 2. Modern Economic Theory'' KK Dewett, Shyarm. 21 Edition. Lal Trust New Delhi.

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 248	Organizational Behaviour	3(3+0)	
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Understand the components of individual behaviour and group behaviours in the organizational context			
Understand the relevance of the OB theories and practices, emphasized by Western texts, in local settings			
Understand the Islamic perspective of understanding and directing human behaviour towards achievement of goals			
Understand the causes of job dissatisfaction and stress as well as methods of improving job satisfaction and dealing with stress			
Analyze the impact of individuals and team behaviour on organizational productivity			
Evaluate the impact of organizational structure, design, culture and change			
Synthesize various theories of motivation and leadership and understand their application to workplace.			
Course Content: **Week-1:** What is Organizational Behaviour Importance of organizational behaviour **Week-2:** Foundations of Individual Behaviour: Biographical Characteristics, Ability, Learning **Week-3:** Organizational behaviour from Islamic and indigenous perspective Understanding human psychology through the lenses of Quran and Sunnah **Week-4:** Attitudes and Job Satisfaction Types of attitudes Types of behaviours			

Week-5: Perception and Individual Decision Making Why perception is important Types of decision making Biases and errors in decision making **Week-6:** Motivation concept Content theories of Motivational Process theories of motivation **Week-7:** Motivation: from concept to application Applying motivation concepts for designing reward system 80 1. Emotions and Moods **Week-8:** Mid-Term Examination **Week-9:** Foundations of Group Behaviour Groups in organization **Week-10:** Basic Approaches to Leadership Trait Theories Behavioural theories **Week-11:** Contemporary Issues in Leadership **Week-12:** Power and politics Types and sources of power Politics in organizations **Week-13:** Conflict and negotiation Types of conflicts **Week-14:** Functions of organization structure Types of organizational structure Organizational structure and its impact on individuals and groups **Week-15:** Organizational culture Organizational culture and individual behaviour **Week-16:** Conclusion Session Project/Presentation
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. Robbins, P. S., & Judge, T. A. (2009). Organizational Behaviour. 13th ed.

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 351	Operating Systems	4 (3+1)	
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Understand the characteristics of different structures of the Operating Systems and identify the core functions of the Operating Systems.		Cognitive	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.		Cognitive	4,5
Demonstrate the knowledge in applying system software and tools available in modern operating systems.		Cognitive	3

Course Content: **Week-1:** Operating systems basics, system calls **Week-2:** Process concept and scheduling, inter-process communication **Week-3:** Multithreaded programming, multithreading models, threading issues **Week-4:** Process scheduling algorithms, thread scheduling **Week-5:** Multiple-processor scheduling, synchronization **Week-6:** Critical section, synchronization hardware, synchronization problems **Week-7:** Deadlocks, detecting and recovering from deadlocks **Week-8:** Memory management, swapping, contiguous memory allocation **Week-9:** Segmentation & paging **Week-10:** Virtual memory management, demand paging, thrashing **Week-12:** Memory-mapped files, file systems, file concept **Week-12:** Directory and disk structure, directory implementation, free space management **Week-13:** Disk structure and scheduling, swap space management **Week-14:** System protection **Week-15:** Virtual machines **Week-16:** Operating system security
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: 5. Operating Systems Concepts, 9th edition by Abraham Silberschatz 6. Modern Operating Systems, 4th edition by Andrew S. Tanenbaum 7. Operating Systems, Internals and Design Principles, 9th edition by William Stallings

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 352	Theory of Automata	3(3+0)	
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Explain and manipulate the different concepts in automata theory and formal languages such as formal proofs, automata, regular expressions, Turing machines etc;			
Prove properties of languages, grammars and automata with rigorously formal mathematical methods			
Design of automata, RE and CFG			
Transform between equivalent NFAs, DFAs and REs			
Define Turing machines performing simple tasks.			

Differentiate and manipulate formal descriptions of languages, automata and grammars with focus on regular and context-free languages, finite automata and regular expressions.		
Course Content: **Week-1:** Computability, Complexity, Verifiability **Week-2:** Types of Proofs, Languages **Week-3:** Types of Languages, Recursive Definitions **Week-4:** Regular Expressions **Week-5:** Finite Automata **Week-6:** Nondeterministic Finite Automata, Transition Graphs **Week-7:** Kleene's Theorem **Week-8:** Finite Automata with Output, Regular & Non-regular Languages **Week-9:** Decidability **Week-10:** Context-Free Grammars **Week-11:** Context-Free Languages & Non-Context-Free Languages **Week-12:** Chomsky Normal Form **Week-13:** Pushdown Automata **Week-14:** Turing Machines **Week-15:** Post machine, Variations on Turing Machines **Week-16:** Universal Turing Machine.		
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations		
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam		
Reference Materials: 1. Introduction to computer theory, Daniel I. A. Cohen, 2nd Edition 2. Introduction to the Theory of Computation by Michael Sipser, 3rd Edition		

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 353	Design & Analysis of Algorithms	3(3+0)	
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Explain what is meant by "best", "expected", and "worst" case behavior of an algorithm			
Identify the characteristics of data and/or other conditions or assumptions that lead to different behaviors.			

Determine informally the time and space complexity of simple algorithms		
List and contrast standard complexity classes		
Use big O, Omega, Theta notation formally to give asymptotic upper bounds on time and space complexity of algorithms		
Use of the strategies(brute-force, greedy, divide-and-conquer, and dynamic programming) to solve an appropriate problem		
Solve problems using graph algorithms, including single-source and all-pairs shortest paths, and at least one minimum spanning tree algorithm		
Course Content: **Week-1:** Set Theory **Week-2:** Mathematical Function, Probability Theory **Week-3:** Introduction to Algorithms **Week-4-5:** Algorithm Analysis Techniques **Week-6:** Algorithm Design Techniques **Week-7:** Divide and Conquer Algorithms **Week-8-9:** Greedy Algorithms **Week-10:** Backtracking Algorithms **Week-11:** Dynamic Programming Algorithms **Week-12:** Brute Force Algorithms **Week-13:** Approximation Algorithms **Week-14:** Randomized Algorithms **Week-15:** Non polynomial Time Complexity Algorithms **Week-16:** Revision		
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations		
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam		
Reference Materials: 1) Introduction to Algorithms, By T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, 3rd edition, MIT Press 2) Analysis and Design of Algorithms By Amrinder Arora 3rd edition		

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 354	Computer Networks	4 (3+1)	
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level

Describe the key terminologies and technologies of computer networks		
Explain the services and functions provided by each layer in the Internet protocol stack.		
Identify various internetworking devices and protocols, and their functions in a network		
Analyse working and performance of key technologies, algorithms and protocols. Build Computer Network on various Topologies		

Course Content:

Week-1: Introduction and protocols architecture, basic concepts of networking, network topologies
Week-2: Layered architecture
Week-3-4: Physical layer functionality
Week-5: Data link layer functionality, multiple access techniques
Week-6: Circuit switching and packet switching, LAN technologies
Week-7: Wireless networks, MAC addressing, networking devices
Week-8-9: Network layer protocols, IPv4 and IPv6, IP addressing
Week-10: Sub netting, CIDR, routing protocols
Week-11-13: Transport layer protocols, ports and sockets, connection establishment, flow and congestion control
Week-14-15: Application layer protocols
Week-16: Latest trends in computer networks

Teaching Methodology:

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

Course Assessment:

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

Reference Materials:

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

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 355	Introduction to Philosophy	3(3+0)	
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy

		Level
Understanding basic concepts of philosophy in the fields of metaphysics, axiology, and epistemology.		
Understanding of philosophical terms.		

Course Content:

Week-1: A review of the history of philosophy

Week-2: Discussion on the major problems and methods of philosophy

Studying the work of at least two philosophers from each of the following groups:

Week-3: Greco-Roman Philosophers Plato, Aristotle, Democritus, Pythagoras, Heraclitus, Protagoras, Epicurus, Seneca, and Epictetus

Week-4: Medieval Religious Philosophers Avicenna, Averroes, St. Thomas Aquinas

Week-: Renaissance Philosophers Machiavelli, Erasmus, Thomas More

Week-5: Enlightenment and Sui Generis Philosophers Copernicus, Descartes, Hobbes, Spinoza, Leibniz, Locke, Berkeley, Hume, Kant

Week-6: Idealists Fichte, Schelling, Schiller, Hegel

Week-7: Utilitarian Philosophers Jeremy Bentham, J.S. Mill

Week-8: Romantic Reactionaries Rousseau, Schopenhauer, Kierkegaard

Week-9: Materialist Philosophers Feuerbach, Marx

Week-10: The Irrational Philosophers Bergson, Freud

Week-:11-12 Phenomenologists and Existentialists Husserl, Heidegger, Sartre, Camus, Fanon

Week-13: Marxist Philosophers Lukacs, Gramsci, Croce, Althusser

Week-14-16: Linguists, Semiotician, Structuralist, and Deconstructionists Saussure, Levi-Strauss, Lacan, Barthe, Foucault, Derrida

Teaching Methodology:

Lectures, Written Assignments, Presentations

Course Assessment:

Home Assignments, Quizzes, Presentations, Midterm Exam, Final Exam

Reference Materials:

1. Adorno, T.W., Aesthetic Theory. Tr. By C. Lenhardt. London: Routledge & Kegan Paul,1984
2. Ahmad, Absar, Concept of Self and Self-Identity in Contemporary Philosophy. Lahore: Iqbal Academy,1986
3. Aldrich , Virgil., Philosophy of Art, New Jersey: Prentice Hall,1963
4. Anne, Bruce, Metaphysics: The Elements. Oxford: Basil Blackwell,1986
5. Aristotle, The Works of Aristotle, edited by W.D. Ross. Vol x. Politica, translated by Benjamin Jowett. Oxford: Clarendon Press 1921
6. Ayer , A. J. , Central Questions of Philosophy London: Penguin Books,1973
7. Cairns, Huntington, Legal Theory from Plato to Hegel. Baltimore: John Hopkins Press. 1967.
8. Copleston, Frederick, A History of Philosophy. 9 vols New York: Image Books 1962
9. Frankena , William , K. Ethics Prentice Hall, Inc.
10. Hurley, Patrick, J, A Concise Introduction to Logic, Belmont: Wadsworth Publishing Co. 1988

11. James Rachels [1995] the Elements of Moral Philosophy, McGraw Hill inc.
12. John F. Post [1991] Metaphysics: A Contemporary Introduction. Paragon House NY
13. Russell, Bertrand, A History of Western Philosophy. London: George Allen and Unwin, 1961
14. Russell, Bertrand, Problems of Philosophy. Oxford University Press, 1959
15. Passmore, J., A Hundred Years of Philosophy. Penguin Books, 1966

Course Code: CS 356	**Course Name:** **Introduction to Sociology**	**Credit Hours:** 3(3+0)	**Prerequisites:**
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
The course is designed to introduce the students with sociological concepts and the discipline. The focus of the course shall be on significant concepts like social systems and structures, socio-economic changes and social processes.			

Course Content:

Week-1: Introduction, Definition, Scope, and Subject Matter, Sociology as a Science, Historical back ground of Sociology
Week-2: Basic Concepts, Group, Community, Society, Associations, Non-Voluntary, Voluntary, Organization, Informal, Formal
Week-3: Social Interaction, Levels of Social Interaction
Week-4: Process of Social Interaction, Cooperation, Competition, Conflict, Accommodation
Week-5: Acculturation and diffusion, Assimilation, Amalgamation
Week-6: Social Groups, Definition & Functions, Types of social groups, In and out groups, Primary and Secondary group
Week-7: Reference groups, Informal and Formal groups, Pressure groups
Week-: Culture, Definition, aspects and characteristics of Culture, Material and non-material culture, Ideal and real culture
Week-8: Elements of culture, Beliefs, Values, Norms and social sanctions
Week-9: Organizations of culture, Traits, Complexes, Patterns, Ethos, Theme, Other related concepts
Week-10: Cultural Relativism, Sub Cultures, Ethnocentrism and Xenocentrism
Week-11: Socialization & Personality, Personality, Factors in Personality Formation, Socialization
Week-12: Agencies of Socialization, Role & Status,
Week-13: Deviance Deviance and its types
Week-14: Collective Behaviour, its types, Crowd behaviour, Public opinion, Propaganda
Week-15: Social movements

Teaching Methodology: Lectures, Written Assignments, Presentations
Course Assessment: Home Assignments, Quizzes, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. Anderson, Margaret and Howard F. Taylor. 2001. Sociology the Essentials. Australia: Wadsworth. 2. Brown, Ken 2004. Sociology. UK: Polity Press 3. Gidden, Anthony 2002. Introduction to Sociology. UK: Polity Press. 4. Macionis, John J. 2006. 10th Edition Sociology New Jersey: Prentice-Hall 5. Tischler, Henry L. 2002. Introduction to Sociology 7th ed. New York: The Harcourt Press. 6. Frank N Magill. 2003. International Encyclopedia of Sociology. U.S.A: Fitzroy Dearborn Publishers

Course Code: CS 361	**Course Name:** Software Engineering	**Credit Hours:** 3(3+0)	**Prerequisites:**
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Describe various software engineering processes and activities		Cognitive	1
Apply the system modeling techniques to model a medium size software system		Cognitive	3
Apply software quality assurance and testing principles to medium size software system.		Cognitive	4
Discuss key principles and common methods for software project management such as scheduling, size estimation, cost estimation and risk analysis		Cognitive	2

Course Content:
Week-1: Nature of Software, Overview of Software Engineering, Professional software development
Week-2: Software engineering practice, Software process structure
Week-3: Software process models
Week-4: Agile software Development, Agile process models
Week-5: Agile development techniques
Week-6: Requirements engineering process
Week-7: Functional and non-functional requirements
Week-8: Model driven engineering, Context models
Week-9: Interaction models**,** Structural models
Week-10: Behavioural models
Week-11: Architectural design, Design and implementation, UML diagrams
Week-12: Design patterns
Week-13: Software testing and quality assurance
Week-14: Software evolution
Week-15-: Project management and project planning, configuration management
Week-16: Software Process improvement.

Teaching Methodology:
Lectures, Written Assignments, Practical labs, Semester Project, Presentations

Course Assessment:
Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam

Reference Materials:

8. Software Engineering, Sommerville I., 10th Edition, Pearson Inc., 2014
9. Software Engineering, A Practitioner's Approach, Pressman R. S.& Maxim B. R., 8th Edition, McGraw-Hill, 2015.

Course Code: CS 362	**Course Name:** Compiler Construction	**Credit Hours:** 3 (3+0)	**Prerequisites:**
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Understand the basic techniques used in compiler construction such as lexical analysis, top-down, bottom-			

up parsing, context-sensitive analysis, and intermediate code generation		
Understand the basic data structures used in compiler construction such as abstract syntax trees, symbol tables, three-address code, and stack machines		
Design and implement a compiler using a software engineering approach		
Use generators (e.g. Lex and Yacc)		
Course Content: **Week-1:** Introduction to interpreter and compiler **Week-2-3:** Compiler techniques and methodology **Week-4:** Organization of compilers **Week-5-6:** Lexical and syntax analysis **Week-7-8:** Parsing techniques **Week-9:** Types of parsers, Top-down parsing, bottom-up parsing **Week-10:** Type checking **Week-11-12:** Semantic analyser **Week-13-14:** Object code generation and optimization **Week-15-16:** Detection and recovery from errors		
Teaching Methodology: Lectures, Written Assignments, Semester Project, Presentations		
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam		
Reference Materials: 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 Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 363	Parallel & Distributed Computing	3(3+0)	
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Learn about parallel and distributed computers.			

Write portable programs for parallel or distributed architectures using Message-Passing Interface (MPI) library		
Analytical modelling and performance of parallel programs.		
Analyse complex problems with shared memory programming with openMP.		

Course Content:

Week-1: Introduction to Parallel Computing and its Importance

Week-2-4: Basic architecture of uniprocessor, parallelism in uniprocessor

Week-5-6: Architectural Classification Scheme (Flynn's Classification, Feng's Classification, Handler's Classification) Concurrent Processes Basic Concepts of Concurrency, Concurrency in Operating Systems, Parallel memory architecture (Shared memory, distributed memory and hybrid), distributed Shared Memory, Cache Coherent problem

Week-7: Cache Coherent protocols, Snoopy-Bus Protocol, Directory-Based Protocol, Data parallel Model

Week-8-9: Conditions of parallelism, Bernstein's Conditions. Parallel Algorithms, Evaluation of Parallel Algorithms, Amdahl's Law, Gustafson-Barsis's Law, Karp-Flatt Metric, Algorithms for Shared Memory and Network Models, Parallel Algorithms for Shared Memory, Parallel Algorithms, Designing Parallel Algorithms, Steps of Designing parallel Algorithms

Week-10-11: Problem Decomposition, Granularity of Computation, Minimizing Overheads, Task Allocation and Load Balancing

Week-12-13: Parallel Architectures (Multi-cores, Multiprocessors, Heterogeneous Systems with Graphical Processing Units)

Week-14-16: Unconventional Architectures, Message-passing Programming and Examples, Shared Memory Programming and Examples

Teaching Methodology:

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

Course Assessment:

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

Reference Materials:

1. Czech, Z. J.(2017). Introduction to Parallel Computing (Latest ed.), Cambridge University Press.

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 364	Information Security	3(3+0)	
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level

Explain key concepts of information security such as design principles, cryptography, risk management, and ethics	Cognitive	2
Discuss legal, ethical, and professional issues in information security.	Affective	2
Apply various security and risk management tools for achieving information security and privacy.	Cognitive	3
Identify appropriate techniques to tackle and solve problems in the discipline of information security.	Cognitive	4

Week-1

Information Security , Network Security and Cyber Security,
CIA Triangle i:e Confidentiality, Integrity and Availability
Critical Characteristics of Information
Expended CIA Triangle, Availability, Accuracy, Authenticity, Confidentiality, Integrity, utility & Possession , Components of Information Security (Hardware, Data, People , Procedures and Networks)

Week-2

Security Mechanisms
Encipherment, Digital Signature, Access Control, Data Integrity and Traffic Padding, Routing Control, Notarization & Authentication Exchange
Security Attack
Passive Attacks (Release of message contents and Traffic Analysis)
Active Attack(Masquerade , Modification of messages, repudiation, Replay & DOS)

Week-3

Cyber Security threads
Cryptography
Classical Encryption Techniques
Substitution Cipher (Mono alphabetic cipher, Poly Alphabetic cipher and Play fair cipher)

Week-4

Transposition Techniques

- Rail fence techniques, Simple Columnar Transposition and Vernam Cipher
- Feistel Structure , Block and Stream Cipher
- Private Key Cryptography and Public Key Cryptography

Week-5-7

Cryptographic Algorithms

- Symmetric Algorithms Introduction (DES and 3DES)
- Asymmetric Algorithm (Diffie- Hellman Key Exchange & RSA)

Week-8

Key Management in Cryptography

- Distribution of public keys
  - Public Announcement
  - Publically available Directory

- Public Key Authority
- Public Certification

Week-9
Access Control

- DAC, MAC

Authentication

- Types of Authentication
  - Single factor and multi factor authentication

Week-10-11
Hash Functions and Digital Signature
Security Technology: Firewall

- Firewalls
- Firewall Processing Modes
  - Packet Filtering Firewall, Application Gateways Circuit Gateways and MAC layers Firewall

Week-12
Software Security , Vulnerabilities and Protection, Malware
Week-13-14
Security Policies, policy formation and enforcement
Week-15-16
Pakistan Cyber Law and Ethics in Information Security

Teaching Methodology:
Lectures, Written Assignments, Practical labs, Semester Project, Presentations

Course Assessment:
Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam

Reference Materials:

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

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 365	Visual Programing	3(3+0)	
Course Learning Outcomes			

• Describe the event driven concepts and application of these concepts on GUI programs on desktop applicationsIn • Utilize rapid prototyping techniques to design and develop sophisticated Desktop interfaces • Design, implement, test, debug and publish desktop applications	Domain	Bloom's Taxonomy Level

Course Contents:

Week: 1 Installation of Visual Studio.Net, Installation of SQL-Server, Introduction to Vb.Net IDE (C#)

Week: 2 Data Types, Byte, Short, Integer, Long, Double, Char, Date, Declaring Variables & Constants

Week: 3 Structures, Functions

Week: 4 Conditional Statements, Loops

Week: 5 Procedures (Types, Scope of Procedures Public, Private, Friend)
Exceptions Handling (Try, Catch, Finally)

Week: 6
Introduction to classes and Objects

Week: 7
Introduction to Window Forms
Working with different controls in Window Forms
Common Properties (Textbox Control, Button Control, Checkbox and Radio Controls, Listbox Control, Combo box Control)

Week: 8
Creating Multi Document Interfaces
MDI Parents, MDI Childs, Adding Menus in MDI Forms

Week: 9 & 10
Database Creation, Tables Creation
Working with DML Statements (Insert, Delete, Update)
SQL Server joins statements(Cross-Join, Inner Join, Full Outer Join)

Week: 11 ADO.NET Architecture
ADO.Net objects & Classes

Week: 12
Working with Data grid (Bind it with Sql Server Tables)
Bind the following Controls
Buttons, Text boxes, Combo boxes

Week: 13 & 14 Perform Data Manipulation Using Ado.net Coding Methods
Add New Records
Delete Record
Update Records
Search a Particular Record

Week: 15
Into. to Crystal Reports
Working with Crystal Reports
Different Section of Crystal Reports
Crystal Report Viewer

Week: 16 ***Project***
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: **Reference Materials:** 1. Event processing in action by Opher Etzion and Peter Niblett 2. Windows presentation foundation unleashed by Adam Nathan

Course Code: CS 366	**Course Name:** **Mobile Applications Development**	**Credit Hours:** 3(3+0)	**Prerequisites:** Programming Fundamentals, java
Course Learning Outcomes			
At the end of the course the students will be able to: • Describe the characteristic of the android operating system. • Design user interface using different widgets, menus • Design, implement, test, debug and publish android applications. • Deploy android applications on the android marketplace.		Domain	Bloom's Taxonomy Level
Introduction to JAVA programming, OOP concept in JAVA, Classes, Objects, Inheritance, Polymorphism, Interfaces, Exception Handling, Introduction to Android operating system, Android activity lifecycle, Fragments, Android components including View and View Group, Widgets, Services, Content provider, Broadcast Receivers, Intents (Explicit and Implicit intent), Shared Preferences, Notification, Sensors, Android layouts including Linear Layout, Relative Layout, Table Layout, Scroll view Layout, Constraint Layout, Frame layout, Creating and using databases, Querying in database, Deploying android application on Android market.			
Teaching Methodology:			

Lectures, Written Assignments, Practical labs, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. Horton, J. (2015). Android Programming for Beginners (Latest ed.). Packt Publishing Ltd. 2. Phillips, B., & Hardy, B. (2013). Android programming: the beginners guide (Latest ed.). Pearson Education. 3. Lee, W. M. (2012). Beginning android 4 application Development (Latest ed.). John Wiley & Sons

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 367	Introduction to Management	3(3+0)	
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Hold informed conversations with functional specialists and understand how to draw effectively on their expertise in managing organizations.			
Understand the relevance of the western management principles and theories, for local settings.			
Understand the Islamic perspective of managing businesses and organizations.			
Apply course concepts and theory in a practical context.			
Integrate several of the disciplines studied			
Demonstrate empirical investigative skills by producing an in-depth analysis of a management situation usually presented through case studies, resulting in recommendations for a programme of action.			
Recognise the need to take a holistic approach to performance improvement rather than a narrowly functional approach.			
Course Content: **Week-1:** Introduction to Management Organization, The management Process **Week-2:** The History and evaluation of Management Organizational theories and different approaches to management **Week-3:** The organizational Culture and the Manager The external environment and the Manager The internal environment and the manager **Week-4:** Foundations and basic elements of Planning Process of planning and MBO Effective strategic planning			

Week-5: Decision Making The manager's role as decision maker Decision making process **Week-6:** Basics of Strategic Management Case of Strategic Management Strategic management process **Week-7:** Organizational Structure Types of organizational structures **Week-8:** Case Decision-making **Week-9:** Human Resource Management HRM processes **Week-10:** Motivation its theories Current issues in Motivation **Week-11:** Team work and Group Behaviour Case of team and team work **Week-12:** Leadership and its characteristics Leadership styles and behaviours **Week-13:** The process of Control the Control Standards **Week-14:** Case of Controlling Presentation **Week-15:** Staffing Presentation **Week-16:** Conclusion Session
Teaching Methodology: Lectures, Written Assignments, Presentations
Course Assessment: Home Assignments, Quizzes, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. Mary Coulter & Robbins, Management, International ed.

Course Code: CS 368	**Course Name:** Principle of Marketing	**Credit Hours:** 3(3+0)	**Prerequisites:**
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Understand the marketplace and the consumers.			
Understand 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.			
Course Content: **Week-1:** Introduction to Marketing, Marketing and The Society, Importance and Scope of Marketing, Nature And Concept Of Marketing **Week-2:** Marketing Environments, The Marketing Environment, Macro Environment, Micro Environment, Environmental Scanning and Monitoring			

Week-3: Marketing & Strategy, Strategic Planning, Strategic Marketing Planning, Forecasting Marketing Demand
Week-4: Marketing Decisions, Information Required for Marketing Decisions, Reasons for Obtaining Information, Marketing Research
Week-5: Consumer Behaviour, Information for Purchase Decisions, Consumer Decision Process, Influence of Social and Psychological Factors
Week-6: Market Segmentation and Targeting, Factors for Segmentation, Selecting The Target Market, Developing The Positioning and Target Market Strategies
Week-7: Products and Services, Definition of Product and Services, Classification of Consumer Goods, Classification of Business Goods
Week-8: Product Development and Life Cycle, Product Development Process and Commercialization, Product Life Cycle Stages and Its Implications
Week-9: Pricing, Overview of Pricing, Importance of Pricing, Break Even Analysis, Factor Effecting Pricing Decisions
Week-10: Setting The Price and Relating Strategies, Pricing Objectives, Sale Based Objectives, Profit Based Objectives, Status Quo Pricing, Price Strategy
Week-11: Pricing Techniques and Their Applications, Cost Based Pricing, Cost Plus Pricing, Target Pricing, Floor Pricing
Week-12: Distribution, Importance of Distribution Channels, Selecting a Channel of Distribution, Recent Trends in Wholesaling and Retailing
Week-13: Promotion, Importance and Types of Promotion, Channels of Communication, Objectives, Budgeting and Promotional Mix,
Week-14: Advertisement and Publicity, Scope of Advertisement and Publicity, Characteristic of Advertisement and Publicity,
Week-15: Introduction to E-Business, Different Trends, Rules of Doing E-Business, E-Business Application in The Market
Week-16: Conclusion Session/presentations

Teaching Methodology:
Lectures, Written Assignments, Presentations

Course Assessment:
Home Assignments, Quizzes, Presentations, Midterm Exam, Final Exam

Reference Materials:

1. Philip Kotler, Principles of Marketing (Latest Edition)
2. David Jobber, Principles of Marketing (Latest Edition)
3. Jerome Mccarthy & William, D. Pareanth, Basics Marketing, (Latest Edition)

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 471	Professional Practices	3(3+0)	

Course Learning Outcomes		
At the end of the course the students will be able to:	Domain	Bloom's Taxonomy Level

Course Content:
Week-1: Computing Profession
Week-2: Computing Ethics
Week-3: Philosophy of Ethics. The Structure of Organizations
Week-4: Finance and Accounting, Anatomy of a Software House, Computer Contracts
Week-5: Intellectual Property Rights
Week-6: The Framework of Employee Relations Law and Changing Management Practices
Week-7: Human Resource Management and IT, Health and Safety at Work
Week-8: Software Liability, Liability and Practice
Week-9: Computer Misuse and the Criminal Law
Week-10: Regulation and Control of Personal Information
Week-11: Overview of the British Computer Society Code of Conduct
Week-12: IEEE Code of Ethics and Professional Conduct
Week-13: ACM Code of Ethics and Professional Conduct
Week-14: ACM/IEEE Software Engineering Code of Ethics and Professional Practice
Week-15-16: Accountability and Auditing, Social Application of Ethics

Teaching Methodology:
Lectures, Written Assignments, Semester Project, Presentations

Course Assessment:
Home Assignments, Quizzes, Project, Report Writing, Presentations, Midterm Exam, Final Exam

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

Course Code: CS 372	**Course Name:** Artificial Intelligence	**Credit Hours:** 4 (3+1)	**Prerequisites:** Data Structures &Algorithms
Course Learning Outcomes			

At the end of the course the students will be able to:	Domain	Bloom's Taxonomy Level
Understand key components in the field of artificial intelligence	Cognitive	2
Implement classical artificial intelligence techniques	Cognitive	3
Analyse artificial intelligence techniques for practical problem solving	Cognitive	4

Course Content:

Week-1: Introduction, basic component of AI

Week-2: Identifying AI systems, branches of AI, etc.

Week-3-4: Reasoning and Knowledge Representation (Introduction to Reasoning and Knowledge

Week-5: Representation, Propositional Logic, First order Logic)

Week-6: Problem Solving by Searching (Informed searching, Uninformed searching, Local searching.)

Week-7-8: Constraint Satisfaction Problems; Adversarial Search (Min-max algorithm, Alpha beta pruning, Game-playing)

Week-9-11: Learning (Unsupervised learning, Supervised learning, Reinforcement learning)

Week-12: Uncertainty handling (Uncertainty in AI, Fuzzy logic)

Week-13-14: Recent trends in AI and applications of AI algorithms (trends, Case study of AI systems

Week-15-16: Analysis of AI systems

Teaching Methodology:

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

Course Assessment:

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

Reference Materials:

1. Stuart Russell and Peter Norvig, Artificial Intelligence. A Modern Approach, 3rd edition, Prentice Hall, Inc., 2010
2. Hart, P.E., Stork, D.G. and Duda, R.O., 2001. Pattern classification. John Willey & Sons
3. Luger, G.F. and Stubblefield, W.A., 2009. AI algorithms, data structures, and idioms in Prolog, Lisp, and Java. Pearson Addison-Wesley

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 473	Distributed Data Base Systems	3(3+0)	
Course Learning Outcomes			

At the end of the course the students will be able to:	Domain	Bloom's Taxonomy Level

Course Content:

Week-1

- What is Distributed Database System?
- Distributed Data Processing
- Advantages of data DDBS

Week-2

- Relational Database Concepts
- Normalization
- Integrity Rules

Week-3

- Data Communication Concepts
- Types of Networks
- Protocols Standards

Week-4

- Client/Server Systems
- Peer-to-peer Distributed Systems
- MDBS Architecture

Week-5

-Characterization of Query Processors

Week-6

- Layers of Query processing

Week-7, 8

- Fragmentation
- Reasons for Fragmentation
- Types of Fragmentation

Week-9, 10

- Parallel DBMSs
- Database Servers
- Centralized Database Systems

Week-11, 12

- Properties of Transactions
- Concurrency control Techniques
- Locking Methods
- Dead Lock
- Timestamp Method

Week-13

- Recovery
- Causes of Failure
- Local Recovery Protocols
- Undo/Redo
- Undo/No-Redo
- Distributed Recovery Protocols

-Distributed Two Phase Commit

Week-14

- Integrity Constraints
- Securities Issues in Distributed Databases
- Identification & Authorization
- Distribution of Authorization
- Encryption
- Global View Mechanism

Week-15

- Data Ware Housing introduction
- World Wide Web introduction

Week-16

- Revision

Teaching Methodology:

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

Course Assessment:

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

Reference Materials:

1. Principles of Distributed Systems By M. Tamer Ozsu

Course Code: CS 474	**Course Name:** Cryptography	**Credit Hours:** 3(3+0)	**Prerequisites:** Discrete Structures
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level

Course Content:

Week-1: Classsical Cipher

Week-2: Prime numbers, Factoring

Week-3: Modular arithmetic

Week-4: Block cipher principles, Feistel networks, S boxes and P boxes, Block cipher modes of operation,

Week-5: DES, 3DES

Week-6: AES

Week-7: Properties of cryptographic hash functions, MD family

Week-8: SHA family

Week-9: Digital signatures **Week-10:** Public key crypto systems, Discrete logarithm problem, DH key Exchange Protocol **Week-11:** Integer factorization Problem, RSA algorithm **Week-12-13:** Elliptic Curve cryptography **Week-14:** Interactive Proofs, Zero-Knowledge Proofs **Week-15:** Multiparty Secure Computation, Chosen Cipher Text Security **Week-16:** Homomorphic Encryption
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. William Stallings, Cryptography and network security, Pearson Education 2. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone , Handbook of Applied Cryptography, CRC Press 3. Margaret Cozzens, Steven J Miller, The mathematics of encryption, American Mathematical Society 4. Research papers related to each topic

Course Code: CS 477	**Course Name:** Advance Programming	**Credit Hours:** 3(2+1)	**Prerequisites:** OOP, OS
Course Learning Outcomes			
1. When students complete this course, they will be able to, • Create Java applications using OOP practices. • Create multi-threaded applications which can execute faster on current multi-core architectures. • Create event-driven Graphical User Interfaces (GUIs).		Domain	Bloom's Taxonomy Level
Introduction to Java, Java programming environment (JDK, JRE, JVM), Characteristics of Java, Compilation and Execution process of Java Program, OOP concepts, Classes, Objects, Encapsulation, Inheritance, Polymorphism, Abstraction, Interfaces in Java, Java keywords(import, this, new, static, final, super), Exception handling, try, catch and finally block, throw and throws, Java Collections and Generics, Inner Classes and usage, Threads, and Importance, Starting Threads, Sleep, Join, Priority, Daemon Threads, Thread Synchronization and Importance, Synchronized Methods and Synchronized Blocks, wait(), notify(), notifyall(), Network Programming, Java Sockets, and the java.net package, (UDP and TCP based			

Programming), RMI, Graphical User Interfaces (GUIs), Java Database Connectivity (JDBC), Select Statement, Insert Statement, Update Statement, Delete Statement.
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. Deitel, H., Deitel, P. (2015). Java How to Program (Latest ed.). Prentice Hall. 2. Schildt, H. (2017). Java: A Beginners Guide (Latest ed.). McGraw-Hill Education.

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 477	Software Project Management	3(2+1)	Software Engineering
Course Learning Outcomes			
At the end of the course the students will be able to: 1. Explain principles of the project lifecycle and how to identify opportunities to work with learners on relevant and appropriate project scenarios to share this understanding 2. Critically evaluate and discuss the issues around project management and its application in the real world with course participants and learners 3. Choose project management techniques for IT projects to initiate, plan, execute and evaluate a project and work in teams to create a project plan for a project scenario that includes key tasks, critical path, dependencies and a realistic timeline. 4. Present strategies for gaining confidence in managing projects through simple project planning examples		Domain	Bloom's Taxonomy Level

Course Content: **Week-1:** Introduction to Software Project Management, Project Management concepts, **Week-2:** Project Management Tools, PMI's Knowledge areas, PMI Framework, PMI Process Groups. **Week-3-4:** Understanding Organizations. **Week-5-6:** Project Planning, Project Evaluation, Selection of an Appropriate Approach in Project, Software Effort Estimation, **Week-7-8:** Activity Planning, Risk Management, **Week-9-10:** Evaluating the Risks to the Schedule, Risk Control, Configuration Management and Maintenance, Environment for Configuration Control, **Week-11-13:** Resource Allocation, Monitoring & Control, Review and Evaluation, **Week-14-16:** Challenges of Outsourcing in Project Management
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: 3. Deitel, H., Deitel, P. (2015). Java How to Program (Latest ed.). Prentice Hall. 4. Schildt, H. (2017). Java: A Beginners Guide (Latest ed.). McGraw-Hill Education.

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 481	Theory of Programming Languages	3(3+0)	
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
The better understating the underlying theory of programming languages		Cognitive	1
Enable a student to choose the appropriate Language for a Project		Cognitive	2
Learning of formal semantics design for a programming Languages		Cognitive	2
Course Content: **Week-1:** Introduction: Models of Computation **Week-2:** Syntax and Semantics, Pragmatics **Week-3:** Language Design Principles **Week-4:** Syntax and Semantics: Context-Free Grammars, Regular Expressions **Week-5:** Attribute Grammars and Static Semantics			

Week-6: Algebraic Semantics **Week-7:** Axiomatic Semantics, Denotational Semantics **Week-8:** BNF grammars and Syntax, Operational Equivalence **Week-9:** Abstraction and Generalization, Expressions **Week-10:** Assignment Statement, and Control Structures **Week-11:** Functional Programming: The Lambda Calculus **Week-12:** Operational Semantics, Reduction Order **Week-13:** Recursive Functions **Week-14:** Logic Programming **Week-15:** Inference Engine **Week-16:** Concurrency
Teaching Methodology: Lectures, Written Assignments, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. Concepts of Programming Languages, Robert W. Sebesta, 10th edition, 2012 2. Scott, Michael L., Programming Language Pragmatics, 2nd edition, 2006 3. Theory Introduction to Programming Languages, by Anthony A. Aaby, 2004 4. Principles of Programming Languages by Mike Grant Zachary Palmer Scott Smith, John Hopkins University 2016.

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
CS 478	Introduction to Data Mining	3(3+0)	
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Recall important pattern discovery concepts, methods, and applications, in particular, the basic concepts of pattern discovery, such as frequent pattern, closed pattern, max-pattern, and association rules			
Learn well-known sequential pattern mining methods, including methods for mining sequential patterns, such as GSP, SPADE, PrefixSpan, and CloSpan			
Learn graph pattern mining, including methods for subgraph pattern mining, such as gSpan, CloseGraph, graph indexing methods, mining top-k large structural patterns in a single large network, and graph mining applications, such as graph indexing and similarity search in graph databases			

Learn popular distance-based partitioning algorithms for cluster analysis, including K-Means, KMedians, K-Medoids, and the Kernel K-Means algorithms		
Learn hierarchical clustering algorithms, including basic agglomerative and divisive clustering algorithms, BIRCH, a micro-clustering-based approach, CURE, which explores well-scattered representative points, CHAMELEON, which explores graph partitioning on the KNN Graph of the data, and a probabilistic hierarchical clustering approach		
Learn the density-based approach to cluster analysis, which can group dense regions of arbitrary shape, such as DBScan and OPTICS, Learn the grid-based approach, which organizes individual regions of the data space into a grid-like structure, such as STING and CLIQUE		

Course Content:

Week-1: Pattern Discovery Overview; Pattern Discovery Basic Concepts
Week-2: Efficient Pattern Mining Methods; Pattern Discovery Programming Assignment
Week-3: Pattern Evaluation; Mining Diverse Frequent Patterns
Week-4: Sequential Pattern Mining; Pattern Mining Applications: Mining Spatiotemporal and Trajectory Patterns
Week-5: Constraint-Based Mining
Week-6: Graph Pattern Mining
Week-7: Pattern-Based Classification
Week-8: Pattern Mining Applications: Mining Quality Phrases from Text Data
Week-9: Advanced Topics on Pattern Discovery, Pattern Discovery Programming
Week-10: Cluster Analysis Overview; Cluster Analysis Introduction
Week-11: Similarity Measures for Cluster Analysis
Week-12: Partitioning-Based Clustering Methods; Hierarchical Clustering Methods
Week-13: Hierarchical Clustering Methods
Week-14: Density Based and Grid-Based Clustering Methods; Cluster Analysis Programming Assignment
Week-15: Methods for Clustering Validation
Week-16: Cluster Analysis Programming Assignment

Teaching Methodology:

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

Course Assessment:

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

Reference Materials:

1. Data Mining: Concepts and Techniques, 3rd Edition by Jiawei Han, Jian Pei, Micheline Kamber, June 2011, Publisher(s): Morgan Kaufmann

Course Code: CS 483	**Course Name:** Introduction to Data Science	**Credit Hours:** 3(3+0)	**Prerequisites:**
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level
Understand basic concepts of data science, statistics and probability and their application in understanding behavior of data.			
Apply basic tools for performing exploratory data analysis and visualization.			
Understand basic predictive modeling and data analysis methods			
Learn Python for performing different data science steps			
Course Content: **Week-1:** Introduction to Data Science **Week-2-3:** Statistical Analysis **Week-4-5:** Visualizing Data **Week-6-7:** Algorithms and Spam Filters **Week-8-9:** Logistic Regression **Week-10-11:** Time Stamp and Financial Modeling **Week-12-13:** Recommendation Engines **Week-14-5:** Data Engineering **Week-16:** Revision, project presentation and discussions			
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations			
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam			
Reference Materials: 1. Data Science and Big Data Analytics by Wiley 2. Doing Data Science by Oreilly			

Course Code: CS 485	**Course Name:** Cyber Security	**Credit Hours:** 3(3+0)	**Prerequisites:**
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level

Course Content:
Week-1: Basic security concepts
Week-2: Information security terminology
Week-3: Types of malware
Week-4: Malware classifications
Week-5: Server side web applications attacks
Week-6: Cross-site scripting
Week-7: SQL Injection, Cross-site request forgery
Week-8-9: Planning and policy
Week-10: Network protocols and service models
Week-11: Transport layer security
Week-12: Network layer security
Week-13: Cloud & IoT security
Week-14-15: Cyber Crimes
Week-16: Cyber Laws

Teaching Methodology:
Lectures, Written Assignments, Semester Project, Presentations

Course Assessment:
Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam

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 Code: CS 486	**Course Name:** Digital Marketing	**Credit Hours:** 3(3+0)	**Prerequisites:**
Course Learning Outcomes			
At the end of the course the students will be able to:		Domain	Bloom's Taxonomy Level

Course Content:
Week-1: Digital Marketing Foundation, Competitor and Website Analysis, Market Research & Niche Potential
Week-2: Website Design using WordPress CMS, Email Marketing
Week-3: Content Creation and Promotion, Search Engine Optimization
Week-4: Social Media Marketing, Optimization & Advertising
Week-5: PPC Google Ads Campaign Management, Optimization, and Reporting, Bing Advertising, Mobile Marketing (SMS Marketing)
Week-6: GEO Marketing, YouTube Video Marketing & Advertising, Website Data Analytics
Week-7: Affiliate Marketing, Blogging, Freelancing
Week-8: Google AdSense, Digital Marketing Plan & Budget Forecast
Week-9: Digital Marketing for MULTIPLE Business TYPES, Product Marketing (Google Ads, Instagram, Facebook)

Week-10: Neuro Marketing Fundamentals, Paid Ads Optimization Strategies, Online Reputation Management **Week-11:** Digital Marketing Automation, FREEMIUM AND PREMIUM Digital Marketing Tools **Week-12:** Case Studies, Internationally Recognized Certification Guidance (Google, Microsoft Bing, and HubSpot) **Week-13:** Career Counselling and Interview Preparation Guidance **Week-14:** Digital Marketing Project Management, MindSet Program, Digital Marketing Growth Hacks. **Week-15-16:** Working on Real-Time Projects (Internship Opportunities for eligible Students)
Teaching Methodology: Lectures, Written Assignments, Practical labs, Semester Project, Presentations
Course Assessment: Home Assignments, Quizzes, Project, Presentations, Midterm Exam, Final Exam
Reference Materials: 1. Recent Research Resources

Course Code:	**Course Name:**	**Credit Hours:**	**Prerequisites:**
Proj-489	Final Year Project	6(0+6)	
Project Learning Outcomes			