CURRICULUM

OF

BS (COMPUTER SCIENCE)

SESSION (2023 – 2027 & ONWARD)

For Affiliated Colleges

Scheme of Study for Bachelor of Science in Computer Science

BS (CS) Session 2023-2027 and Onwards
4-Year program (8 Regular Semesters of 18 weeks each)

#	Areas	Credit Hours	# of Courses
1	**Computing Core**	**46**	**14**
2	**Domain Core**	**19**	**7**
3	**Domain Elective**	**21**	**7**
4	**Mathematics & Supporting courses**	**12**	**4**
5	**Elective Supporting Courses**	**3**	**1**
6	**General Education Requirement**	**30**	**12**
	Total	**131**	**45**

**: Non-credit "Mathematics" course is introduced in compliance with NCEAC policy for Pre - Medical Students. It is mandatory for pre-medical students to pass non-credit "Mathematics" (Part-I and Part-II) within 1st year of BS (CS) to confirm their admission, otherwise their admission shall stand cancelled.

Semester – I: (16 Credit Hours)

#	Course Code	Prerequisites	Course Title	Domain	Credit Hours
1	CS-101		Programming Fundamentals	Comp-Core	4(3-3)
2	COMP-101		Application of Info. & Comm. Technologies	GER	3(2-3)
3	CS-102		QR 1 (Discrete Structures)	GER	3(3-0)
4	G-ENG-101		Functional English	GER	3(3-0)
5	**MATH-000**		**Mathematics(Part-I)****		*3(3+0)* Non- Credit
6	PHYS-120		Natural Science (Applied Physics)	GER	3(2-3)

Semester – II: 17 (13-12) Credit Hours

#	Course Code	Prerequisites	Course Title	Domain	Credit Hours
1	CS-151	Programming Fundamental	Object Oriented Programming	Core	4(3-3)
2	CS-152		Database Systems	Core	4(3-3)
3	CS-153		Digital Logic Design	Core	3(2-3)
4	CS-154		Computer Networks	Core	3(2-3)
5	CS-155		Software Engineering	Core	3(3-0)
6	MATH-000		Mathematics(Part-II)**	Comp Med-Supp	*3(3+0)* Non- Credit

Semester – III: 19 (15-12) Credit Hours

#	Course Code	Prerequisites	Course Title	Domain	Credit Hours
1	CS-201	OOP	Data Structures	Core	4(3-3)
2	CS-202		Information Security	Core	3(2-3)
3	CS-204		Artificial Intelligence	Core	3(2-3)
4	STAT-201		Probability & Statistics	Maths	3(3-0)
5	MATH-101	Mathematics	QR 2 (Calculus and Analytical Geometry)	GER	3(3-0)
6	G-ENG-102		Expository Writing	GER	3(3-0)

Semester – IV: 17 (14-9) Credit Hours

#	Course Code	Prerequisites	Course Title	Domain	Credit Hours
1	CS-251	DLD	Computer Organization & Assembly Language	Core	3(2-3)
2	CS-252		Domain Core 1 (Theory of Automata)	Domain Core	3(3-0)
3	CS-253	DB	Domain Core 2 (Advance Database Management Systems)	Domain Core	3(2-3)
4	MATH-251	CAG	Multivariable Calculus	Maths	3(3-0)
5	MATH-151	CAG	Linear Algebra	Maths	3(3-0)
6	G-ISL-201		Islamic Studies	GER	2(2-0)

Semester – V: 17 (12-15) Credit Hours

#	Course Code	Prerequisites	Course Title	Domain	Credit Hours
1	CS-301		Operating Systems	Core	3(2-3)
2	CS-302		Domain Core 3 (HCI & Computer Graphics)	Domain Core	3(2-3)
3	CS-303	COAL	Domain Core 4 (Computer Architecture)	Domain Core	3(2-3)
4	CS-304		Domain Elective 1	Domain Elective	3(2-3)
5	CS-305		Domain Elective 2	Domain Elective	3(2-3)
6			Social Science (Introduction to Management)	GER	2(2-0)

Semester – VI: 18 (12-18) Credit Hours

#	Course Code	Prerequisites	Course Title	Category	Credit Hours
1	CS-351	TA	Domain Core 5 (Compiler Construction)	Domain Core	3(2-3)
2	CS-352	OS	Domain Core 6 (Parallel & Distributed Computing)	Domain Core	3(2-3)
3	CS-353		Domain Elective 3	Domain Elective	3(2-3)
4	CS-354		Domain Elective 4	Domain Elective	3(2-3)
5	CS-355		Domain Elective 5	Domain Elective	3(2-3)
6	CS-356		Domain Elective 6	Domain Elective	3(2-3)

Semester – VII: 16 (13-9) Credit Hours

#	Course Code	Prerequisites	Course Title	Category	Credit Hours
1	CS-401		Final Year Project-I	Core	2(0-6)
2	CS-402	DS	Analysis of Algorithms	Core	3(3-0)
3	CS-403		Domain Elective 7	Domain Elective	3(2-3)
4			Elective Supporting Course	SS	3(3-0)
5			Technical & Business Writing	EN	3(3-0)
6	G-MGT- 401		Entrepreneurship	GER	2(2-0)
7			Internship		1(0-3)

Semester – VIII: 10 (6-12) Credit Hours

#	Course Code	Prerequisites	Course Title	Domain	Credit Hours
1	CS-451	FYP I	Final Year Project-II	Core	4(0-12)
2	PAKS-101		Ideology and Constitution of Pakistan	GER	2(2-0)
3			Arts & Humanities (Professional Practices)	GER	2(2-0)
4	G-SOC-202		Civics and Community Engagement	GER	2(2-0)

Electives for BS (CS)
CS Elective Courses:

#	*Category*	*Course Title*	*Credit Hours*	*Prerequisites*
1	CS-Elec	Computer Graphics	2-1	Programming Fundamentals
2	CS-Elec	Digital Image Processing	2-1	
3	CS-Elec	Visual Programming	2-1	Object oriented programming
4	CS-Elec	Distributed Computing	2-1	Operating Systems
5	CS-Elec	Network Security	3-0	Computer networks
6	CS-Elec	Computer Vision	3-0	
7	CS-Elec	Systems Programming	2-1	
8	CS-Elec	Distributed Database Systems	2-1	Intro. to Database Systems
9	CS-Elec	Data Warehousing	3-0	Intro. to Database Systems
10	CS-Elec	Web Engineering	2-1	Programming Fundamentals
11	CS-Elec	Web Design and Development	2-1	Programming Fundamentals
12	CS-Elec	Artificial Neural Networks	2-1	Discrete Structures
13	CS-Elec	Expert Systems	2-1	Discrete Structures
14	CS-Elec	Fuzzy Logic System	2-1	Discrete Structures
15	CS-Elec	Operations Research	3-0	
16	CS-Elec	Network Programming	2-1	Computer networks
17	CS-Elec	Wireless Networks	3-0	Computer networks
18	CS-Elec	Telecommunication Systems	2-1	Computer networks
19	CS-Elec	Mobile Computing	2-1	Computer networks
20	CS-Elec	Mobile Application and Development	3-0	Object oriented programming
21	CS-Elec	Java Programming	2-1	Object oriented programming
22	CS-Elec	Android Programming	2-1	
23	CS-Elec	Cloud Computing	2-1	
24	CS-Elec	Cyber Security	3-0	
25	CS-Elec	Object-Oriented Analysis & Design	3-0	Software Engineering
26	CS-Elec	Ethical Hacking	2-1	

27	CS-Elec	Social Computing	3-0	
28	CS-Elec	Computational Intelligence	3-0	Discrete Structures
29	CS-Elec	Multi-Agent Systems	3-0	Computer Networks
30	CS-Elec	Natural Language Processing	3-0	
31	CS-Elec	Game Development	3-0	Object-Oriented Programming
32	CS-Elec	Logical Paradigms of Computing	3-0	Discrete Structures
33	CS-Elec	Principles of Programming Languages	3-0	Programming Fundamentals
34	CS-Elec	Formal Methods in Software Engineering	3-0	Discrete Structures
35	CS-Elec	Fundamentals of Data Mining	3-0	Intro to Database Systems
36	CS-Elec	Web technologies	3-0	
37	CS-Elec	Digital image processing	3-1	
38	CS-Elec	e-commerce	3-0	Web engineering
39	**CS-Elec**	**Enterprise system**	**3-0**	Database system
40	**CS-Elec**	**Global software development**	**3-0**	
41	**CS-Elec**	**Human computer Interaction**	**3-0**	Software engineering

University Electives Courses:

#	*Course Code*	*Category*	*Course Title*	*Credit Hours*
1	MGT-101	Univ-Elec	Financial Accounting	3-0
2	MGT-301	Univ-Elec	Financial Management	3-0
3	MGT-202	Univ-Elec	Human Resource Management	3-0
4	MGT-206	Univ-Elec	Principles of Marketing	3-0
5	MGT-401	Univ-Elec	Entrepreneurship	3-0
6	ECON-101	Univ-Elec	Introduction to Economics	3-0
7	PSY-101	Univ-Elec	Psychology	3-0
8	POL-253	Univ-Elec	Introduction to International Relations	3-0

General Education Courses

#	*Course Title*	*Credit Hours*
1	English Composition &Comprehension	3-0
2	Technical &Business Writing	3-0
3	Communication and presentation Skills	3-0
4	Professional practices	3-0
5	Introduction to Info.& comm. Technologies	2-1
6	Pakistan Studies	2-0
7	Islamic Studies/Ethics	2-0

STANDARDIZED FORMAT/SCHEME OF STUDIES FOR BS(CS)

Program	BSCS,
Semester	1st Semester
Title of the course	**Programming Fundamentals**
SDG	**09**
Prerequisite	**Nill**
Course Code.	IT-101
Credit hours	4(3+3)
Category	Comp core
Course contents	**Course Contents:** Introduction to problem solving, a brief review of Von-Neumann architecture, Introduction to programming, role of compiler and linker, introduction to algorithms, basic data types and variables, input/output constructs, arithmetic, comparison and logical operators, conditional statements and execution flow for conditional statements, repetitive statements and execution flow for repetitive statements, lists and their memory organization, multi-dimensional lists, introduction to modular programming, function definition and calling, stack rolling and unrolling, string and string operations, pointers/references, static and dynamic memory allocation, File I/O operations **Recommended Books:** 1.Starting out with Python, 4th Edition, Tony Gaddis. 2. Starting out with Programming Logic &Degins, 4th Edition, Tony Gaddis, 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. C How to Program, 7th Edition by Paul Deitel& Harvey Deitel 8. Problem Solving and Program Design in C++, 7th Edition by Jeri R. Hanly& Elliot B. Koffman
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	At the end of this course the students will able to: Understand basicproblem solvingsteps and logic Constructs C2 (Understand) Apply basic programing concepts C3 (Apply) Design and implement algorithms to solve real world problems C3 (Solve)

Lesson Plan

Week 1	**Contents to be covered**
Week 2	• Introduction of Programming • History • Language processors • Structure of C++ program
Week 3	• Writing program in C++ • Data types and variables • Variable rules • Data types
Week 4	• Constants • Arithmetic operators and expression • Relational operators and Expression
Week 5	Input and output objects • Cout and cin objects • endl manipulator • Programs
Week 6	Conditional Statements • What are conditional statements? • If statement • If else statement
Week 7	• Nested if else statement • Switch statements • Break statement
Week 8	• Mid Term
Week 9	Loops • What are loops? • For loop • While loop
Week 10	• Do-while loop Arrays • What is array? • Types of arrays
Week 11	• One dimensional and multidimensional array • Programs tructure • What is structure?
Week 12	• Programs Pointers • What is pointer? • Programs
Week 13	Functions • What are functions • Types of functions • Built in and user define functions
Week 14	• User define functions programs • Overloaded functions • String functions

Week 15	• definition and declaration of functions • function call • built in functions
Week 16	Stream and Files • Stream classes • File pointers • Programs
Week 17	• Examination and Result preparation

Sr#	**Experiments (Programming Fundamentals)**
1	Programming environment
2	Basic decision constructs and for loop
3	While loops and sentinel controlled repetition
4	Functions
5	Arrays
6	Pointers
7	Strings, structures , file management

Program	BSCS,
Semester	1st Semester
Title of the course	Application of Info & Comm Technologies
SDG	**09**
Prerequisite	**Nill**
Course Code.	COMP-101
Credit hours	3(2+3)
Category	Ger
Course contents	**Course Contents:** Number Systems, Binary numbers, Boolean logic, History computer system, basic machine organization, Von Neumann Architecture, Algorithm definition, design, and implementation, Programming paradigms and languages, Graphical programming, Overview of Software Engineering and Information Technology, Operating system, Compiler, Computer networks and internet, Computer graphics, AI, Social and legal issues. **Recommended Books:** 1. Computers: Information Technology in Perspective, 9/e by Larry Long and Nancy Long, 2. Prentice Hall, 2002 / ISBN: 0130929891 3. An Invitation to Computer Science, Schneider and Gersting, Brooks/Cole Thomson Learning, 2000 4. Computer Science: An overview of Computer Science, Sherer,
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	This course focuses on a breadth-first coverage of computer science discipline, introducing computing environments, general application software, basic computing hardware, operating systems, desktop publishing, Internet, software applications and tools and computer usage concepts; Introducing Software engineering and Information technology within the broader domain of computing, Social issues of computing.
Laboratory Projects/Experiments Done in the Course	Projects on Microsoft word Microsoft PowerPoint Microsoft excel Microsoft access Microsoft Visio

Lesson Plan

Week	Topics
Week 1	• Introduction to course • History of Computers
Week 2	• Generations of computer • Basic Computer Organization
Week 3	• Von Neumann Architecture, • Algorithm definition • Design and implementation
Week 4	• Programming paradigms and languages
Week 5	• Graphical programming
Week 6	• Overview of Software Engineering • Information Technology
Week 7	• Software Engineering and Information Technology • Presentation Activity
Week 8	• Mid Term
Week 9	• Operating system, Compiler
Week 10	• Number Systems, Binary numbers
Week 11	• Boolean logic
Week 12	• Computer networks and internet
Week 13	• Computer graphics
Week 14	• Artificial Intelligence
Week 15	• Social and legal Issues
Week 16	• Course Wrap Up • Presentation Activity
Week 17	• Final Term

Program	BSCS,
Semester	1st Semester
Title of the course	Discrete Structures
SDG	
Prerequisite	Nill
Course Code.	IT-102
Credit hours	3(3+0)
Category	Comp-Core
Course contents	**Course Contents:** Introduces the foundations of discrete mathematics as they apply to Computer Science, focusing on providing a solid theoretical foundation for further work. Further, this course aims to develop understanding and appreciation of the finite nature inherent in most Computer Science problems and structures through study of combinatorial reasoning, abstract algebra, iterative procedures, predicate calculus, tree and graph structures. In this course more emphasis shall be given to statistical and probabilistic formulation with respect to computing aspects. 1. **Recommended Books:** Discrete Mathematics and Its Applications, 7th edition by Kenneth H. Rosen 2. Discrete Mathematics with Applications, 4th Edition by Susanna S. Epp Discrete Mathematics, 7th edition by Richard Johnson Baugh Discrete Mathematical Structures, 4th edition by Kolman, Busby & Ross 3. Discrete and Combinatorial Mathematics: An Applied Introduction by Ralph P. Grimaldi 4. Logic and Discrete Mathematics: A Computer Science Perspective by Winifred Grassman
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	Understand the key concepts of Discrete Structures such C2 (Understand) as Sets, Permutations, Relations, Graphs and Trees etc. Apply formal logic proofs and/or informal, but rigorous, C3 (Apply) logical reasoning to real problems, such as predicting the behavior of software or solving problems such as puzzles. Apply discrete structures into other computing problems C3 (Apply) such as formal specification, verification, databases, artificial intelligence, and cryptography. Differentiate various discrete structures and their C4 (Differentiate) relevance within the context of computer science, in the areas of data structures and algorithms, in particular

Marks Distribution

Mid (30%)	Sessional (20%)	Final (50%)	3	Total
30	20	50	100(theory)	100

Week	• Course Contents
Week 1	• Mathematical Reasoning ,Propositional and predicate logic
Week 2	• Rules of inference, Proof by induction
Week 3	• Rules of inference, Proof by induction cont...
Week 4	• Set Theory
Week 5	• Set Theory Cont..
Week 6	• Function composition ,Inverse functions, Recursive functions
Week 7	• Functions Cont..
Week 8	• **Mid Term**
Week 9	• Equivalence relations and partitions, Partial orderings
Week 10	• Recurrence relations
Week 11	• Number Theory, Sequences Series Counting
Week 12	• Number Theory, Sequences Series Counting Contd…
Week 13	• Inclusion and exclusion principle
Week 14	• Sequences Series Counting, Pigeonhole principle
Week 15	• Planar graphs graph coloring, Hamiltonian path, Rooted Trees Traversals.
Week 16	• Permutations and combinations, Elements of graph theory
Week 17	• **Final Term**

Program	BSCS,
Semester	1st Semester
Title of the course	Functional English
SDG	
Prerequisite	
Course Code.	ENG-`101
Credit hours	3(3+0)
Category	GER
Course contents	Paragraph and Essay Writing, Descriptive Essays; Sentence Errors, Persuasive Writing; How to give presentations, Sentence Errors; Oral Presentations, Comparison and Contrast Essays, Dialogue Writing, Short Story Writing, Review Writing, Narrative Essays, Letter Writing **Reference Materials: (or use any other standard and latest books)** 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
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	
Laboratory Projects/Experiments Done in the Course	

Week	• Contents to be covered
Week 1	Paragraph and Essay Writing
Week 2	• Essay Writing
Week 3	• Descriptive Essays
Week 4	• Sentence Errors
Week 5	• Persuasive Writing
Week 6	How • to give presentations
Week 7	• Sentence Errors
Week 8	• Oral Presentations
Week 9	• Comparison
Week 10	• Contrast Essays
Week 11	• Dialogue Writing
Week 12	• Short Story Writing
Week 13	• Review Writing
Week 14	• Narrative Essays
Week 15	• Letter Writing
Week 16	• Quiz and Test

Course Outline and week plan: Mathematics-000

Course Description

This course is designed to prepare Student Teachers for teaching mathematics in elementary grades. It provides opportunities for Student Teachers to strengthen their mathematical knowledge and skills and to gain confidence in their understanding of mathematics. An important outcome of this course is for Student Teachers to be able to teach mathematics successfully in the primary, elementary, and middle grades.

Research-based knowledge about good maths instruction provides a solid base of information for educators to use as they identify mathematics skills that Student Teachers need to develop, as well as teaching strategies and instructional approaches that best support the development of these skills. The course design is based on what research tells us about good maths instruction.

The overall organization of the course is divided into four units:

1) Numbers and operations
2) Algebra
3) Geometry and geometric measurement
4) Information handling

Each unit of study has a consistent design or organization and is meant to maximize Student Teachers' time for learning.

1 UNIT 1:		Numbers and operations (5 weeks, 15 hours)
Week	Themes	Subthemes
1	Addition and subtraction Equivalence	Counting Models for addition and subtraction with natural numbers Addition and subtraction as inverse operations Word problems involving addition and subtraction
2	Place value Multiplication and division of whole numbers	Working in the base-10 system Models for multiplication with natural numbers Multiplication and division as inverse operations Models for division with natural numbers Nature of the remainder in division Factors, prime, and composite numbers
3	Fractions and decimals	Models of fractions (sets, number line, area, volume) Types of fractions (proper, improper, and mixed number) Decimals as fractions linked to base-10 place value Concept of GCF and LCM Operations with fractions and decimals
4	Per cent Ratios and proportion Rates	Per cent as related to fractions and decimals Ratio and proportion Rates
5	Integers	Integers, operations with integers Venn diagrams

2 UNIT 2:	Algebra (4 weeks, 12 hours)	
Week	Themes	Subthemes
1	Algebra as generalized arithmetic Patterns	Repeating patterns and growing patterns Generalizing a pattern and finding a rule
2	Algebraic terminology *x* as a variable Coordinate graphs Multiple representations Identity	Creating coordinate graphs Continuous, discontinuous, and discrete graphs Equivalent expressions
3	Linear functions Order of operations	Interpreting tables, graphs, and equations of linear functions The concept of slope Order of operations
4	Square expressions and equations Symbol manipulation	Interpreting tables, graphs, and equations of quadratic functions Solving for *x*, the unknown

3 UNIT 3:		Geometry and geometric measurement (5 weeks, 15 hours)
Week	Themes	Subthemes
1	Polygons	Characteristics of polygons with an emphasis on triangles and quadrilaterals Benchmark angles
2	Undefined terms in geometry Identification and construction of angles	Point, line, line segment, and ray Models of angles Classifying angles by measurement Tessellations
3	Geometric measurement Area and perimeter of polygons and irregular shapes	Perimeter and area formulae
4	Geometric measurement Circumference and area of circles Surface area of cuboids and cylinders	Circumference and area formulae Surface area formulae
5	Volume of cuboids and cylinders Introduction to the Pythagorean theorem	Volume formulae Squares, square numbers, and square roots (surds) The Pythagorean theorem

4 UNIT 4:		Information handling (2 weeks, 6 hours)
Week	Themes	Subthemes
1	Graphic displays of information	Collect and organize data via tally marks, pictographs, line plots, bar graphs, and line graphs (discrete and continuous) Interpret these graphic displays of data
2	Measures and central tendency	Range Mean Median Mode

Real Number Systems, Inequalities (Linear, Polynomial and Rational), Linear equations and applications, Quadratic equations and applications, solution of equation involving absolute function, functions, domain and range of functions, matrices and determination.

Program	BSCS,
Semester	1st Semester
Title of the course	Applied Physics
SDG	**09**
Prerequisite	**Nill**
Course Code.	PHYS-120
Credit hours	3(2+3)
Category	
Course contents	**Course Contents:** Electric force and its applications and related problems, conservation of charge, charge quantization, Electric fields due to point charge and lines of force. Ring of charge, Disk of charge, A point charge in an electric field, Dipole in a n electric field, The flux of vector field, The flux of electric field, Gauss' Law, Application of Gauss' Law, Spherically symmetric charge distribution, A charge isolated conductor, Electric potential energy, Electric potentials, Calculating the potential from the field and related problem Potential due to point and continuous charge distribution, Potential due to dipole, equipotential surfaces, Calculating the field from the potential , Electric current, Current density, Resistance, Resistivity and conductivity, Ohm's law and its applications, The Hall effect, The magnetic force on a current, The BiotSavart law, Line of B, Two parallel conductors, Amperes' s Law, Solenoid, Toroids, Faraday's experiments, Faraday's Law of Induction, Lenz's law, Motional emf, Induced electric field, Induced electric fields, The basic equation of electromagnetism, Induced Magnetic field, The displacement current, Reflection and Refraction of light waves, Total internal reflection, Two source interference, Double Slit interference, related problems, Interference from thin films, Diffraction and the wave theory, related problems, Single-Slit Diffraction, related problems, Polarization of electromagnetic waves, Polarizing sheets, related problems. **Recommended Books:** 1. Fundamentals of Physics (Extended), 10th edition, Resnick and Walker 2. Narciso Garcia, Arthur Damask, Steven Schwarz., "Physics for Computer Science Students", Springer Verlag, 1998.
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	

Lesson plan

Week 1	• **Contents to be covered**
Week 2	• Electric force and its applications and related problems , conservation of charge, charge quantization, Electric fields due to point charge and lines of force.
Week 3	• Ring of charge, Disk of charge, A point charge in an electric field, Dipole in a n electric field, The flux of vector field, The flux of electric field,
Week 4	• Gauss' Law, Application of Gauss' Law, Spherically symmetric charge distribution, A charge isolated conductor Electric potential energy, Electric potentials,
Week 5	• Calculating the potential from the field and related problem Potential due to point and continuous charge distribution, Potential due to dipole, equipotential surfaces.
Week 6	• Calculating the field from the potential, Electric current, Current density,Resistance, Resistivity and conductivity, Ohm's law and its applications.
Week 7	• , The Hall effect ,The magnetic force on a current, The Biot- Savart law, Line of B, Two parallel conductors,
Week 8	• Amperes' s Law, Solenoid, Toroids,
Week 9	• Mid Term
Week 10	• Lenz's law, Motional emf, Induced electric field, Induced electric fields,
Week 11	• The displacement current, • Reflection and Refraction of light waves, Total internal reflection, Two source interference
Week 12	• Double Slit interference, related problems, Interference from thin films,
Week 13	• Diffraction and the wave theory, related problems
Week 14	• Single-Slit Diffraction, related problems,
Week 15	• Polarization of electromagnetic waves, Polarizing sheets, related problems.
Week 16	• Faraday's experiments, Faraday's Law of Induction Programs
Week 17	• The basic equation of electromagnetism, Induced Magnetic field,
	• Examination and Result preparation

Experiments

1. Introduction to widely used electronic components.
2. Finding resistance using color coding techniques & connecting them in series and parallel.
3. Familiarization with analog and digital multi meter.
4. Verification of Ohm's Law.
5. Voltage divider and current divider.
6. Kirchhoff's voltage law & Kirchhoff's current law.
7. Magnetic lines of force.
8. Familiarization with function generator and oscilloscope.
9. Familiarization with light dependent resistor (LDR).
10. Generating waveforms of different frequencies on oscilloscope.
11. Familiarization with capacitor coding
12. Charging and discharging of a capacitor.

BSCS 2ND SEMESTER:

Program	BSCS,
Semester	2nd Semester
Title of the course	Object Oriented Programming
SDG	**07,09**
Prerequisite	**Nill**
Course Code.	IT-151
Credit hours	4(3+3)
Category	Comp-Core
Course contents	**Course Contents:** Introduction to object oriented design, history and advantages of object oriented design, introduction to object oriented programming concepts, classes, objects, data encapsulation, constructors, destructors, access modifiers, const vs non-const functions, static data members & functions, function overloading, operator overloading, identification of classes and their relationships, composition, aggregation, inheritance, multiple inheritance, polymorphism, abstract classes and interfaces, generic programming concepts, function & class templates, standard template library, object streams, data and object serialization using object streams, exception handling. **Recommended Books:** 1. Java: How to Program, 9th Edition by Paul Deitel 2. Beginning Java 2, 7th Edition by Ivor Horton 3. An Introduction to Object Oriented Programming with Java, 5th Edition by C. Thomas Wu 4. Starting Out with C++ from Control Structures to Objects, 9th Edition, Tony Gaddis 5. C++ How to Program, 10th Edition, Deitel&Deitel. 6. Object Oriented Programming in C++, 3rd Edition by Robert Lafore
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	**Understand basic problem solving steps and logic constructs C2 (Understand)** **Apply basic programing concepts C3 (Apply)** **Design and implement algorithms to solve real world problems C3 (Solve)**

Week	• **Course Content**
Week 1	• Introduction to object oriented design, history and advantages of object oriented design,
Week 2	• introduction to object oriented programming concepts, classes, objects,
Week 3	data encapsulation, constructors, destructors,
Week 4	access modifiers, const vs non-const functions, static data members & functions,. •
Week 5	• function overloading, operator overloading,
Week 6	• function overriding • identification of classes and their relationships,
Week 7	• composition, aggregation,
Week 8	• inheritance,
Week 9	• multiple inheritance,
Week 10	• polymorphism,
Week 11	• abstract classes and interfaces,
Week 12	• generic programming concepts, function & class templates,
Week 13	• object streams, data and object serialization using object streams,
Week 14	• exception handling
Week 15	• file handling
Week 16	• standard template library
Week 17	• Final Exam

Lab Content: Object Oriented Programming

List of Experiments

Experiments are designed in order to cover the following topics:

- Getting started with C++
- Basics of C++
- Operators in C++
- Control Structures
- Loop Statements
- Arrays
- Functions
- Structure
- Pointers
- File Handling

Experiments

Introduction of software (Dev C++) To get familiar with Dev C++ IDE working environment.
Basics of C++ using DeV C++ Compiler Write basic input/output and arithmetic operations in DeV C++ IDE environment.
Operators in C++ To get familiarize with the arithmetic, assignment, relational, logical and bitwise operators.
Control Structure To see how to use the control structures (IF, IF/ELSE, NESTED IF's, NESTED IF/ELSE)
Control Structure and Loop Statements To see how control structures (switch statement) can be used and also get familiar with the loop statements (for, while)
Loop and Control Statements To get familiar with the loop statements (for, while, do while) and also with the use of control statements (break and continue)
Arrays To provide an overview of declaring, initializing arrays and their use.
Multi-dimensional Arrays Declaring and initializing multi-dimensional arrays, and their use.
Functions (Call by Value) To see how declare, call and define the function.
Functions (Call by Reference & Recursive Function)

Program	BSCS,
Semester	2nd Semester
Title of the course	**Database Systems**
SDG	**09**
Prerequisite	**Nill**
Course Code.	IT-152
Credit hours	4(3+3)
Category	Comp-Core
Course contents	**Course Contents:** The course aims to introduce basic database concepts, different data models, data storage and retrieval techniques and database design techniques. The course primarily focuses on relational data model and DBMS concepts Basic database concepts, Database approach vs. file based system, database architecture, three level schema architecture, data independence, relational data model, attributes, schemas, tuples, domains, relation instances, keys of relations, integrity constraints, relational algebra, selection, projection, Cartesian product, types of joins, normalization, functional dependencies, normal forms, entity relationship model, entity sets, attributes, relationship, entity-relationship diagrams, Structured Query Language (SQL), Joins and subqueries in SQL, Grouping and aggregation in SQL, concurrency control, database backup and recovery, indexes, NoSQL systems **Recommended Books:** 1. Database Systems: A Practical Approach to Design, Implementation, and Management, 6 th 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
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	CLO-1 Explain fundamental database concepts. C2 (Explain) CLO-2 Design conceptual, logical and physical database schemas using different data models. C5 (Design) CLO-3 Identify functional dependencies and resolve database anomalies by normalizing database tables. C2 (Identify) CLO-4 Use Structured Query Language (SQL) for database definition and manipulation in any DBMS C4 (Use)

Lesson Plan:

Week 1	• Basic Database Concepts • Data • Information • Database • Meta data • Types of data base • DBMS • Advantages and Disadvantages of Database Approach • Database VS file base system • File base system • Limitations of file base system
Week 2	• Database approach • Database(Application Programs) • Components of DBMS Environment • Database system Development Life Cycle
Week 3	• Roles in Data Base Environment • Data Base Architecture • Three Level Schema Architecture • External level • Conceptual Level • Internal Level • Data Independence • Logical data Independence • Physical data Independence • Schemas, Mapping and Instances • Database Languages • DDL • DML
Week 4	• Relational Data Model • Components of Relational data model • Advantages of Relational Model • Relational data model terminologies • Attributes • Schemas • Degree • Tuple • Cardinality • Domain • Properties of Relation
Week 5	• Keys of Relations • Integrity Constraints

	• Types of Integrity Constraints • Entity Integrity • Domain Integrity • Referential Integrity • Indexes
Week 6	• Relational Algebra • Relational Algebra operators • Selection operator • Projection • Cartesian Product
Week 7	• Purpose of normalization • Data redundancy and update Anomalies ○ Functional dependencies
Week 8	• Normalization • 1NF • 2NF • 3NF • BOYCE-CODD NORMAL FORM • 4NF • 5NF • Case Studies
Week 9	• Entity relationship model • Elements of ERD • Entities • Attributes • Relationship • Cardinalities of Relationship • Entity sets • Existence Dependencies
Week 10	• Aggregation • Specialization and Generalization • Entity relationship diagram • Case Studies
Week 11	• SQL (Structured Query Language) • Sql as Data manipulation Language • Select Statement • Grouping and Aggregation in SQL • Joins and sub queries in SQL
Week 12	• Sql as Data manipulation Language • INSERT • UPDATE • DELETE • Creating and Managing tables
Week 13	• Constraints • Views • Transactions

	• Concurrency control • Dead Lock
Week 14	• Database Recovery • Backup • No SQL
Week 15	• Presentation Activity
Week 16	• Course Wrap Up • Presentation Activity
Week 17	• Final Term

Marks Distribution

Mid (30%)	Sessional (20%)	Final (50%)	Practical	Total
30	20	50	100	200

Sr#	Experiments
1	Oracle 11G and oracle SQL developer Installation, using and understanding tools.
2	Generic operations
3	Introduction to SQL Select statement usage
4	Query modifiers ORDER by LIMIT
5	SINGLE row functions and set operations Type conversions
6	SQL join operations Outer / inner joins
7	Aggregation operation and groups Sub queries DML, DDL operation Normalization ERD

Program	BSCS
Semester	2nd Semester
Title of the course	Digital Logic Design
SDG	**07**
Prerequisite	
Course Code.	IT-153
Credit hours	3(2+3)
Category	Core
Course contents	**Course Contents:** The main objective of this course is to introduce the organization of computer systems and usage of assembly language for optimization and control. Emphasis should be given to expose the low-level logic employed for problem solving while using assembly language as a tool. At the end of the course the students should be capable of writing moderately complex assembly language subroutines and interfacing them to any high level language. Introduction to computer systems: Information is bits + context, programs are translated by other programs into different forms, it pays to understand how compilation systems work, processors read and interpret instructions stored in memory, caches matter, storage devices form a hierarchy, the operating system manages the hardware, systems communicate with other systems using networks; Representing and manipulating information: information storage, integer representations, integer arithmetic, floating point; Machine-level representation of programs: a historical perspective, program encodings, data formats, accessing information, arithmetic and logical operations, control, procedures, array allocation and access, heterogeneous data structures, putting it together: understanding pointers, life in the real world: using the gdb debugger, out of-bounds memory references and buffer overflow, x86-64: extending ia32 to 64 bits, machine-level representations of floating-point programs; Processor architecture: the Y86 instruction set architecture, logic design and the Hardware Control Language (HCL), sequential Y86 implementations, general principles of pipelining, pipelined Y86 implementations **Recommended Books:** 1. Computer System Architecture, M. Morris Mano, Latest Edition, 2. Assembly Language Programming for Intel- Computer, Latest Edition 3. Computer Systems: A Programmer's Perspective, 3/E (CS:APP3e), Randal E. Bryant and David R.O' Hallaron, Carnegie Mellon University 4. Robert Britton, MIPS Assembly Language Programming, Latest Edition,
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	Acquire the basic knowledge of computer organization computer architecture and assembly language C2 (Understand) Understand the concepts of basic computer organization, architecture, and assembly language techniques C2 (Understand) Solve the problems related to computer organization and assembly language C3 (Apply)

Week	• Course Content
Week 1	• Information representation: • Binary number system, octal and hexa decimal number, • arithmetic operation, • conversion from decimal to other bases,decimal codes
Week 2	• Decimal codes,Binary addition, subtraction, multiplication, octal and hexaaddition,subtraction,multiplication, • BCD addition.
Week 3	• Binary logic gates: • And,OR,Not • Boolean algebra,basic identities of Boolean algebra,algebraicmanipulation,complement of a function, • Demorgan's theorem.
Week 4	• Standard forms,sum of products,product of sums,minterms and maxterms
Week 5	• K-Map • Two variable map,three variable map,four variable ,five variable and six variable map,don't cares conditions
Week 6	• NAND and NOR Gates; • NAND Circuits, two level implementation, multilevel NAND Circuits, • NOR Circuits, Exclusive-OR gates, Exclusive-NOR gates
Week 7	• Combination Circuits • Analysis Procedure, Design procedure, • Code Converters, • Decoders
Week 8	• Encoder,Multiplexer
Week 9	• **Mid Term**
Week 10	• Binary Adders, Half Adder, Full adder, Binary ripple carry adder, carry lookahead adder
Week 11	• Binary subtraction using 1's complement, 2's complement, Binary adder, subtractors, signed binary numbers, signed binary addition and subtraction, overflow, binary multipliers.
Week 12	• Sequential Circuits • Sequential circuit definition, • Meally and moore model, Introduction to flip flops, • RS-Flip flops,D-Flip flop,JK-Flip flop,T-Flip flop, • Master slave,Characteristics tables.
Week 13	• Sequential circuit analysis, input equations,

	• state table, state diagram
Week 14	• Sequential Circuit Design • Design procedure, finding state diagrams, and state tables, • Flip Flop excitation tables.
Week 15	• Sequential counters • Definition of registers and counters, Registers, • serial shift registers, parallel in and serial out, serial in and parallel out, parallel in and parallel out.
Week 16	• Couters: Synchronous, asynchronous counters, up counters and down counters • BCD Counters,
Week 17	• Final Exam

Marks Distribution

Mid (30%)	Sessional (20%)	Final (50%)	Practical	Total
30	20	50	100	200

Digital Logic Design List of Experiments

Experiment No.	Experiment Name
1	Introduction to digital logic circuitry
2	Implementation and Verification of Basic Logic Gates
3	To implement circuits using Boolean algebra
4	To and implement four variable K Map
5	To design and implement Half and Full Adders.
6	To design and implement Decoders & Encoders
7	To implement seven segment display
8	To design and implement Multiplexer & De-multiplexer
9	To design and implement Comparator
10	To implement Flip Flop operations

11	To design and implement three bit synchronous Up Counter
12	To design and implement four bit Asynchronous Up/down Counters
13	To design and implement BCD Ripple counter
14	To design and implement Serial-in & Serial–out shift register
15	To design and implement Parallel-in/Serial-out and Parallel-in/Parallel-out shift register
16	To design and implement Ring and Johnson Counter

Program	BSCS
Semester	2nd Semester
Title of the course	Computer Networks
SDG	**09**
Prerequisite	**Nill**
Course Code.	IT-154
Credit hours	3(2+3)
Category	Comp-CORE
Course contents	**Course Contents:** Introduction and protocols architecture, basic concepts of networking, network topologies, layered architecture, physical layer functionality, data link layer functionality, multiple access techniques, circuit switching and packet switching, LAN technologies, wireless networks, MAC addressing, networking devices, network layer protocols, IPv4 and IPv6, IP addressing, sub netting, CIDR, routing protocols, transport layer protocols, ports and sockets, connection establishment, flow and congestion control, application layer protocols, latest trends in computer networks **Recommended Books:** 1. Computer Networking: A Top-Down Approach Featuring the Internet, 6th edition by James F. Kurose and Keith W. Ross 2. Computer Networks, 5th Edition by Andrew S. Tanenbaum 3. Data and Computer Communications, 10th Edition by William Stallings 4. Data Communication and Computer Networks, 5th Edition by Behrouz A. Forouzan
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	CLO-1 Describe the key terminologies and technologies of computer networks C2 (Describe) CLO-2 Explain the services and functions provided by each layer in the Internet protocol stack. C2 (Explain)

	CLO-3 Identify various internetworking devices and protocols and their functions in a networking C4 (Identify) CLO-4 Analyze working and performance of key technologies, algorithms and protocols C4 (Analyze) CLO-5 Build Computer Network on various Topologies P3 (Build)

Lesson plan

Week1	Introduction, Data and Network, Layers, OSI Model,
Week 2	Analog and digital Transmission ,Noise, Media, Encoding,
Week3	Introduction to Signals, Transmission Media, Digital Transmission, PAM, PCM, ASK, FSK, PSK, QAM, .
Week 4	Asynchronous and Synchronous transmission,
Week 5	Protocol design issues. Network system architectures (OSI, TCP/IP), .
Week 6	Error Control, Flow Control, Data Link Protocols
Week 7	. Local Area Networks
Week 8	MAC Layer protocols (Ethernet, Token ring),
Week 9	Multiplexing

Week 10	, Switched and IP Networks, Internetworking,
Week 11	Routing, Bridging
Week 12	Network layer protocol ,IP Routing,Network Security,, Transport layer protocols TCP/IP, UDP.
Week 13	Network security issues
Week 14	Connecting LANs
Week 15	Transport layer(TCP,UDP,STP) labs or projects involving implementation of protocols at different layers
Week 16 WEEK 17	DNS Application Layer

Computer Networks: Lab Scheme

S.No	Experiment
1	Study of different types of Network cables and Practically implement the cross-wired cable and straight through cable using clamping tool.
2	Study of Network Devices in Detail.
3	Study of network IP.
4	Connect the computers in Local Area Network.
5	Study of basic network command and Network configuration commands.
6	Performing an Initial Switch Configuration
7	Performing an Initial Router Configuration
8	Configuring and Troubleshooting a Switched Network
9	Connecting a Switch
10	Configuring WEP on a Wireless Router
11	Using the Cisco IOS Show Commands
12	Examining WAN Connections
13	Interpreting Ping and Traceroute Output
14	Demonstrating Distribution Layer Functions
15	Placing ACLs
16	Exploring Different LAN Switch Options
17	Implementing an IP Addressing Scheme
18	Examining Network Address Translation (NAT)
19	Observing Static and Dynamic Routing
20	Configuring Ethernet and Serial Interfaces
21	Configuring a Default Route
22	Configuring Static and Default Routes
23	Configuring RIP
24	Planning Network-based Firewalls
25	Configuring a Cisco Router as a DHCP Server

Program	BSCS
Semester	2nd Semester
Title of the course	Software Engineering
SDG	**09**
Prerequisite	**Nill**
Course Code.	IT-155
Credit hours	3(3+0)
Category	Comp-Core
Course contents	**Course Contents:** Nature of Software, Overview of Software Engineering, Professional software development, Software engineering practice, Software process structure, Software process models, Agile software Development, Agile process models, Agile development techniques, Requirements engineering process, Functional and non-functional requirements, Context models, Interaction models, Structural models, behavioral models, model driven engineering, Architectural design, Design and implementation, UML diagrams, Design patterns, Software testing and quality assurance, Software evolution, Project management and project planning, configuration management, Software Process improvement **Recommended Books:** \1. Software Engineering, Sommerville I., 10th Edition, Pearson Inc., 2014 2. Software Engineering, A Practitioner's Approach, Pressman R. S.& Maxim B. R., 8th Edition, McGraw-Hill, 2015.
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
9Learning Outcomes	CLO-1 Describe various software engineering processes and activates C1 (Describe) CLO-2 Apply the system modeling techniques to model a medium size software systems C3 (Apply) CLO-3 Apply software quality assurance and testing principles to medium size software systems C4 (Apply) CLO-4 Discuss key principles and common methods for software project management such as scheduling, size estimation, cost estimation and risk analysis C2 (Discuss)

Lesson plan:

Week 1	• Nature of Software • Overview of Software Engineering • Professional software development
Week 2	• Software engineering practice • Software process structure • Software process models
Week 3	• Agile software Development • Agile process models • Agile development techniques
Week 4	• Agile development techniques
Week 5	• Requirements engineering process • Functional and Non-functional Requirement
Week 6	• Requirements engineering process • Context Model • Interaction Models • Case studies examples
Week 7	• Presentation Activity • Structural models, • behavioral models, • model driven engineering
Week 8	• Mid Term Exam
Week 9	• Case studies examples • Context Model • Interaction Models • Structural models • behavioral models,
Week 10	• UML diagrams • Design patterns
Week 11	• Architectural design
Week 12	• Design and implementation
Week 13	• Software testing and quality assurance • Software evolution
Week 14	• Presentation activity • Project management and project planning
Week 15	• configuration management • Software Process improvement
Week 16	• Course Wrap Up • Project report
Week 17	• Final Exam

Program	BSCS,
Semester	2nd Semester
Title of the course	Mathematics(Part-II)**
SDG	
Prerequisite	Nill
Course Code.	MATH-000
Credit hours	3(3+0)
Category	CompMed-Supp
Course contents	**Course Contents:** **Recommended Books:**
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)

1	Review of Mathematics-I Real number Systems, Functions and their domain ranges
2	Review of Mathematics-I Quadratic Equations and their solutions, Factorization, completing square, quadratic formula
3	Matrices and their Determinants, Minors, Cofactors and inverse of 3x3 matrices
4	System of Linear Equations and Their solutions, Inversion method and Crammer rule
5	Binomial theorem, , Partial fractions Case I, Case II, Case III
6	Introduction to Derivatives, Geometrical interpretation
7	Concept of tangents, Basic derivative formulae(Polynomial, exponential, lograthimic) Derivatives of Trigonometric functions
	MID Term Exam
8	Explicit and implicit derivatives Higher order derivatives; Finding tangential change.
9	Applications of Derivatives ; Absolute Extrema
10	Local extrema, locating extremes on graphs of function
11	Use of derivatives finding extrema's Critical points
12	Monotonically increasing decreasing functions Inflection points, concavity
13	Basic concept of Integration, geometrical interpretation
14	Definite integral (Polynomial , exponential, trigonometric functions) Indefinite integrals
15	Integration by separating terms ; Integration by eliminating terms
16	Integration by parts, Integration by substitution; Integration by partial fractions
17	**Final Term Exam**

BSCS 3RD SEMESTER:

Program	BSCS,
Semester	3rd Semester
Title of the course	**Data structures**
SDG	**09**
Prerequisite	**Object oriented programming**
Course Code.	IT-201
Credit hours	4(3+3)
Category	
Course contents	**Course Contents:** Abstract data types, complexity analysis, Big Oh notation, Stacks (linked lists and array implementations), Recursion and analyzing recursive algorithms, divide and conquer algorithms, Sorting algorithms (selection, insertion, merge, quick, bubble, heap, shell, radix,bucket), queue, dequeuer, priority queues (linked and array implementations of queues),linked list & its various types, sorted linked list, searching an unsorted array, binary search for sorted arrays, hashing and indexing, open addressing and chaining, trees and tree traversals, binary search trees, heaps, M-way tress, balanced trees, graphs, breadth-first and depth-first traversal, topological order, shortest path, adjacency matrix and adjacency list implementations, memory management and garbage collection. **Reference Materials: (or use any other standard and latest books)** 1. Data Structures and Algorithm Analysis in Java by Mark A. Weiss 2. Data Structures and Abstractions with Java by Frank M. Carrano & Timothy M. Henry 3. Data Structures and Algorithms in C++ by Adam Drozdek 4. Data Structures and Algorithm Analysis in C++ by Mark Allen Weiss Java Software Structures: Designing and Using Data Structures by John Lewis and Joseph Chase
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	

Lesson plan:

Theory and Lab Weekly Schedule	Topic Covered
Week1	Introduction to Data Structures and Algorithms; Complexity Analysis;
Week 2	Arrays insertion deletion traversing
Week3	Sorting Algorithms: Insertion Sort, Selection Sort,
Week 4	Bubble Sort, Shell Sort, Heap Sort, Quick Sort, Merge Sort, Radix Sort, Bucket Sort;
Week 5	Linked Lists: Singly Linked Lists, Doubly Linked Lists, Circular List
Week 6	Stacks, Queues, and Priority Queue
Week 7	Recursion: Function call and Recursion Implementation,
Week 8	Tail Recursion, Non-tail Recursion, Indirect Recursion, Nested Recursion, Backtracking.
Week 9	Trees: Binary Trees, Binary Heap, Binary tree Search.
Week 10	Tree Traversal, Insertion, Deletion, and Balancing a Tree; Heap; B-Tree;
Week 11	Spanning Tree, Splay Trees,2 tree
Week 12	Heap, Min heap, Max heap, Heap sort
Week 13	Graphs: Representation, Traversal, Shortest Path,
Week 14	Cycle Detection; Isomorphic Graphs
Week 15	Breath First Search, Depth First Search
Week 16	Graph Traversal Algorithms; shortest path algorithm
Week 17	Hashing; Memory Management and Garbage Collection Hash function, hash tables
Week 18	Final Term

Program	BSCS,
Semester	3th semester
Title of the course	Information security
SDG	**09**
Prerequisite	None
Course Code.	IT-202
Credit hours	3(2+3)
Category	COMP-Core
Course contents	**Course Contents:** Information security foundations, security design principles; security mechanisms, symmetric and asymmetric cryptography, encryption, hash functions, digital signatures, key management, authentication and access control; software security, vulnerabilities and protections, malware, database security; network security, firewalls, intrusion detection; security policies, policy formation and enforcement, risk assessment, cybercrime, law and ethics in information security, privacy and anonymity of data. **Reference Materials: (or use any other standard and latest books**) 1. Computer Security: Principles and Practice, 3rd edition by William Stallings 2. Principles of Information Security, 6th edition by M. Whitman and H. Mattord 3. Computer Security, 3rd edition by Dieter Gollmann 4. Computer Security Fundamentals, 3rd edition by William Easttom 5. Official (ISC)2 Guide to the CISSP CBK, 3rd edition
Follow up	
Learning Outcomes	CLO-1 Explain key concepts of information security such as design principles, cryptography, risk management, and ethics C2 (Explain) CLO-2 Discuss legal, ethical, and professional issues in information security A2 (Discuss) CLO-3 Apply various security and risk management tools for achieving information security and privacy C3 (Apply) CLO-4 Identify appropriate techniques to tackle and solve problems in the discipline of information security C4 (Identify)

Week 1	• Information security foundations, security design principles; security mechanisms.
Week 2	• Symmetric and asymmetric cryptography, encryption, hash functions, digital signatures, key management.
Week 3	• Assignment.
Week 4	• Protections, malware, database security;
Week 5	• Quiz
Week 6	• Enforcement, risk assessment, cybercrime, laws.

Week 7	• Presentation.
Week 8	• Mid Term
Week 9	• Ethics in information security, privacy and anonymity of data.
Week 10	• Assignment.
Week 11	• Security policies, policy formation.
Week 12	• Authentication and access control; software security, vulnerabilities.
Week 13	• Quiz
Week 14	• Network security, firewalls, intrusion detection;
Week 15	• Presentation
Week 16	• Test and Quiz
Week 17	• Examination and Results preparation

Labs

Lab Week: Information Security

S No	Topics
1.	Write a C program that contains a string(char pointer) with a value \Hello World'. The programs should XOR each character in this string with 0 and display the result.
2.	Write a C program that contains a string (char pointer) with a value \Hello World'. The program should AND or and XOR each character in this string with 127 and display the result.
3.	Write a Java program to perform encryption and decryption using the following algorithms: a. Ceaser Cipher b. Substitution Cipher c. Hill Cipher
4.	Write a Java program to implement the DES algorithm logic
5	Write a C/JAVA program to implement the Blowfish algorithm logic
6	Write a C/JAVA program to implement the Rijndael algorithm logic

7	1) Write the RC4 logic in Java Using Java Cryptography, encrypt the text "Hello world" using Blowfish. Create your own key using Java key tool. 2) Write a Java program to implement RSA Algorithm
8	1. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript. 2. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.
9	Calculate the message digest of a text using the MD5 algorithm in JAVA.

Program	BSCS
Semester	3th Semester
Title of the course	**ARTIFICIAL INTELLIGENCE**
SDG	**09**
Prerequisite	
Course Code.	IT-204
Credit hours	3 (2+3)
Category	
Course contents	**Course Outline**: An Introduction to Artificial Intelligence and its applications towards Knowledge Based Systems; Introduction to Reasoning and Knowledge Representation, Problem Solving by Searching (Informed searching, Uninformed searching, Heuristics, Local searching, Minmax algorithm, Alpha beta pruning, Game-playing); Case Studies: General Problem Solver, Eliza, Student, Macsyma; Learning from examples; ANN and Natural Language Processing; Recent trends in AI and applications of AI algorithms. Python programming language will be used to explore and illustrate various issues and techniques in Artificial Intelligence.. **Reference Materials:** (or use any other standard and latest books) 1. Russell, S. and Norvig, P. "Artificial Intelligence. A Modern Approach", 3rd ed, Prentice Hall, Inc., 2015. 2. Norvig, P., "Paradigms of Artificial Intelligence Programming: Case studies in Common Lisp", Morgan Kaufman Publishers, Inc., 1992. 3. Luger, G.F. and Stubblefield, W.A., "AI algorithms, data structures, and idioms in Prolog, Lisp, and Java", Pearson Addison-Wesley. 2009. 4. Severance, C.R., 2016. "Python for everybody: Exploring data using Python 3." CreateSpace Independent Publ Platform. 5. Miller, B.N., Ranum, D.L. and Anderson, J., 2019. "Python programming in context." Jones & Bartlett Pub. 6. Joshi, P., 2017. "Artificial intelligence with python." Packt Publishing Ltd.
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	Understand the fundamental constructs of Python programming language. C2 (Understand) Understand key concepts in the field of artificial intelligence C2 (Understand) Implement artificial intelligence techniques and case studies C3 (Apply**)**

Lesson Plan

Week 1	• Introduction to AI, Turing Test, Strong AI vs. Weak AI, Heuristics, Applications and methods
Week 2	• History of AI, Semantic Networks, recent Approaches, Agents and their types, Types of Environments
Week 3	• Uninformed Search: Search in IS, Generate and Test paradigm, Blind Search Algorithm
Week 4	• Informed Search: Heuristics, The Best-First Search ,The Beam Search
Week 5	• The A* Search, The Bi-directional Search, Optimal Searching
Week 6	• Search Using Games: Game tress and Minimum, Game Theory
Week 7	• Knowledge Representation: Search Tress, Production System, Objects, Frames, Scripts and the conceptual Dependency System
Week 8	• Mid Term
Week 9	• Genetic Algorithms, Genetic Programming, Examples Case Based Reasoning, Reasoning and its types, Rules
Week 10	• Logic in AI: Logic and Representation, Propositional Logic, Predicate Logic, Other Logics
Week 11	• Expert Systems, Characteristics of ES, Knowledge Engineering, Knowledge Acquisition, Classical ES
Week 12	• Neural Networks, Introduction, the Perception Learning Rule, Back Propagation, Applications
Week 13	• Learning, Machine learning, Learning Types, Supervised and Unsupervised Learning Techniques
Week 14	• Natural Language Processing, Prolog Programming , Automated Planning, Cased Based Planning, Planning Approaches
Week 15	• Uncertainty in AI, Fuzzy sets, Fuzzy Logic, Fuzzy Inference
Week 16	• Advanced topics in Artificial Intelligence, Robotics and their applications
Week 17	• Examination and Results preparation
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Mid (30%)	**Sessional (20%)**	**Final (50%)**	**Practical**	**Total**
30	20	50	100	200

Lab Plan: Artificial Intelligence

Artificial Intelligence Programs Using PROLOG

Name of the Program
Study of PROLOG Programming language and its Functions. Write simple facts for the statements using PROLOG.
Implementation of Depth First Search for Water Jug problem.
Implementation of Breadth First Search for Tic-Tac-Toe problem.
Solve 8-puzzle problem using Best First Search.
Write a PROLOG program to solve N-Queens problem.
Implementation of Traveling Salesman Problem.

Machine Learning Programs Using Python

Name of the Program
A) Implementation of Python Basic Libraries such as Math, Numpy and Scipy B) Implementation of Python Libraries for ML application such as Pandas and Matplotlib.
A) Creation and Loading different datasets in Python. B) Write a python program to compute Mean, Median, Mode, Variance and Standard Deviation using Datasets C) Write a python program to compute Reshaping the data, Filtering the data , Merging the data and Handling the missing values in datasets.
A) Implementation of Find-S Algorithm B) Implementation of Candidate elimination Algorithm
A) Write a Python program to implement Simple Linear Regression and plot the graph. B) Implementation of Logistic Regression for iris using sklearn
A) Implementation of navie bayes classifier algorithm B) Implementation of SVM classification.
Performance Analysis on a specific dataset (Mini Project)

Program	BSCS,
Semester	3rd Semester
Title of the course	Probability & Statistics
SDG	
Prerequisite	
Course Code.	STAT-201
Credit hours	3(3+0)
Category	
Course contents	**Course Contents:** To introduce the concepts of data analysis, presentation, counting techniques, probability and decision making.Introduction to Statistics and Data Analysis, Statistical Inference, Samples, Populations, and the Role of Probability. Sampling Procedures. Discrete and Continuous Data. Statistical Modeling. Types of Statistical Studies. Probability: Sample Space, Events, Counting Sample Points, Probability of an Event, Additive Rules, Conditional Probability, Independence, and the Product Rule, Bayes' Rule. Random Variables and Probability Distributions. Mathematical Expectation: Mean of a Random Variable, Variance and Covariance of Random Variables, Means and Variances of Linear Combinations of Random Variables, Chebyshev's Theorem. Discrete Probability Distributions. Continuous Probability Distributions. Fundamental Sampling Distributions and Data Descriptions: Random Sampling, Sampling Distributions, Sampling Distribution of Means and the Central Limit Theorem. Sampling Distribution of S2, t-Distribution, FQuantile and Probability Plots. Single Sample & One- and Two-Sample Estimation Problems. Single Sample & One- and Two-Sample Tests of Hypotheses. The Use of PValues for Decision Making in Testing Hypotheses (Single Sample & One- and TwoSample Tests), Linear Regression and Correlation. Least Squares and the Fitted Model, Multiple Linear Regression and Certain, Nonlinear Regression Models, Linear Regression Model Using Matrices, Properties of the Least Squares Estimators. **Recommended Books:** 1. Probability and Statistics for Engineers and Scientists by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying E. Ye, Pearson; 9th Edition (January 6, 2011). ISBN-10: 0321629116 2. Probability and Statistics for Engineers and Scientists by Anthony J. Hayter, Duxbury Press; 3rd Edition (February 3, 2006), ISBN-10:0495107573 3. Schaum's Outline of Probability and Statistics, by John Schiller, R. Alu Srinivasan and Murray Spiegel, McGraw-Hill; 3rd Edition (2008). ISBN-10:0071544259
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	

Lesson Plan

Week 1	• To introduce the concepts of data analysis, presentation, counting techniques, probability and decision making. Introduction to Statistics and Data Analysis,
Week 2	• statistical Inference, Samples, Populations, and the Role of Probability. Sampling Procedures. Discrete and Continuous Data.
Week 3	• Statistical Modeling. Types of Statistical Studies. Probability: Sample Space, Events, Counting Sample Point
Week 4	• Probability of an Event, Additive Rules, Conditional Probability, Independence, and the Product Rule,
Week 5	• Bayes' Rule. Random Variables and Probability Distributions. Mathematical Expectation: Mean of a Random Variable,
Week 6	• Variance and Covariance of Random Variables, Means and Variances of Linear Combinations of Random Variables, Chebyshev's Theorem.
Week 7	• Discrete Probability Distributions. Continuous Probability Distributions. Fundamental Sampling Distributions and Data Descriptions: Random Sampling,
Week 8	• Mid Term
Week 9	• Sampling Distributions, Sampling Distribution of Means and the Central Limit Theorem. Sampling Distribution of S2, t-Distribution, FQuantile and Probability Plots
Week 10	• Single Sample & One- and Two-Sample Estimation Problems. Single Sample & One- and Two-Sample Tests of Hypotheses
Week 11	• The Use of PValues for Decision Making in Testing Hypotheses (Single Sample & One- and TwoSample Tests),
Week 12	• Linear Regression and Correlation. Least Squares and the Fitted Model
Week 13	• Multiple Linear Regression and Certain, Nonlinear Regression Models
Week 14	• Linear Regression Model Using Matrices, Properties of the Least Squares Estimators.
Week 15	• Fundamental Sampling Distributions and Data Descriptions: Random Sampling,
Week 16	• Test and Quiz
Week 17	• Examination and Results preparation

Program	BSCS,
Semester	3rd Semester
Title of the course	Calculus and Analytical Geometry
SDG	**09**
Prerequisite	Mathematics
Course Code.	MATH-101
Credit hours	3(3+0)
Category	
Course contents	**Course Contents:** Limits and Continuity; Introduction to functions, Introduction to limits, Techniques of funding limits, Indeterminate forms of limits, Continuous and discontinuous functions and their applications, Differential calculus; Concept and idea of differentiation, Geometrical and Physical meaning of derivatives, Rules of differentiation, Techniques of differentiation, Rates of change, Tangents and Normals lines, Chain rule, implicit differentiation, linear approximation, Applications of differentiation; Extreme value functions, Mean value theorems, Maxima and Minima of a function for single-variable, Concavity, Integral calculus; Concept and idea of Integration, Indefinite Integrals, Techniques of integration, Riemann sums and Definite Integrals, Applications of definite integrals, Improper integral, Applications of Integration; Area under the curve, Analytical Geometry; Straight lines in R3, Equations for planes **Recommended Books:** 1. Calculus and Analytic Geometry by Kenneth W. Thomas. 2. Calculus by Stewart, James. 3. Calculus by Earl William Swokowski; Michael Olinick; Dennis Pence; Jeffery A. Cole
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	

Lesson Plan

Week	• Contents to be covered
Week 1	• Limits and Continuity; Introduction to functions,
Week 2	• Introduction to limits, Techniques of funding limits, Indeterminate forms of limits
Week 3	• Continuous and discontinuous functions and their applications
Week 4	• Differential calculus; Concept and idea of differentiation
Week 5	• Geometrical and Physical meaning of derivatives • Rules of differentiation, Techniques of differentiation
Week 6	• Rates of change, Tangents and Normals lines
Week 7	• Chain rule, implicit differentiation, linear approximation
Week 8	• Mid Term
Week 9	• Applications of • differentiation; Extreme value functions
Week 10	• Mean value theorems, Maxima and Minima of a • function for single-variable
Week 11	• Concavity, Integral calculus
Week 12	• Concept and idea of • Integration, Indefinite Integrals
Week 13	• Applications of definite integrals, Improper integral
Week 14	• Analytical Geometry • Area under the curve
Week 15	• Straight lines in R3, Equations
Week 16	• Quiz and Test
Week 17	• Examination and Result preparation

Marks Distribution

Mid (30%)	Sessional (20%)	Final (50%)	Practical	Total
30	20	50	0	100

Program	BSCS,
Semester	3rd Semester
Title of the course	***Expository Writing***
SDG	
Prerequisite	**Functional english**
Course Code.	
Credit hours	3(3-0)
Category	
Course contents	**Course Outline:** Principles of writing good English, understanding the composition process: writing clearly; words, sentence and paragraphs; Comprehension and expression; Use of grammar and punctuation. Process of writing, observing, audience collecting, composing, drafting and revising, persuasive writing, reading skills, listening skills and comprehension, skills for taking notes in class, skills for exams; Business communications; planning messages, writing concise but with impact. Letter formats, mechanics of business, letter writing, letters, memo and applications, summaries, proposals, writing resumes, styles and formats, oral communications, verbal and non-verbal communication, conducting meetings, small group communication, taking minutes. Presentation skills; presentation strategies, defining the objective, scope and audience of the presentation, material gathering material organization strategies, time management, opening and concluding, use of audio-visual aids, delivery and presentation. **Reference Materials: (or use any other standard and latest books)** 1. Practical Business English, Collen Vawdrey, 1993, ISBN = 0256192740 2. Effective Communication Skills: The Foundations for Change, John Nielsen, 2008, ISBN = 1453506748 3. College Writing Skills with Readings, by John Langan, McGraw-Hill, 5th Edition. 4. A Textbook of English Prose and Structure by Arif Khattak, et al, GIKI Institute, 2000

Lesson Plan

Week	Contents to be covered
Week 1	• Principles of writing good English, understanding the composition process
Week 2	• writing clearly; words, sentence and paragraphs;
Week 3	• Comprehension and expression; Use of grammar and punctuation.
Week 4	• Process of writing, observing, audience collecting, composing,
Week 5	• drafting and revising, persuasive writing, reading skills
Week 6	• listening skills and comprehension, skills for taking notes in class, skills for examss
Week 7	• , skills for exams; Business communications;
Week 8	• Mid Term
Week 9	• planning messages,writing concise but with impact.
Week 10	• Letter formats, mechanics of business, use of audio-visual aids, delivery and presentation.
Week 11	• letter writing, letters, memo and applications, time management, opening and concluding
Week 12	• summaries, proposals, writing resumes, styles and formats, oral communications
Week 13	• verbal and non-verbal communication, conducting meetings
Week 14	• small group communication, taking minutes. Presentation skills; presentation strategies, defining the objective,
Week 15	• scope and audience of the presentation, material gathering material organization strategies
Week 16	• Quiz and Test
Week 17	• Examination and Result preparation

BSCS 4th SEMESTER:

Program	BSCS
Semester	4th Semester
Title of the course	Computer Organization & Assembly Language
SDG	**09**
Prerequisite	**DLD**
Course Code.	IT-251
Credit hours	3(2+3)
Category	CORE
Course contents	**Course Contents:** Introduction to computer systems: Information is bits + context, programs are translated by other programs into different forms, it pays to understand how compilation systems work, processors read and interpret instructions stored in memory, caches matter, storage devices form a hierarchy, the operating system manages the hardware, systems communicate with other systems using networks; Representing and manipulating information: information storage, integer representations, integer arithmetic, floating point; Machine-level representation of programs: a historical perspective, program encodings, data formats, accessing information, arithmetic and logical operations, control, procedures, array allocation and access, heterogeneous data structures, putting it together: understanding pointers, life in the real world: using the gdb debugger, out of-bounds memory references and buffer overflow, x86-64: extending ia32 to 64 bits, machine-level representations of floating-point programs; Processor architecture: the Y86 instruction set architecture, logic design and the Hardware Control Language (HCL), sequential Y86 implementations, general principles of pipelining, pipelined Y86 implementation **Recommended Books:** 1. Computer System Architecture, M. Morris Mano, Latest Edition, 2. Assembly Language Programming for Intel- Computer, Latest Edition 3. Computer Systems: A Programmer's Perspective, 3/E (CS:APP3e), Randal E. Bryant and David R.O' Hallaron, Carnegie Mellon University 4. Robert Britton, MIPS Assembly Language Programming, Latest Edition,
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	CLO-1 Acquire the basic knowledge of computer organization computer architecture and assembly language C2 (Understand) CLO-2 Understand the concepts of basic computer organization, architecture, and assembly language techniques C2 (Understand) CLO-3 Solve the problems related to computer organization and assembly language C3 (Apply)

Lesson Plan

Week	Contents to be covered
1	Introduction to computer organization & architecture, general introduction of the course Assembly and Machine language, compiler and assembler, why learn assembly, comparison of assembly and high-level language. Programmer's view of a computer system, (App. Program, assembly language, operating system, instruction set architecture, microarchitecture, digital logic) Data representation, Binary numbers, converting binary to decimal, hexadecimal integers, hexadecimal to binary, decimal to hexadecimal, Integer storage sizes
2	Binary addition, Hexadecimal addition, Signed Integers (sign-magnitude, Biased representation) Signed Integers (1's complement, 2's complement), Exercises, Dis advantages of signed magnitude.Excess representation, floating point representation, Summary of number representation 2's complement of hexadecimal ranges of signed integers, carry and overflow, character storage, Printable ASCII Codes, control characters.
3	Introduction to the IAPX88 architecture, registers (General Purpose, Pointer register, Segment register) The 88 flag register and interruption of flags (ZF, CF, SF, OF, AF, PF, IF), Instruction groups (Data Movement, arithmetic and logic, control, special instructions) First assembly program, tools debugger, linker, assembler, how to assemble and run the assembly program Segmented memory model in IAPX88, using the debugger to explain the segmented memory model.
4	Discussion on the Command file, List file, relative address and physical address. Offset, segment, physical address calculation, paragraph boundaries, overlapping segments Exercise questions from the notes Data declaration, difference between direct and in direct addressing, assembly programs showing different ways to represent data in the memory. Register addressing, memory addressing register to memory, memory to register, register to register, register to constant.
5	Segments, default segments in direct and indirect modes, [base + offset + index] method to calculate the effective address and using it with the associated segment to calculate the physical address. Conditional Jumps, Flags and their role in decision making, Adding logic in assembly programs.
6	Conditional Jumps , Interpretation of flags using conditional jumps, Unconditional Jumps, Bubble Sort, Short, Near, Far Jumps , Relative addressing, Questions from exercises, Relative, Addressing, Shift Instructions
7	Bit manipulations, Shifting and rotation, SHR,SHL,SAR,SAL,ROR,ROL,RCL,RCR Register operations, Multiplication Algorithm, limitations in multiplication using MUL instruction Extended shift operations, Add with carry operation, subtract with carry Improvement on the Multiplication algorithm using extended shift and add operations, Masking operations Selective bit retrieval, selective bit set, selective bit inverse, selective bit not
8	Subroutines using Stack introduction, Using Call, Ret instruction Parameter Passing in the stack and stack operations, Writing bubble sort code for generic implementation of the subroutines, Stack In Assembly Language, NASM

	Stack Pointer Register, Push And Pop In Stack Instructions Machine Instruction Cycle, Register Transfer Level Activity of machine instruction cycle, timing diagram of machine instruction cycle, Data Path architecture, data path architecture of the machine instruction cycle
9	Data path control architecture hardwired; Firmware approach Data path control Continued Master Slave JK Flip Flop system firm ware approach, Master Slave JK Flip Flop System hardwired approach
10	Introduction to computer organization & architecture, general introduction of the course Assembly and Machine language, compiler and assembler, why learn assembly, comparison of assembly and high-level language. Programmer's view of a computer system, (App. Program, assembly language, operating system, instruction set architecture, microarchitecture, digital logic) Data representation, Binary numbers, converting binary to decimal, hexadecimal integers, hexadecimal to binary, decimal to hexadecimal, Integer storage sizes
11	Binary addition, Hexadecimal addition, Signed Integers (sign-magnitude, Biased representation) Signed Integers (1's complement, 2's complement), Exercises, Dis advantages of signed magnitude.Excess representation, floating point representation, Summary of number representation 2's complement of hexadecimal ranges of signed integers, carry and overflow, character storage, Printable ASCII Codes, control characters
12	Introduction to the IAPX88 architecture, registers (General Purpose, Pointer register, Segment register) The 88 flag register and interruption of flags (ZF, CF, SF, OF, AF, PF, IF), Instruction groups (Data Movement, arithmetic and logic, control, special instructions) First assembly program, tools debugger, linker, assembler, how to assemble and run the assembly program Segmented memory model in IAPX88, using the debugger to explain the segmented memory model.
13	Discussion on the Command file, List file, relative address and physical address. Offset, segment, physical address calculation, paragraph boundaries, overlapping segments Exercise questions from the notes Data declaration, difference between direct and in direct addressing, assembly programs showing different ways to represent data in the memory. Register addressing, memory addressing register to memory, memory to register, register to register, register to constant.
14	Segments, default segments in direct and indirect modes, [base + offset + index] method to calculate the effective address and using it with the associated segment to calculate the physical address. Conditional Jumps, Flags and their role in decision making, Adding logic in assembly programs. Conditional Jumps , Interpretation of flags using conditional jumps, Unconditional Jumps, Bubble Sort, Short, Near, Far Jumps , Relative addressing, Questions from exercises, Relative, Addressing, Shift Instructions
15	Bit manipulations, Shifting and rotation, SHR,SHL,SAR,SAL,ROR,ROL,RCL,RCR Register operations, Multiplication Algorithm, limitations in multiplication using MUL instruction Extended shift operations, Add with carry operation, subtract with carry Improvement on the Multiplication algorithm using extended shift and add

	operations, Masking operations Selective bit retrieval, selective bit set, selective bit inverse, selective bit not
16	Subroutines using Stack introduction, Using Call, Ret instruction Parameter Passing in the stack and stack operations, Writing bubble sort code for generic implementation of the subroutines, Stack In Assembly Language, NASM Stack Pointer Register, Push And Pop In Stack Instructions Machine Instruction Cycle, Register Transfer Level Activity of machine instruction cycle, timing diagram of machine instruction cycle, Data Path architecture, data path architecture of the machine instruction cycle
17	Examination and Result preparation

Program	BSCS
Semester	4th Semester
Title of the course	Theory of Automata
SDG	**09**
Prerequisite	**Nill**
Course Code.	IT-252
Credit hours	3(3+0)
Category	Core
Course contents	**Course Contents:** Finite State Models: Language definitions preliminaries, Regular expressions/Regular languages, Finite automata (FAs), Transition graphs (TGs), NFAs, Kleene's theorem, Transducers (automata with output), Pumping lemma and non-regular language Grammars and PDA: CFGs, Derivations, derivation trees and ambiguity, Simplifying CFLs, Normal form grammars and parsing, Decidability, Context sensitive languages, grammars and linear bounded automata (LBA), Chomsky's hierarchy of grammars Turing Machines Theory: Turing machines, Post machine, Variations on TM, TM encoding, Universal Turing Machine, Defining Computers by TMs. Reference **Recommended Books:** \1. Introduction to computer theory, Daniel I. A. Cohen, 2nd Edition 2. Automata, Computability and Complexity: Theory and Applications, by Elaine Rich, 2011 3. An Introduction to Formal Languages and Automata, by Peter Linz, 4th edition, Jones & Bartlett Publishers, 2006 4. Theory of Automata, Formal Languages and Computation, by S. P. Eugene, Kavier, 2005, New Age Publishers
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	CLO-1 Explain and manipulate the different concepts in automata theory and formal languages such as formal proofs, automata, regular expressions, Turing machines etc. C2 (Understand) CLO-2 Prove properties of languages, grammars and automata with rigorously formal mathematical methods C2 (Understand) CLO-3 Design of automata, RE and CFG C3 (Apply) CLO-4 Transform between equivalent NFAs, DFAs and REs C3 (Apply) CLO-5 Define Turing machines performing simple tasks C2 (Understand) CLO-6 Differentiate and manipulate formal descriptions of languages, automata and grammars with focus on regular and context-free languages, finite automata and regular expressions. C3 (Apply)

Mid (30%)	Sessional (20%)	Final (50%)	Practical	Total
30	20	50		100

Duration	Topics Covered
Week1	Introduction to Automata: Introduction to languages, Defining Languages, Kleene Closure, Kleene Closure, The Central Concepts of Automata Theory
Week2	Automata and Complexity, Introduction to Formal Proof: Deductive Proofs, Proof by Contradiction, Proof by Contrapositive, Proof by Induction
Week3	Recursive Definitions , Regular Expressions, Defining Languages Using Regular Expressions, Algebraic Laws For Regular Expressions.
Week 4	Finite Automata: Introduction of Finite Automata, Deterministic Finite Automata.Even-Even FA
Week 5	Finite Automata and Regular Expressions, Applications of Regular Expressions
Week 6	Properties of Regular Languages, Closure Properties of Regular Languages
Week 7	Decision Properties of Regular Languages, Proving Languages Not to Be Regular, Pumping Lemma Nondeterministic Finite Automata, Finite Automata With Epsilon Transitions
Week 8	**Relaxing the restriction on inputs** **Transition graph ,TG constructions, Generalized TG**
Week 9	Kleene's Theorem Turing TG into regular expressions Converting regular expressions into FAs Kleene's theorem Part III

Week 10	FA with Outputs Moore Machines Mealy Machine Moore=Mealy ,
Week11	Pumping Lemma Pushdown Automata syntax as a method for defining language.
Week12	Context Free Grammar (CFG),Context free language(CFL) Properties of Context-Free Languages. CFG terminologies
Week 13	Killing unit production ,Chomsky normal form
Week 14	Pushdown automata, adding a pushdown stack,Non-Context-Free language. Pumping lemma for CFLs
Week 15	Nondeterministic PDA.,PDA corresponding to CFG
Week 16	Turing Machines,Sub algorithm
Week 17	Final term

Program	BSCS
Semester	4th Semester
Title of the course	Advance Database Management System
SDG	
Prerequisite	**DB**
Course Code.	IT-253
Credit hours	3(2-3)
Category	
Course contents	**Course Outline:** Introduction to advance data models such as object relational, object oriented. File organizations concepts, Transactional processing and Concurrency control techniques,Recovery techniques, Query processing and optimization, Database Programming (PL/SQL, T-SQL or similar technology), Integrity and security, Database Administration (Role management, managing database access, views), Physical database design and tuning,Distributed database systems, Emerging research trends in database systems, MONGO DB, MONGO DB, **Reference Materials:** 1. Database Systems: A Practical Approach to Design, Implementation, and Management, 6th Edition by Thomas Connolly and Carolyn Begg 2. Database Management Systems, 3rd Edition by Raghu Ramakrishnan, Johannes Gehrke 3. Database System Concepts, 6th Edition by Avi Silberschatz, Henry F. Korth and S. Sudarshan. 4. Database Systems: The Complete Book, 2nd Edition by Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	

Lesson Plan

Week 1	• Introduction to advance data models such as object relational,
Week 2	• File organizations concepts,
Week 3	• Transactional processing
Week 4	• Recovery techniques, Query processing and optimization,
Week 5	• Database Programming (PL/SQL,
Week 6	• T-SQL or similar technology), Integrity and security,
Week 7	• Database Administration

Week 8	• Mid Term
Week 9	• (Role management, managing database access, views)
Week 10	• Physical database design and tuning
Week 11	• Distributed database systems,
Week 12	• Emerging research trends in database systems
Week 13	• MONGO DB,
Week 14	• MONGO DB,
Week 15	• Concurrency control techniques
Week 16	• Test and Quiz
Week 17	• Examination and Results preparation

Sr#	Experiments
1	Oracle 11G and oracle SQL developer Installation, using and understanding tools.
2	Generic operations
3	Introduction to SQL Select statement usage
4	Query modifiers ORDER by LIMIT
5	SINGLE row functions and set operations Type conversions
6	SQL join operations Outer / inner joins
7	Aggregation operation and groups Sub queries DML, DDL operation Normalization ERD
8	DCL,TCL, Database connectivity with Oracle Mongo DB

Program	BSCS
Semester	4th Semester
Title of the course	Multivariable Calculus
SDG	**09**
Prerequisite	Calculus and Analytical Geometry
Course Code.	MATH-251
Credit hours	3(3-0)
Category	
Course contents	**Course Outline:** Functions of Several Variables and Partial Differentiation. Multiple Integrals, Line and Surface Integrals.Green's and Stoke's Theorem. Fourier Series: periodic functions, Functions of any period P-2L, Even & odd functions, Half Range expansions, Fourier Transform. Laplace Transform, Z-Transform. **Reference Material:** 1. James Stewart, Multivariable Calculus, 6th edition, 2007, Cengage Learning publishers. 2. Swokowski, Olinick and Pence, *Calculus and Analytical Geometry*, 6th edition, 1994, Thomson Learning EMEA, Ltd. 3. Bernard Kolman, William F. Trench, Elementary Multivariable Calculus, 1971, Academic Press. 4. Howard Anton, Albert Herr, Multivariable Calculus, 5th edition, 1995, John Wiley
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	

Lesson Plan

Week 1	• Functions of Several Variables
Week 2	• Partial Differentiation.
Week 3	• Multiple Integrals,
Week 4	• Line and Surface Integrals.
Week 5	• .Green's Theorem
Week 6	• Stoke's Theorem.
Week 7	• Fourier Series
Week 8	• Mid Term
Week 9	• periodic functions,
Week 10	• Functions of any period P-2L,
Week 11	• Even & odd functions,
Week 12	• Half Range expansions
Week 13	• Fourier Transform.
Week 14	• Laplace Transform
Week 15	• Z-Transform.
Week 16	• Test and Quiz
Week 17	• Examination and Results preparation

Program	BSCS
Semester	4th Semester
Title of the course	**Linear Algebra**
SDG	**07**
Prerequisite	
Course Code.	MATH-151
Credit hours	3(3-0)
Category	
Course contents	**Course Outline:** Vectors, Vector Spaces, Matrices & Determinants, Cofactor and Inverse, Rank, Linear Independence, Solution of system of Linear systems, Positive Definite matrix, Linear Transformations, Operations on matrices, Inner products, orthgonality and least squares, Eigenvalue & Eigenvectors. Applications to Systems of Equations and to Geometry, Singular Value Decomposition. **Reference Material:** *1.* Bernard Kolman, David Hill, Elementary Linear Algebra with Applications, 9th edition, Prentice Hall PTR, 2007. *2.* Gilbert Strang, Strang, Brett Coonley, Andy Bulman-Fleming, Andrew Bulman-Fleming, Strang's Linear Algebra And Its Applications, 4th edition, Brooks/Cole, 2005 *3.* Howard Anton, Chris Rorres, Elementary Linear Algebra: Applications Version, 9th edition, Wiley, 2005. David C. Lay, Linear Algebra and Its Applications, 2nd edition, Addison-Wesley, 2000.
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	

Lesson plan

Week 1	• Vectors
Week 2	• Vector spaces
Week 3	• Matrices and determinants
Week 4	• Cofactor and inverse
Week 5	• Rank, linear independence
Week 6	• Solution of system of linear systems
Week 7	• Positive definite matrix
Week 8	• Linear transformstions
Week 9	• Mids term
Week 10	• Operations on matrices
Week 11	• Inner products
Week 12	• orthgonality and least squares
Week 13	• Eigenvalue & Eigenvectors
Week 14	• . Applications to Systems of Equations
Week 15	• . Applications of Systems to Geometry
Week 16	• Singular Value Decomposition
Week 17	• Final term

Program	BSCS,
Semester	4th Semester
Title of the course	Islamic Studies
SDG	**16**
Prerequisite	**Nill**
Course Code.	ISL-201
Credit hours	2(2+0)
Category	Gen-Edu
Course contents	**Course Contents:** To provide Basic information about Islamic Studies. To enhance understanding of the students regarding Islamic Civilization. History of Islam, understanding of the worship and its usefulness. The basic concept of Quran Pak: wisdom, patience, loyalty. The comparative analysis of Islam with other religions. The Concept and Value of HaqooqulIbad (Bandon Kay Haqooq) in Islam. What is The rights of people in Islamic Point of View. Islamic point of view about other religions. Basic Themes of Quran, Introduction to Sciences of Hadith, Introduction to Islamic Jurisprudence, Primary & Secondary Sources of Islamic Law, Makken&Madnian life of the Prophet, Islamic Economic System, Political theories, Social System of Islam. Definition of Akhlaq.The Most Important Characters mentioned in the Holy Qur'an and Sunnah, SIDQ (Truthfulness)Generosity Tawakkaul(trust on Allah)Patience Taqua (piety). Haqooqulibad in the light of Quran & Hadith - the important characteristic of Islamic society. **Recommended Books:** 1. Introduction to Islam by Dr Hamidullah, Papular Library Publishers Lahore 2. Principles of Islamic Jurisprudence by Ahmad Hassan, Islamic Research Institute, IIUI 3. Muslim Jurisprudence and the Quranic Law of Crimes, By Mir Waliullah, Islamic Books Services
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	• To further enhance the knowledge of Islam. • To understand the basic concept of Islam and Quran Pak. • To understand the concept of Haqooqulibad in the light of Quran. • To know the importance of Islamic concept about other religions.

Lesson Plan

Week	• Contents to be covered
Week 1	• Basic Themes of Quran
Week 2	• Basic Themes of Quran
Week 3	• Basic Themes of Quran
Week 4	• Introduction to Sciences of Hadith
Week 5	• Introduction to Sciences of Hadith
Week 6	• Introduction to Sciences of Hadith
Week 7	• Introduction to Islamic Jurisprudence
Week 8	• Mid Term
Week 9	• Introduction to Islamic Jurisprudence
Week 10	• Primary & Secondary Sources of Islamic Law,
Week 11	• Primary & Secondary Sources of Islamic Law,
Week 12	• Makken&Madnian life of the Prophet,
Week 13	• Makken&Madnian life of • the Prophet,
Week 14	• Political theories
Week 15	• Islamic Economic System
Week 16	• Social System of Islam
Week 17	• Examination and Results preparation

Marks Distribution

Mid (30%)	Sessional (20%)	Final (50%)	Practical	Total
30	20	50		100

BSCS 5TH SEMESTER:

Program	BSCS
Semester	5TH Semester
Title of the course	**OPERATING SYSTEMS**
SDG	**09**
Prerequisite	Data Structures and Algorithms
Course Code.	IT-301
Credit hours	3(2+3)
Category	Comp-Core
Course contents	**Course Contents:** Abstract data types, complexity analysis, Big Oh notation, Stacks (linked lists and array implementations), Recursion and analyzing recursive algorithms, divide and conquer algorithms, Sorting algorithms (selection, insertion, merge, quick, bubble, heap, shell, radix, bucket), queue, dequeuer, priority queues (linked and array implementations of queues), linked list & its various types, sorted linked list, searching an unsorted array, binary search for sorted arrays, hashing and indexing, open addressing and chaining, trees and tree traversals, binary search trees, heaps, M-way tress, balanced trees, graphs, breadth-first and depth-first traversal, topological order, shortest path, adjacency matrix and adjacency list implementations, memory management and garbage collection **Recommended Books:** 1. Data Structures and Algorithm Analysis in Java by Mark A. Weiss 2. Data Structures and Abstractions with Java by Frank M. Carrano & Timothy M. Henry 3. Data Structures and Algorithms in C++ by Adam Drozdek 4. Data Structures and Algorithm Analysis in C++ by Mark Allen Weiss Java Software Structures: Designing and Using Data Structures by John Lewis and Joseph Chas.
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	Implement various data structures and their algorithms and apply them in implementing simple applications C3 (Apply) Analyze simple algorithms and determine their complexities. C5 Analyze) CLO-3 Apply the knowledge of data structure to other application domains. C3 (Apply) CLO-4 Design new data structures and algorithms to solve problems. C6 (Design)

Mid (30%)	**Sessional (20%)**	**Final (50%)**	**Practical**	**Total**
30	20	50	100	200

Lesson Plan

Week	• Contents to be covered
Week 1	• History and Goals, Evolution of multi-user systems.
Week 2	• Introduction to the techniques used to implement operating systems and related kinds of systems software.
Week 3	• Among the topics covered will be process management (creation, synchronization, and communication);
Week 4	• Parallel Processing
Week 5	• Multi-processing and Multi-Threading,
Week 6	• deadlock prevention, avoidance, and recovery;
Week 7	• Synchronization and concurrency
Week 8	• Mid Term
Week 9	• virtual memory management
Week 10	• swapping, paging, segmentation and page-replacement algorithms
Week 11	• file-system structure and implementation
Week 12	• main-memory management
Week 13	• control of disks , input/output devices
Week 14	• protection and security, free space management, disk structure and scheduling, swap space management
Week 15	• uniprocessor scheduling, file concept, directory • and disk structure, directory implementation,
Week 16	• Multiprocessor scheduling, system protection, virtual machines, operating system security
Week 17	• Examination and Result preparation

Labs	Write a program that uses functions to perform the following operations on singly linked list i) Creation ii) Insertion iii) Deletion iv) Traversal.
	Write a program that implement stack (its operations) using i) Arrays ii) Linked list(Pointers).
	i)Write a program that implement Circular Queue (its operations) using Arrays . ii) Write a program that uses both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers: a) Linear search b) Binary search.
	Write a program that implements the following sorting i) Bubble sort ii) Selection sort iii)Quick sort. Write a program that implements the following i) Insertion sort ii) Merge sort iii)Heap sort. Write a program to implement all the functions of a dictionary (ADT)using Linked List. Write a program to perform the following operations: a) Insert an element into a binary search tree. b) Delete an element from a binary search tree. Search for a key element in a binary search tree. Write a program to implement the tree traversal methods.

	Write a program to perform the following operations: a) Insert an element into a AVL tree. b) Delete an element from a AVL tree. c) Search for a key element in a AVL tree

Program	BSCS,
Semester	5TH Semester
Title of the course	HCI & Computer Graphics
SDG	
Prerequisite	
Course Code.	IT-302
Credit hours	3(2-3)
Category	
Course contents	**Course Outlines:** The Human, Computer and Interaction, Usability paradigm and principles, Introduction to design basics, HCI in software process, Design rules, prototyping, evaluation techniques, task analysis, Universal design and User support and Computer Supported Cooperative Work. Introduction to specialized topics such as Groupware, pervasive and ubiquitous applications. **Computer graphics** Fundamental Concepts: forward and backward rendering (i.e., ray-casting and rasterization), applications of computer graphics: including game engines, cad, visualization, virtual reality, polygonal representation, basic radiometry, similar triangles, and projection model, use of standard graphics APIs (see HCI GUI construction); basic rendering: rendering in nature, i.e., the emission and scattering of light and its relation to numerical integration, affine and coordinate system transformations, ray tracing, visibility and occlusion, including solutions to this problem such as depth buffering, painter's algorithm, and ray tracing, the forward and backward rendering equation, simple triangle rasterization, rendering with a shader-based API, texture mapping, including minification and magnification (e.g., trilinear MIP-mapping), application of spatial data structures to rendering, sampling and anti-aliasing, scene graphs and the graphics pipeline; geometric modeling: basic geometric operations such as intersection calculation, proximity tests, polynomial curves and surfaces, approximation techniques such as polynomial curves, bezier curves, spline curves and surfaces, animation as a sequence of still images. **Resources:** 1. Human-Computer Interaction, 3/E **Alan Dix**, *Computing Dept, Lancaster University* **Janet E. Finlay**, *Leeds Metropolitan University*, **Gregory D. Abowd**, *Georgia Institute of Technology*, **Russell Beale**, *University of Birmingham* ISBN-10: 0130461091 ISBN-13: 9780130461094 Publisher: Prentice Hall

	Designing the User Interface: Strategies for Effective Human-Computer Interaction, 4/E **Ben Shneiderman**, *University of Maryland* **Catherine Plaisant**, *University of Maryland* ISBN-10: 0321197860 ISBN-13: 9780321197863 Publisher: Addison-Wesley Computer Graphics with Open GL (4th Edition) by Donald D. Hearn, Prentice Hall, 2010, ISBN-10: 0136053580. 2. Foundations of 3D Computer Graphics by S. J. Gortler, The MIT press, 2012. 3. Fundamentals of Computer Graphics, 3rd Edition, A K Peters, 2009. 4. Computer Graphics: Principles and Practice, 3rd Edition, Addison Wesley, 2013. 5. Real-Time Rendering, 3rd Edition, A K Peters, 2008.
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	Explain context of HCI and different measures for evaluation. 2. Apply the principles of good design for people from the perspective of age and disabilities. 3. Analyze techniques for user centered design for a medium sized software. 4. Evaluate the usability of a medium size software user interface. Comprehend the structure of modern computer graphics systems 2. Explain the basic principles of implementing computer graphics fundamentals Compare key algorithms for modelling and rendering graphical data. Develop design and problem solving skills with applications to computer graphics

Lesson plan

Week 1	• Fundamental Concepts: forward and backward rendering (i.e., ray-casting and rasterization)
Week 2	• applications of computer graphics: including game engines, cad, visualization, virtual reality
Week 3	• polygonal representation, basic radiometry, similar triangles, and projection model
Week 4	• use of standard graphics APIs (see HCI GUI construction); basic rendering: rendering in nature, i.e., the emission and scattering of light and its relation to numerical integration
Week 5	• use of standard graphics APIs (see HCI GUI construction);
Week 6	• affine and coordinate system transformations, ray tracing, visibility and occlusion
Week 7	• including solutions to this problem such as depth buffering, painter's algorithm

Week 8	• Mids term
Week 9	• ray tracing, the forward and backward rendering equation
Week 10	• simple triangle rasterization, rendering with a shader-based API, texture mapping
Week 11	• including minification and magnification (e.g., trilinear MIP-mapping)
Week 12	• application of spatial data structures to rendering, sampling and anti-aliasing
Week 13	• scene graphs and the graphics pipeline
Week 14	• geometric modeling: basic geometric operations such as intersection calculation
Week 15	• proximity tests, polynomial curves and surfaces, approximation techniques such as polynomial curves
Week 16	• bezier curves, spline curves and surfaces, animation as a sequence of still images
Week 17	• Final term

Lab Contents

2. List of Experiment

Setting the VC++ environment for OpenGL

1 A: Introduction to OpenGL

- Objectives.
- What is OpenGL and how does it work.
- OpenGL Architecture
- OpenGL as a Renderer
- OpenGL and Related APIs

1 B: GLUT (Graphics Language Utility Toolkit)

- Introduction
- Design Philosophy
- Library installation.
- OpenGL conventions
- Basic OpenGL Syntax.
- OpenGL Related Libraries.
- Display-Window Management.
- Writing a simple displaying function.
- Writing a complete simple OpenGL program.

1 C: Study & implement of basic graphics function defined in graphics.h

2 A : Study of graphics standards

- CORE
- GKS (Graphics Kernel System)
- GKS-3D(Graphics Kernel System -3 Dimensions)
- PHIGS (Programmer's Hierarchical Interactive Graphics Systems)
- CGM (Computer Graphics Metafile)
- CGI (Computer Graphics Interface).

2 B: Program for Line drawing using DDA algorithm .

3 : Program for Line drawing using Bresenhams algorithm.

4 : Program for Mid-Point Circle Generation algorithm .

5 : Drawing Basic Graphics Primitive

- Drawing Points
- Drawing Lines

- Drawing Polygons
- Set-up Gradient Colors

6 : Interactive program using Keyboard /Mouse in OpenGL.

7 : Interactive program using Menu/Submenu in OpenGL.

8 : Program using 2D Transformations.

- Creating Menu
- Rotation, Scale and Translation

9 : Window to Viewport transformations in C.

10: Program for Cohen Sutherland Line Clipping Algorithm.

11 : Program for polygon filling using flood fill method.

12 : Design an application in OpenGL.

COURSE OBJECTIVES

- To analyze and identify usability issues in User interfaces.
- To design user interfaces according to the standards.
- To evaluate user interfaces using Heuristic Evaluation and Thinking aloud Test.
- To demonstrate skills to collaborate in a team for justifying identified problems and to write interface related reports as per the standards.

COURSE LEARNING OUTCOMES (CLO)

CLO: 1. Analyze and identify usability issues in User interfaces.
CLO: 2. Design user interfaces according to the standards.
CLO: 3. Evaluate user interfaces using Heuristic Evaluation and Thinking aloud Test.
CLO: 3. Demonstrate skills to collaborate in a team for justifying identified problems and to write interface related reports as per the standards.

COURSE CONTENTS

\
- The Psychology of Usable Things
- Usability Engineering
- Know the User
- Usability Benchmarking
- Goal-Oriented Interaction Design
- Prototyping
- Usability Inspection Methods
- Usability Testing Methods
- Usability in Practice
- Visual Design and Typography, Icon Design
- Brief History of HCI Revision
- Revision

Program	BSCS
Semester	5th Semester
Title of the course	**computer architecture**
SDG	**09**
Prerequisite	
Course Code.	IT-303
Credit hours	3(2-3)
Category	COAL
Course contents	**Course Outlines:** Fundamentals of Computer Design including performance measurements & quantitative principles, principles of Instruction Set Design, Operands, addressing modes and encoding, pipelining of Processors: Issues and Hurdles, exception handling features, Instruction-Level Parallelism and Dynamic handling of Exceptions, Memory Hierarchy Design, Cache Design, Performance Issues and improvements, Main Memory Performance Issues, Storage Systems, Multiprocessors and Thread Level Parallelism. Case Studies. **Resources:** 1. *Computer Architecture: A Quantitative Approach* by Hennessy & Patterson, Morgan & Kauffman Series (2006) Fourth Edition. *Computer Organization & Design* : *The Hardware/Software Interface* By Patterson & Hennessy, Morgan & Kauffman Series (2008) Fourth Edition.
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	

Lesson plan

Week 1	• Fundamentals of Computer Design including performance measurements & quantitative principles
Week 2	• principles of Instruction Set Design
Week 3	• Operands
Week 4	• addressing modes and encoding
Week 5	• pipelining of Processors: Issues and Hurdles, exception handling features
Week 6	• Quiz
Week 7	• Instruction-Level Parallelism and Dynamic handling of Exceptions
Week 8	• Mids term
Week 9	• Memory Hierarchy Design
Week 10	• Performance Issues and improvements
Week 11	• Assignment
Week 12	• , Main Memory Performance Issues
Week 13	• Storage Systems
Week 14	• Multiprocessors and Thread Level Parallelism
Week 16	• Case studies
Week 17	• Final term

Lab Contents: Computer Architecture

Table of Contents

Program	BSCS
Semester	5th Semester
Title of the course	**Introduction to management**
SDG	**09**
Prerequisite	
Course Code.	SOC-101
Credit hours	2(2-0)
Category	
Course contents	
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
	This course introduces students to the roles and functions of managers. The content includes an introduction to organisations and the need for and nature of management. It examines the evolution of management theory, organisational environments, and corporate social responsibility and ethics. The course also includes a detailed investigation of the four functions of management: planning and decision making, organising, leading and motivating, and controlling.
Learning Outcomes	This course is designed to develop student awareness of organisations and the variety of skills useful in managerial roles, while fostering a spirit of critical inquiry and stimulating student pursuit of personal development and lifelong learning. By the end of this course students should be able to: 1. Demonstrate a foundational knowledge of the diversity of management thinking. 2. Autonomously and collaboratively analyse, evaluate, synthesise and apply knowledge in a timely fashion from wide inquiry of a variety of sources. 3. Demonstrate awareness of research as a source of contested and uncertain knowledge. 4. Effectively communicate their findings independently and as part of a group using an evolving variety of media.

Lesson plan

Week 1	Introduction to Management • "History of Ideas, The Management Century" Evolution of Management Principles . Introduction to Management (cont.) • Classroom Technology Overview • Review Syllabus • "Does Management Really Work?" • Introduce Management Framework
Week 2	1.Strategic Management • What is Strategy • Why is Strategy Important • The Strategy Process • Mission, Vision, Values & Goal Setting 2.Strategic Management (cont.) • External Analysis 2. Strategic Management (cont.) • Internal Analysis Strategic Management (cont.) • Executing Strategy • Strategic Options/Selecting Strategies
Week 3	MANDATORY ATTENDANCE SESSION Form Teams/Seat Assignment Workshop/Group Exercises - Exercise 1 Form Business Concept, Value Proposition, Core Values, Mission Statement, Vision
Week 4	Governance & Leadership • Governance Governance & Leadership

	• Control and Risk Management . Governance & Leadership • Leadership
Week 5	Managing a Positive and Productive Work Environment • Organization Design o Designing Productive & Meaningful Jobs o Creating Organizational Structure Managing a Positive and Productive Work Environment (cont.) • Human Resource Management o HR Management System
Week 6	Managing a Positive and Productive Work Environment (cont.) • Employee Engagement o “Inner Work Life” o Engaging Employees
Week 7	Performance Management • Process Management - Overview • Measurement Systems . Performance Management (cont.) • Process Management – Tools Performance Management (cont.) • Business Assessment • Performance Improvement
Week 8	• Mids term
Week 9	Managing Innovation & Growth • Managing Growth • Growth Strategies Managing Innovation & Growth (cont.) • What is Innovation? • Why Innovation is Important • Developing an Innovation Strategy

Week 10	. Managing Innovation & Growth (cont.) • What is Entrepreneurship • Corporate Entrepreneurship
Week 11	. Global Management • Globalization of Markets . Global Management (cont.) • Global Strategies • Multi-cultural Management
Week 12	Values Based Management • Diversity/Multi-cultural Society • Legal Aspects of Diversity • Managing Diversity Effectively
Week 13	Values Based Management (cont.) • Sexual Harassment
Week 14	• Quiz
Week 15	Values Based Management (cont.) • Ethics and Ethical Decision Making • Why Behave Ethically?
Week 16	Values Based Management (cont.) • Corporate Social Responsibility • Sustainability
Week 17	• Final term

BSCS 6TH SEMESTER:

Program	BSCS
Semester	6th Semester
Title of the course	**Compiler Construction**
SDG	**09**
Prerequisite	Theory of Automata
Course Code.	IT-351
Credit hours	3(2-3)
Category	Major course
Course contents	**Course Outline:** Compiler techniques and methodology. Organization of compilers. Lexical and syntax analysis. Parsing techniques. Object code generation and optimization, detection and recovery from errors. Contrast between compilers and interpreters. **Reference Material:** 1. Compilers: Principles, Techniques, and Tools By Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Contributor Jeffrey D. Ullman ,Addison-Wesley Pub. Co., 2nd edition,1987 Original from the University of Michigan 2. Modern Compiler Design, By Dick Grune, Henri E. Bal, Ceriel J. H. Jacobs, Koen G. Langendoen, John Wiley, 2000. 3. Modern Compiler Implementation in C, By Andrew W. Appel, Maia Ginsburg, Contributor Maia Ginsburg, Cambridge University Press, 2004. Modern Compiler Design by Dick Grune, Henri E. Bal, Ceriel J. H. Jacobs, Koen G. Langendoen, 2003, John Wiley & Sons.
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	

Lesson plan:

Week 1	• Introduction, Phases of compiler ,front end and backend of compiler
Week 2	• Application of compiler technology, Lexical analysis (Role of lexical analyzer, input buffering), formal languages
Week 3	• Specification and recognition of tokens, FSM and lexical tables, Lexical analyzer generator Lex, Look ahead operator
Week 4	• Finite automata ,transition tables, DFA, NFA, Construction of NFA From RE, pattern matching based on NFA
Week 5	• Implementing the look ahead operator, Optimization of DFA-Based Pattern Matchers
Week 6	• Optimization of DFA-Based Pattern Matchers
Week 7	• Syntax analysis, grammar, context free grammar(derivation and parse tree)Ambiguity
Week 8	• **Mid Term**
Week 9	• Elimination ambiguity, Left factoring, Non CFG Construct
Week 10	• Top down parsing(Recursive descent parsing ,first and follows set, LL(1) Grammar, non-recursive predictive parsing
Week 11	• LR Parsing with tables, error recovery in LR Parsing, Syntax directed definition, synthesized and inherited attributes
Week 12	• Evaluation order of SSD, , syntax directed translation scheme
Week 13	• Intermediate code generation, three address code, translation of expression, addressing array elements, Type checking, Translating control structures
Week 14	• Intermediate code for procedure, Runtime management, stack allocation of stack, access to nonlocal data to stack
Week 15	• Register allocation, Code generation addresses in target code, Register and address descriptor, optimization of basic block
Week 16	• Peephole optimization • Register allocation and assignment
Week 17	• **Final Term**

LAB CONTENTS: COMPILER CONSTRUCTION

COURSE LEARNING OUTCOMES (CLO)

CLO: 1. Use compiler construction tools to automatically generate lexical analyzer and syntax analyzer. (C-1)
CLO: 2. Develop a lexical analyzer for given regular expressions. (C-3)
CLO: 3. Develop a syntax analyzer for a given context-free grammar. (C-3)
CLO: 4. Implement appropriate algorithms for lookup and insert operations on a symbol table. (C-3)

COURSE CONTENTS

1. Java File Handling
2. JFlap Tool
3. JFlex Tool
4. Lexical Analyzer Part 1
5. Lexical Analyzer Part 2
6. Coco/R Tool Part 1
7. Coco/R Tool Part 2
8. LL1 Parsing Part 1
9. LL1 Parsing Part 2
10. SLR Parsing Part 1
11. SLR Parsing Part 2
12. Symbol Table Part 1
13. Symbol Table Part 2

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Program	BSCS
Semester	6th Semester
Title of the course	Parallel and Distributed Computing
SDG	**09**
Prerequisite	**Operating System**
Course Code.	IT-352
Credit hours	3(2+3)
Category	Core
Course contents	**Course Contents:** Asynchronous/synchronous computation/communication, concurrency control, fault tolerance, GPU architecture and programming, heterogeneity, interconnection topologies, load balancing, memory consistency model, memory hierarchies, Message passing interface (MPI), MIMD/SIMD, multithreaded programming, parallel algorithms & architectures, parallel I/O, performance analysis and tuning, power, programming models (data parallel, task parallel, process-centric, shared/distributed memory), scalability and performance studies, scheduling, storage systems, synchronization, and tools (Cuda, Swift, Globus, Condor, Amazon AWS, OpenStack, Cilk, gdb, threads, MPICH, OpenMP, Hadoop, FUSE). **Recommended Books:** Distributed Systems: Principles and Paradigms, A. S. Tanenbaum and M. V. Steen, Prentice Hall, 2nd Edition, 2007 2. Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet, K Hwang, J Dongarra and GC. C. Fox, Elsevier, 1st Ed.
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	At the end of this course the students will able to: Learn about parallel and distributed computers. Write portable programs for parallel or distributed architectures using Message-Passi Interface (MPI) library – Analyze complex problems with shared memory programming with openMP.

Lesson plan:

Details of Course plan	
Week 1	• Introduction to Parallel and distributed Computing
Week 2	• Asynchronous / Synchronous Computation
Week 3	• Concurrency Control
Week 4	• Fault Tolerance, MIMD/SIMD
Week 5	• GPU Architecture and Programming
Week 6	• Heterogeneity, Interconnection Topologies
Week 7	• Load Balancing , Memory Consistency Models
Week 8	• Memory Hierarchies, Message Passing Interface(MPI)
Week 9	• Multithreaded Programming
Week 10	• Parallel Algorithms and architectures, Parallel I/O
Week 11	• Performance Analysis and Tuning
Week 12	• Programming Models(data model, task parallel, process-centric, shared /distributed memory)
Week 13	• Scalability and performance studies, Scheduling, Storage systems
Week 14	• Introduction to tools(Cuda, Swift, Globus, Condor, Amazon AWS, FUSE)
Week 15	• Introduction to tools(OpenStack, Cilk, gdb, threads, MPICH, OpenMP, Hadoop)
Week 16	• Presentations and Assignments
Week 17	• Final Term

Marks Distribution

Mid (30%)	Sessional (20%)	Final (50%)	PRACTICAL	Total
30	20	50	100	200

Lab Contents: Parallel & Distributed Computing
1. Introduction to MPI Programming 2. Finding large primes with MPI

BSCS 7TH SEMESTER:

Program	BSCS
Semester	7th Semester
Title of the course	Analysis of Algorithms
SDG	
Prerequisite	DS
Course Code.	IT-402
Credit hours	3(3-0)
Category	
Course contents	Introduction; role of algorithms in computing, Analysis on nature of input and size of input Asymptotic notations; Big-O, Big Ω, Big Θ, little-o, little-ω, Sorting Algorithm analysis, loop invariants, Recursion and recurrence relations; Algorithm Design Techniques, Brute Force Approach, Divide-and-conquer approach; Merge, Quick Sort, Greedy approach; Dynamic programming; Elements of Dynamic Programming, Search trees; Heaps; Hashing; Graph algorithms, shortest paths, sparse graphs, String matching; Introduction to complexity classes. **Reference Materials: (or use any other standard and latest books)** 1. Introduction to Algorithms (3rd edition) by Thomas H. Corman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein 2. Algorithm Design, (1st edition, 2013/2014), Jon Kleinberg, Eva Tardos, 3. Algorithms, (4th edition, 2011), Robert Sedgewick, Kevin Wayne
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	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-andconquer, and dynamic programming) to solve an appropriate problem ,Solve problems using graph algorithms, including singlesource,and all-pairs shortest paths, and at least one

	minimum spanning tree algorithm Trace and/or implement a string-matching algorithm

Lecture No. **(Per Week)**	**Topic**
1	The Role of Algorithms in Computing
2	Introduction to Design and Analysis of Algorithms
3	Asymptotic Notations
4	Sorting algorithm analysis, loop invariants
5	Recursion and recurrence relations
6	Recursion and recurrence relations
7	Divide and Conquer Approach
	Mid-term Exam
9	Heapsort (Heaps, Maintaining Heap property, Building Heap, Heapsort, and Priority Queues)
10	Dynamic Programming (Elements of Dynamic Programming)
11	Greedy Algorithms (Activity-Selection Problem, Greedy Strategy, and Huffman Codes)
12	Graph Algorithms (shortest paths, sparse graphs)
13	Network Flow, Disjoint Sets
14	Polynomial and matrix calculations, String matching
15	NP-Complete Problems,
16	Approximation algorithm
	Final Exam

Program	BSCS
Semester	7th Semester
Title of the course	Technical & Business writing
SDG	
Prerequisite	
Course Code.	
Credit hours	3(3-0)
Category	
Course contents	**Course Content:** Overview of technical reporting, use of library and information gathering, administering questionnaires, reviewing the gathered information; Technical exposition; topical arrangement, exemplification, definition, classification and division, casual analysis, effective exposition, technical narration, description and argumentation, persuasive strategy, Organizing information and generation solution: brainstorming, organizing material, construction of the formal outline, outlining conventions, electronic communication, generation solutions. Polishing style: paragraphs, listening sentence structure, clarity, length and order, pomposity, empty words, pompous vocabulary, document design: document structure, preamble, summaries, abstracts, table of contents, footnotes, glossaries, cross-referencing, plagiarism, citation and bibliography, glossaries, index, appendices, typesetting systems, creating the professional report; elements, mechanical elements and graphical elements. Reports: Proposals, progress reports, Leaflets, brochures, handbooks, magazines articles, research papers, feasibility reports, project reports, technical research reports, manuals and documentation, thesis. Electronic documents, Linear verses hierarchical structure documents. Reference material Technical Report Writing, by Pauley and Riordan, Houghton Mifflin Company, 8th Edition. 2. Effective Technical Communication by Ashraf Rizvi, Tata McGraw-Hill.
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	

Week	• Contents to be covered
Week 1	• Overview of technical reporting
Week 2	• Use of library and information gathering, administering questionnaires, reviewing the gathered information.
Week 3	• Technical exposition; topical arrangement, exemplification, definition, classification and division, casual analysis, effective exposition.
Week 4	• Technical narration, description and argumentation, persuasive strategy,
Week 5	• Organizing information and generation solution: brainstorming, organizing material, construction of the formal outline.
Week 6	• Outlining conventions, electronic communication, generation solutions.
Week 7	• Polishing style: paragraphs, listening sentence structure, clarity, length and order, pomposity, empty words.
Week 8	• Mid Term
Week 9	• Document structure, preamble, summaries, abstracts, table of contents, footnotes, glossaries, cross-referencing, plagiarism, citation and bibliography, glossaries,
Week 10	• Cross-referencing, plagiarism, citation and bibliography, glossaries, index, appendices, typesetting systems, creating the professional report; elements,
Week 11	• Elements, mechanical elements and graphical elements. Reports: Proposals,
Week 12	• Proposals, progress reports, Leaflets, brochures, handbooks, magazines articles, research papers, feasibility reports, .
Week 13	• Project reports, technical research reports, manuals and documentation, thesis.
Week 14	• Electronic documents, Linear verses hierarchical structure documents.
Week 15	• Presentation.
Week 16	• Quiz and Test
Week 17	• Examination and Result preparation

Program	BSCS
Semester	7th Semester
Title of the course	Entrepreneurship
SDG	
Prerequisite	Introduction to Management
Course Code.	
Credit hours	2(2-0)
Category	
Course contents	**Course Outlines:** This course provides the student with an understanding of the entrepreneurship process. It exposes them to the concepts, practices and tools of the entrepreneurial world. This will be accomplished through a combination of readings, cases studies and projects designed to convey the unique environment of the entrepreneurs and new ventures. The course gives students the tools necessary to think creatively, to plan out whether their idea is marketable to investors, guide them through the launch their own business, or to support an employer in launching and growing an entrepreneurial venture. As CS students, the focus shall be on items particularly important for technology ventures. **Text Books/Reference Books:** The Art of the Start: The Time-Tested, Battle-Hardened Guide for Anyone Starting Anything by Guy Kawasaki, ISBN: 1591840562
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	

Lesson Plan

Week	Contents to be cover
Week 1	• This course provides the student with an understanding of the entrepreneurship process.
Week 2	• . It exposes them to the concepts, practices and tools of the entrepreneurial world.
Week 3	• This will be accomplished through a combination of readings.
Week 4	• The course gives students the tools necessary to think creatively.
Week 5	• Quiz.
Week 6	• guide them through the launch their own business.
Week 7	• Presentation.
Week 8	• Mid Term
Week 9	• the focus shall be on items particularly important for technology ventures.
Week 10	• projects designed to convey the unique environment of the entrepreneurs.
Week 11	• cases studies and new ventures.
Week 12	• Assignment.
Week 13	• support an employer in launching and growing an entrepreneurial venture.
Week 14	• plan out whether their idea is marketable to investors.
Week 15	• Quiz and Test.
Week 16	• Presentation.
Week 17	• Examination and Result preparation

BSCS 8TH SEMESTER:

Program	BSCS,
Semester	8th Semester
Title of the course	Professional Practices
SDG	**09**
Prerequisite	**Nill**
Course Code.	
Credit hours	2+0
Category	Gen-Edu
Course contents	**Course Contents:** Historical, social, and economic context of Computing (software engineering, Computer Science, Information Technology); Definitions of Computing (software engineering, Computer Science, Information Technology) subject areas and professional activities; professional societies; professional ethics; professional competency and life-long learning; uses, misuses, and risks of software; information security and privacy; business practices and the economics of software; intellectual property and software law (cyber law); social responsibilities, software related contracts, Software house organization. Intellectual Property Rights, The Framework of Employee Relations Law and Changing Management Practices, Human Resource Management and IT, Health and Safety at Work, Software Liability, Liability and Practice, Computer Misuse and the Criminal Law, Regulation and Control of Personal Information. Overview of the British Computer Society Code of Conduct, IEEE Code of Ethics, ACM Code of Ethics and Professional Conduct, ACM/IEEE Software Engineering Code of Ethics and Professional Practice. Accountability and Auditing, Social Application of Ethics. **Recommended Books:** 1. Professional Issues in Software Engineering by Frank Bott, Allison Coleman, Jack Eaton and Diane Rowland, CRC Press; 3rd Edition (2000). ISBN-10: 0748409513 2. Computer Ethics by Deborah G. Johnson, Pearson; 4th Edition (January 3, 2009). ISBN10: 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
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	

Lesson Plan

Week	Contents to be covered
1	Introduction to Professional Practices. Historical, social, and economic context of Computing (software engineering, Computer Science, Information Technology)
2	Introduction to Profession Ethics. Professional Ethics: • Computer Crime. • Quality of Work or Work Quality.
3	Overview of the British Computer Society Code of Conduct, IEEE Code of Ethics
4	ACM Code of Ethics and Professional Conduct, ACM/IEEE Software Engineering Code of Ethics and Professional Practice
5	• Anatomy of a Software House/Software house organization • The Structure of Organizations
6	• Finance and Accounting • Practices and the Economics of software
7	• Computer/software related Contracts, Software Liability, Liability and Practice Intellectual Property Rights • The Framework of Employee Relations Law and Changing Management Practices
8	• Human Resource Management and IT • Health and Safety at Work
10	• Business Ethics • Information security and privacy
11	• Ethical Leadership • Definitions of Computing (software engineering, Computer Science, Information Technology) subject areas and professional activities
12	• Social responsibilities • Computer Misuse and the Criminal Law, Regulation and Control of Personal Information (Cyber Laws)
13	• Uses, Misuses, and Risks of Software; • Risk Management
14	• Accountability and Auditing • Cyber security Laws
15	Entrepreneurship • Define innovation and entrepreneurship • General commercialization and extracting value from ideas Brainstorming.
16	• Professional Competency and life-long learning • Social Networking and Ethics Internet Security
17	Examination and Result preparation

Marks Distribution

Mid (30%)	Sessional (20%)	Final (50%)	Practical	Total
30	20	50	0	100

Program	BSCS
Semester	8th Semester
Title of the course	Ideology and constitution of Pakistan
SDG	
Prerequisite	
Course Code.	PAKs-101
Credit hours	2(2-0)
Category	
Course contents	Historical background of Pakistan: Muslim society in Indo-Pakistan, the movement led by the societies, the downfall of Islamic society, the establishment of British Raj-Causes and consequences. Political evolution of Muslims in the twentieth century: Sir Syed Ahmed Khan; Muslim League; Nehru; Allama Iqbal: Independence Movement; Lahore Resolution; Pakistan culture and society, Constitutional and Administrative issues, Pakistan and its geopolitical dimension, Pakistan and International Affairs, Pakistan and the challenges ahead. **Reference Materials: (or use any other standard and latest books)** 1. The Emergence of Pakistan, Chaudary M., 1967 2. The making of Pakistan, Aziz. 1976 3. A Short History of Pakistan, I. H. Qureshi, ed., Karachi, 1988
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)
Learning Outcomes	To educate students about the history of Pakistan • To educate student about the various pillar of the state • To educate student Government and politics

Marks Distribution

Mid (30%)	Sessional (20%)	Final (50%)	Practical	Total
30	20	50	0	100

Lesson Plan

Week 1	● Historical background of Pakistan: Muslim society in Indo-Pakistan.
Week 2	● ● The movements led by societies.
Week 3	● Assignment.
Week 4	● Political evolution of Muslims in the twentieth century:Sir Syed Ahmad Khan
Week 5	● ; Muslim League; Nehru; Allama Iqbal: Independence Movement.
Week 6	● Lahore Resolution and consequences.
Week 7	● Presentation.
Week 8	● Mid Term
Week 9	● Pakistan culture and society, Constitutional and Administrative issues.
Week 10	● Assignment.
Week 11	● Pakistan and International Affairs, Pakistan and the challenges ahead
Week 12	● Pakistan and its geopolitical dimension,
Week 13	● Quiz.
Week 14	● The downfall of Islamic society, the establishment of British Raj- Causes.
Week 15	● Presentation
Week 16	● Test and Quiz.
Week 17	● Examination and Results preparation

Program	BSCS
Semester	8th Semester
Title of the course	Civics and community engagement Provides a cross-disciplinary foundation of civic and community engagement related to broader-issues of social justice, including ways to sustain democratic society through civility, citizenship,and community service. Various theoretical perspectives create a diverse overview of the concept of civic engagement, especially as related to social, cultural, philosophical, and political perspective.
Course Code.	G-SOC-202
Credit hours	2(2-0)
Category	
Course contents	
Follow up	Quizzes (10 mark) Assignments (5 mark) Presentation (5 mark)

Week 1	• Provides a cross-disciplinary foundation of civic.
Week 2	• Assignment.
Week 3	• Including ways to sustain democratic society through civility,
Week 4	• Quiz.
Week 5	• Various theoretical perspectives.
Week 6	• Citizenship,and community service.
Week 7	• Presentation.
Week 8	• Mid Term
Week 9	• Create a diverse overview of the concept of civic engagement.
Week 10	• Assignment.
Week 11	• Especially as related to social and issues.
Week 12	• cultural, philosophical, and political perspectives
Week 13	• Quiz
Week 14	• Community engagement related to broader issues of social justice,
Week 15	• Presentation.
Week 16	• Test and Quizzes.
Week 17	• Examination and Results preparation