DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

COMILLA UNIVERSITY

COMILLA, BANGLADESH

SYLLABUS FOR BACHELOR OF SCIENCE (ENGINEERING) DEGREE FOR THE ACADEMIC SESSIONS 2018-19, 2019-20, 2020-21

COURSE CURRICULUM

FOR

B. SC. (Engg.) IN COMPUTER SCIENCE AND ENGINEERING

Course Distribution

YEAR-1 SEMESTER-I

Sl.	Course Code	Course Title	Credits
1	CSE-1101	Computer Fundamentals	2
2	CSE-1102	Computer Fundamentals LAB	1.5
3	CSE-1103	Discrete Mathematics	3
4	MATH-1104	Differential and Integral Calculus	3
5	CSE-1105	Electrical Circuits and Devices	3
6	CSE-1106	Electrical Circuits and Devices LAB	1.5
7	ENG-1107	Communicative English	2
8	CSE-1108	Structured Programming Language	3
9	CSE-1109	Structured Programming Language LAB	1.5
	Total		**20.5**

YEAR-1 SEMESTER-II

Sl.	Course Code	Course Title	Credits
1	CSE-1201	Data Structures	3
2	CSE-1202	Data Structures LAB	1.5
3	CSE-1203	Analog Electronics	3
4	CSE-1204	Analog Electronics LAB	1.5
5	PHY-1205	Physics	2
6	MATH-1206	Differential Equations and Vector Analysis	3
7	ACCT-1207	Financial and Managerial Accounting	2
8	STAT-1208	Probability and Statistics	3
9	ECO-1209	Economics	2
10		Viva-voce	1
	Total		**22**

YEAR-2 SEMESTER-I

Sl.	Course Code	Course Title	Credits
1	CSE-2101	Algorithm Analysis and Design	3
2	CSE-2102	Algorithm Analysis and Design LAB	1.5
3	CSE-2103	Object Oriented Programming Language	3
4	CSE-2104	Object Oriented Programming Language LAB	1.5
5	CSE-2105	Digital Logic Design	3
6	CSE-2106	Digital Logic Design LAB	1.5
7	LAW-2107	Cyber Law and Engineering Ethics	2
8	MATH-2108	Algebra, Trigonometry and Matrices	3
9	BDS-2109	Liberation War and Bangladesh Studies	2
	Total		**20.5**

YEAR-2 SEMESTER-II

Sl.	Course Code	Course Title	Credits
1	CSE-2201	Database Management Systems	3
2	CSE-2202	Database Management Systems LAB	1.5
3	CSE-2203	Computer Architecture and Organization	3
4	CSE-2204	Java Technologies	3
5	CSE-2205	Java Technologies LAB	1.5
6	CSE-2206	Data Communication	3
7	CSE-2207	Data Communication LAB	1.5
8	MATH-2208	Complex Variable and Geometry	3
9		Viva-voce	1
	Total		**20.5**

YEAR-3 SEMESTER-I

Sl.	Course Code	Course Title	Credits
1	CSE-3101	Numerical Methods	3
2	CSE-3102	Numerical Methods LAB	1.5
3	CSE-3103	Theory of Computation	3
4	CSE-3104	Microprocessor and Assembly Language	3
5	CSE-3105	Microcontroller and Assembly Language LAB	1.5

6	CSE-3106	Computer Networks	3
7	CSE-3107	Computer Networks LAB	1.5
8	CSE-3108	E-Commerce	3
9	CSE-3109	Database Management System Based Project (LAB)	1.5
	Total		**21**

YEAR-3 SEMESTER-II

Sl.	Course Code	Course Title	Credits
1	CSE-3201	Operating Systems	3
2	CSE-3202	Operating Systems LAB	1.5
3	CSE-3203	Software Engineering and Information System Design	3
4	CSE-3204	Software Engineering Based Project (LAB)	1.5
5	CSE-3205	Introduction to Data Science	3
6	CSE-3206	Compiler Design	3
7	CSE-3207	Compiler Design LAB	1.5
8	CSE-3208	Technical Writing	1.5
9		Viva-voce	1
	Total		**19**

YEAR-4 SEMESTER-I

Sl.	Course Code	Course Title	Credits
1	CSE-4101	Artificial Intelligence and Neural Networks	3
2	CSE-4102	Artificial Intelligence and Neural Networks LAB	1.5
3	CSE-4103	Web Engineering	3
4	CSE-4104	Web Engineering LAB	1.5
5	CSE-4105	Computer Graphics	3
6	CSE-4106	Computer Graphics LAB	1.5
7	CSE-4107	Digital Signal Processing	3
8	CSE-4108	Digital Signal Processing LAB	1.5
9	CSE-4109	Research Project (Part-I)	1
	Total		**19**

YEAR-4 SEMESTER-II

Sl.	Course Code	Course Title	Credits
1	Option-I Code	Option-I	3
2	Option-I LAB Code	Option-I based LAB	1.5
3	Option-II Code	Option-II	3
4	Option-II LAB Code	Option-II LAB	1.5
5	Option-III Code	Option-III	3
6	Option-III LAB Code	Option-III LAB	1.5
7	CSE-4221	Research Project (Part-II)	3
8		Viva-voce	1
	Total		**17.5**

Students will select any three of the optional courses which are listed below:

Options

Sl.	Course Code	Course Title	Credits
1	CSE-4201	Advanced Algorithm	3
2	CSE-4202	Advanced Algorithm LAB	1.5
3	CSE-4203	Human Computer Interaction	3
4	CSE-4204	Human Computer Interaction LAB	1.5
5	CSE-4205	Digital Image Processing	3
6	CSE-4206	Digital Image Processing LAB	1.5
7	CSE-4207	Machine Learning	3
8	CSE-4208	Machine Learning LAB	1.5
9	CSE-4209	Network Security	3
10	CSE-4210	Network Security LAB	1.5
11	CSE-4211	Parallel and Distributed Systems	3
12	CSE-4212	Parallel and Distributed Systems LAB	1.5
13	CSE-4213	VLSI Design	3
14	CSE-4214	VLSI Design LAB	1.5
15	CSE-4215	Wireless Sensor Network	3
16	CSE-4216	Wireless Sensor Network LAB	1.5

Summary

Year and Semester	Credits	No. of LAB	No. of Theory Courses	No. of Departmental Courses	No. of Non-Departmental Courses (credit hour)
Year-1 Semester-I	20.5	3	6	7	2(5)
Year-1 Semester-II	22	2	7	4	5(12)
Year-2 Semester-I	20.5	3	6	6	3(7)
Year-2 Semester-II	20.5	3	5	7	1(3)
Year-3 Semester-I	21	4	5	9	0
Year-3 Semester-II	19	3	5	8	0
Year-4 Semester-I	19	4	5	9	0
Year-4 Semester-II	17.5	3	4	7	0
Grand Total	**160**	**25**	**43**	**57**	**11(16.25%)**

DETAIL SYLLABUS

First Year First Semester

CSE 1101: Computer Fundamentals

Credits: 2, Hours/Week: 2

Introduction to Computers: Evolution of Computers, Generation of Computers, Classification of Computers Analog Digital and Hybrid Computers, Classification of Computers according to size, Super Computers, Mainframe Computers, Personal Computers and Terminals, Characteristics of Computers, Block Diagram of a Digital Computer.
Introduction to Number System and Codes: Different number systems and their conversions (Decimal, Binary, Octal, and Hexadecimal), 1's complement and 2's complement, Floating Point numbers, Coding - BCD, Gray, ASCII and EBCDIC.
Boolean algebra and Gate networks: Fundamental concepts of Boolean algebra, Inverter gates, AND gate, OR gate, NAND gate, NOR gate, X-OR gate, X-NOR gate, The universal property of NAND gate and NOR gate, Basic laws of Boolean algebra, De Morgan's theorems.
Computer Organization: Instruction format, Addressing modes, Instruction set.
Memory: Memory Hierarchy, Primary Memory-Volatile and non-volatile memory, RAM and ROM, EPROM and EEPROM, Secondary Memory-Floppy Disk and Hard Disk.
Input / Output Devices: Input Devices-Keyboard, Mouse, Output Devices - VDU, Printers.
Introduction to Programming Concepts: Types of Programming Languages, software, Classification of software, Application software and System Software, Structured Programming, Algorithms and Flowcharts with Examples.

Recommended Books:

1. **Computer Fundamentals** – Peter Norton.
2. **P.K. Sinha**, Computer Fundamentals, BPB Publications
3. **Thomas L Floyd**, Digital Fundamentals, Universal Book Stall
4. **Bartee T.C**, Digital Computer Fundamentals, THM

Course Objectives

- To understand the structure, function and characteristics of computer systems.
- To identify the elements of modern computers and its functionality.
- To explain the function of each element of a computer and memory allocation.
- To identify and compare different methods for computer I/O.
- To understand the design of the various functional units and components of computers.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. Demonstrate computer organization and its applications related to modern computers.
CLO 2. Understand different number systems, Boolean algebra and basic gates.
CLO 3. Make ability to be familiar with different programming languages and flowcharts.
CLO 4. Evaluate the performance of commercially available computers.
CLO 5. Develop their ability to do different work with a computer.

Table1.11: CSE1101 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓	✓	✓		
PLO 2: Requirement Analysis	✓			✓	
PLO 3: Problem Analysis	✓	✓		✓	
PLO 4: Design					
PLO 5: Problem Solving		✓	✓	✓	
PLO 6: Implementation		✓	✓		✓
PLO 7: Experiment and Analysis			✓	✓	✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork			✓		✓
PLO 10: Communication			✓		✓
PLO 11: Self-Motivated			✓		✓
PLO 12: Ethics					

CSE 1102: Computer Fundamentals LAB

Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE 1101.

Course Objectives

- To understand the structure, function and characteristics of computer systems.
- To identify the elements of modern computers and its functionality.
- To explain the function of each element of a computer and memory allocation.
- To identify and compare different methods for computer I/O.
- To understand the design of the various functional units and components of computers.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. Demonstrate computer organization and its applications related to modern computers.
CLO 2. Understand different number systems, Boolean algebra and basic gates.
CLO 3. Make ability to be familiar with different programming languages and flowcharts.
CLO 4. Evaluate the performance of commercially available computers.
CLO 5. Develop their ability to do different work with a computer.

Table 1.12: CSE1102 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓	✓	✓		
PLO 2: Requirement Analysis	✓			✓	
PLO 3: Problem Analysis	✓	✓		✓	
PLO 4: Design					

PLO 5: Problem Solving		✓	✓	✓	
PLO 6: Implementation		✓	✓		✓
PLO 7: Experiment and Analysis			✓	✓	✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork			✓		✓
PLO 10: Communication			✓		✓
PLO 11: Self-Motivated			✓		✓
PLO 12: Ethics					

CSE 1103: Discrete Mathematics

Credits: 3, Hours/Week: 3

Logic and Proofs: Proposition, propositional variables, compound propositions, propositional calculus, truth table, conditional statements, converse, contrapositive and inverse of a conditional statement, bi-conditional statements, precedence of logical operators, concept of tautology, contradiction and contingency; logical equivalences;
Predicates and Quantifiers: propositional function and predicate calculus, quantification, universal and existential quantification, bound and free variables, logical equivalences involving quantifiers, negating quantified expressions, concept of nested quantifiers.
Rules of Inference: arguments and valid arguments, premises, rules of inference and their uses in building arguments, resolution.
Introduction to proofs: formal and informal proofs, concept of theorem, axioms, lemma, corollary and conjectures; direct and indirect proofs, proof by contraposition, vacuous and trivial proof, proof by contradiction, exhaustive proof and proof by cases, existence and uniqueness proof.
Set Theory: Definition of sets and operations on sets.
Functions: function definition; domain, co-domain and range of functions, images and pre-images, one-to-one and onto functions; increasing and decreasing function; one-to-one correspondence; identity and inverse functions; composition of functions; floor and ceiling functions;
Number theory: Integers and Division, primes and greatest common divisors, applications.
Mathematical Induction: Introduction to mathematical induction.
Counting: Basics of counting; pigeonhole principle, permutations and combinations.
Relations: Relations and their properties; n-ary relations and their applications, representing relations, closures of relations, equivalence relations.
Graphs and Trees: Graph and Graph Models, Graph terminology and special type of graphs, representing graphs, graph isomorphism, connectivity, shortest-path problem, graph coloring; Trees: Introduction, traversal and applications.

Recommended Books:

1. **Rosen, K.R**., Discrete Mathematics & Its Application, McGraw-Hill, 1999.
2. **Lipschutz S.** , Lipson M., Theory and Problems of Discrete Mathematics, Schaum's Outlines TATA McGraw-Hill, 2004.
3. **J. P. Tremblay and R. Manohar**, Discrete Mathematical Structures with Applications to Computer Science, TATA McGraw-Hill, 1997.
4. **K. D. Josh**i, Fundamentals of Discrete Mathematics, New Age International Limited, 1996.
5. **C.L. Liu**, Elements of Discrete Mathematics, 2nd Ed. McGraw-Hill, 1985.
6. **Sharon Ross**, Discrete Mathematical Structure.

Course Objectives

- Simplify and evaluate basic logic statements including compound statements, implications, inverses, converses, and contrapositives using truth tables and the properties of logic.
- Express a logic sentence in terms of predicates, quantifiers, and logical connectives.
- Analyze the growth of elementary functions and determine their Big-O value; analyze simple algorithms and compare two algorithms based on computational complexity.
- Use elementary number theory including the divisibility properties of numbers to determine prime numbers and composites, the greatest common divisor, and the least common multiple; perform modulo arithmetic and computer arithmetic.
- Determine if a given graph is simple or a multigraph, directed or undirected, cyclic or acyclic, an Euler or a Hamilton path or circuit and determine the connectivity of a graph.
- Represent a graph using an adjacency list and an adjacency matrix and apply graph theory to application problems such as computer networks.
- Determine if a graph is a binary tree, N-ary tree, or not a tree; use the properties of trees to classify trees, identify ancestors, descendants, parents, children, and siblings; determine the level of a node, the height of a tree or subtree and apply counting theorems to the edges and vertices of a tree.
- Perform tree traversals using preorder, inorder, and postorder traversals and apply these traversals to application problems; use binary search trees or decision trees to solve problems.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. Express a logic sentence in terms of predicates, quantifiers, and logical connectives.
CLO 2. Apply the rules of inference and methods of proof including direct and indirect proof forms, proof by contradiction, and mathematical induction.
CLO 3. Use tree and graph algorithms to solve problems.
CLO 4. Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.
CLO 5. Demonstrate knowledge and understanding of the basic ideas and techniques.
CLO 6. Solve various real-world problems by using counting techniques and graph theory.
CLO 7. Develop their ability to read, comprehend, and create mathematical argument

Table 1.13: CSE1103 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
PLO 1: Knowledge	✓						
PLO 2: Requirement Analysis	✓		✓	✓			
PLO 3: Problem Analysis	✓		✓	✓			
PLO 4: Design	✓						
PLO 5: Problem Solving		✓				✓	✓
PLO 6: Implementation		✓	✓	✓	✓		✓
PLO 7: Experiment and Analysis		✓	✓	✓	✓		
PLO 8: Community Engagement & Engg.						✓	
PLO 9: Teamwork						✓	
PLO 10: Communication					✓	✓	
PLO 11: Self-Motivated							✓
PLO 12: Ethics							

MATH 1104: Differential and Integral Calculus

Credits: 3, Hours/Week: 3

Differential Calculus: Limits, continuity and differentiability; Successive differentiation of various types of functions; Leibniz Theorem; Rolle Theorem; Mean value Theorem in finite and infinite forms; Lagrange form of remainders; Cauchy form of remainder; Expansion of functions; Evaluation of indeterminate forms by LHospital rule; Partial differentiation; Euler Theorem; Tangent and Normal, Subtangent and subnormal in cartesian and polar co-ordinates; Maximum and minimum values of functions of single variable; Points of inflexion; Curvature, radius of curvature, center of curvature; Asymptotes, curve tracing.
Integral Calculus: Definitions of integration; Integration by the method of substitutions; Integration by parts; Standard integrals; Integration by the method of successive reduction; Definite integrals and its properties and use in summing series; Walli formula, Improper integrals, Beta function and Gamma function; Area under a plane curve in cartesian and polar co-ordinates; Area of the region enclosed by two curves in cartesian and polar co-ordinates; Trapezoidal rule, Simpson rule. Arc lengths of curves in cartesian and polar co-ordinates, parametric and pedal equations; Intrinsic equation; Volume of solids of revolution; Volume of hollow solids of revolution by shell method. Area of surface of revolution; Jacobian, multiple integrals and their application.

Recommended Books:

1. B.C. Das and B.N. Mukherjee : Differential calculus
2. Mohammad, Bhattacharjee and Latif : A text book on differential calculus
3. B.C. Das : Integral calculus
4. Dr. Abdul Matin : Integral calculus
5. Howard and Anton : Calculus a new horizon
6. Ayres, F : Calculus
6. Edwards : Differential calculus

Course Objectives

- Learn to find and use limits of functions.
- Learn to find the derivatives of elementary algebraic functions and trigonometric functions.
- Learn to use derivatives for graphing algebraic and trigonometric functions and to solve optimization problem.
- Learn to evaluate definite and indefinite integrals and use them in applications.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. Demonstrate knowledge and understanding of basic calculus and ordinary differential equations as well as their relationship with some typical physical/engineering applications: unerringly perform the calculation details for the solution, and accurately correlate the solution approach with the fundamental concepts involved

CLO 2. Apply mathematical skills to model and solve some basic physical/engineering problems: analyze the given problem, identify the appropriate mathematical skills, articulate a convincing rationale for the approach used, clearly give the mathematical formulation, and correctly find the solution.

CLO 3. Understand well established methods to solve differential equations, and correlate qualitatively with potential applications in engineering topics like oscillations and electric circuits. Identify the occurrence of resonance where large amplitude displacements can be expected.

CLO 4. Explore the technique and usage of integral transform, using the Laplace transform as an illustrative example. Appreciate the power of these techniques in initial value problems and applications like vibrations and signal processing.

CLO 5. Be well prepared to cope with a higher level of engineering mathematics required in different engineering disciplines

Table 1.14: MATH 1104 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge		✓	✓		
PLO 2: Requirement Analysis		✓			
PLO 3: Problem Analysis		✓			
PLO 4: Design					
PLO 5: Problem Solving	✓				
PLO 6: Implementation	✓			✓	
PLO 7: Experiment and Analysis			✓		
PLO 8: Community Engagement & Engg.				✓	✓
PLO 9: Teamwork					
PLO 10: Communication					
PLO 11: Self-Motivated					
PLO 12: Ethics					

CSE 1105: Electrical Circuits and Devices

Credits: 3, Hours/Week: 3

Introduction to voltage, current, voltage source, conductors, insulators, resistances; Ohm's law, KVL, KCL, voltage and current divider rules;
Network sources and Analysis: Voltage sources; Voltage sources in parallel; Open and short circuits; Current sources in series and parallel; Source conversion; Branch-current analysis; Mesh analysis; Nodal analysis; Y-Δ and Δ-Y conversion.
Network Theorems: Superposition theorem; Thevenin's theorem; Norton's theorem; Maximum power transfer theorem; Millman's theorem; Substitution theorem; Reciprocity theorem.
Basic Passive Elements: Resistors, inductors and capacitors in series and parallel; transient response in capacitive networks; Charging and discharging phases; R-L transients; Storage cycle, Decay phase.
Fundamentals of AC and the Basic elements and Phasors: AC fundamentals; Generation of alternating voltage & currents; Sine wave; Frequency spectrum and phase relations; General format of sinusoidal voltage and currents; Phase & algebraic representations of sinusoids; Average & RMS (effective) values; Response of basic R,L,C elements to a sinusoidal voltage & currents; frequency response of basic elements; Impedance and phasor diagram; Average power & power factor; Complex numbers: Rectangular & polar form: Active & reactive power; Resonance, Series & parallel resonance circuit; Qualify factor, Selectivity; Fourier Series.
Transformer: Construction and features of transformer; Transformer on no- load and on load; emf-equation; Phasor diagram; Equivalent circuits; Losses and efficiency.

Recommended Books:

1. **R. L. Boylestad**, Introductory Circuit Analysis, Prentice Hall, 2006.
2. **R. M. Kerchner, G. F. Corcoran**, Alternating Current Circuits, Wiley Eastern Limited, 1994.
3. **J. Nagarath and D. P. Kothari**, Electric Machines, Tata McGraw-Hill, 1999.
4. **F. Puschstein, T. C. Lloyd, A. G. Conrad**, Alternating Current Machines, Asia Publishing House, 1996.

Course Objectives

- To understand operation of semiconductor devices.
- To understand DC analysis and AC models of semiconductor devices.
- To apply concepts for the design of Regulators and Amplifiers.
- To verify the theoretical concepts through laboratory and simulation experiments.
- To implement mini projects based on concept of electronics circuit concepts.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. Understand the current voltage characteristics of semiconductor devices.
CLO 2. Analyze dc circuits and relate ac models of semiconductor devices with their physical operation.
CLO 3. Design and analyze of electronic circuits.
CLO 4. Evaluate frequency response to understand behavior of Electronics circuits.

Table 1.15: CSE1105 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4
PLO 1: Knowledge	✓			
PLO 2: Requirement Analysis		✓		
PLO 3: Problem Analysis		✓	✓	
PLO 4: Design			✓	
PLO 5: Problem Solving				✓
PLO 6: Implementation		✓		✓
PLO 7: Experiment and Analysis		✓	✓	✓
PLO 8: Community Engagement & Engg.				
PLO 9: Teamwork			✓	
PLO 10: Communication				
PLO 11: Self-Motivated				
PLO 12: Ethics				

CSE 1106: Electrical Circuits and Devices LAB

Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE 1105.

Course Objectives

- To understand the physical construction, working and operational characteristics of Semiconductor devices.
- To understand the operation of power supply circuits built using filters, rectifiers and voltage regulators.
- To discuss the manufacturing process of monolithic ICs & the fabrication of components on monolithic IC.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. Study experimentally the characteristics of diodes, BJT's and FET's.
CLO 2. Verify practically the response of various special purpose electronic devices.
CLO 3. Construct and simulate various semiconductor devices using tools such as Pspice and hardware implementation.
CLO 4. Design and analyze of electronic circuits.

Table 1.16: CSE1106 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4
PLO 1: Knowledge	✓			
PLO 2: Requirement Analysis		✓		✓

PLO 3: Problem Analysis		✓		✓
PLO 4: Design			✓	✓
PLO 5: Problem Solving			✓	
PLO 6: Implementation			✓	
PLO 7: Experiment and Analysis				✓
PLO 8: Community Engagement & Engg.				
PLO 9: Teamwork			✓	
PLO 10: Communication			✓	
PLO 11: Self-Motivated				
PLO 12: Ethics				

ENG-1107: Communicative English

Credits: 2, Hours/Week: 2

Speaking: How to ask questions, make requests and give instructions; How to respond to queries, invitations and statements; How to introduce and thank, express gratitude, regret or appreciation; How to communicate in particular everyday situations; How to express different concepts: ability, possibility, futurity, necessity, obligation, assumption, regularity, continuity, arrangement, comparison, etc.
Reading: Skimming, scanning and comprehend a paragraph and able to write summary from complex paragraphs. Select list of Heading and information matching from different passages.
Writing: Spelling, punctuation, indenting, brackets, abbreviation, numbers and fractions, capitalization, underlining, hyphenation, etc, Organization of writing- of different complex and compound sentences in paragraph, and of paragraphs, in essays and letters. Practical Writing**:** personal & official correspondence, job application, CV.
Vocabulary: Clues to the meaning of a word: Position in the clause, prefixes, suffixes, roots, revising and expanding vocabulary.
Grammar: Clause: structure, function, variation and expansion, The noun in the clause: number, determiners, The Pronoun in the clause: number, case, agreement and reference. The verb in the clause: form, tense, voice, mood, subject-verb agreement. The modifiers in the clause: adjective, adverb, infinitive, participles, The conjunctions and prepositions to suggest different relationships: time, space, cause, result, purpose, condition, exception, etc., Remedial grammar: Identifying and correcting errors and weaknesses.
Listening Comprehension/Movie show: Introducing audio visual materials and/or movies to develop listening skills.

Recommended Books:

1. **P.C. Das**, Applied English Grammar & Composition, 4ed, M. L. Dey & Co. (C Estd. 1868), 1997.
2. **Matthew M Monippally**, The Craft of Business Letter Writing, 1ed, Tata McGraw-Hill Publishing Company Limited, NEW DELHI, 1997.
3. **Yung-Yee Wu**, The Princeton Review GRE Verbal Workout, Random House, Inc.
4. **Angus Maciver**, The New First Aid in English, Revised edition, 1986.
5. **Mark Alan Stewart**, Arco Word Smart, Macmillan, USA, reprint 2002

Course Objectives

- The objective of this course is to develop students' skills and strategies for effective communication in English for a variety of business purposes and in various business contexts.
- Through a variety of task-based contextualized activities, students will interact with one another for effective business communication.

- In the learning process, students are encouraged to make use of different types of learning materials and of electronic tools, and apply their English knowledge and skills to the business environment

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. Identify the different formats and styles in English used for different business purposes and contexts.
CLO 2. Analyze and respond to different types of business texts.
CLO 3. Produce a wide variety of writing required in text genres for business communication.
CLO 4. Adopt skills in presentation, meeting and discussion, negotiation, and interview in a business context.
CLO 5. Grow the confidence to initiate an exchange and give a presentation in front of others in a business context.

Table 1.17: ENG1107 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	✓
PLO 2: Requirement Analysis		✓			
PLO 3: Problem Analysis		✓			
PLO 4: Design					
PLO 5: Problem Solving				✓	
PLO 6: Implementation			✓		
PLO 7: Experiment and Analysis		✓			
PLO 8: Community Engagement & Engg.					✓
PLO 9: Teamwork					✓
PLO 10: Communication			✓		✓
PLO 11: Self-Motivated					✓
PLO 12: Ethics			✓		

CSE 1108: Structured Programming Language

Credits: 3, Hours/Week: 3

Problem solving techniques: Problem Analysis, Algorithm, Flowchart, Debugging, Coding and Documentation.
Structured programming language: Overview of C, data types, variables, constants, operators, expressions, control structures; Functions and program structure: parameter passing conventions, scope rules and storage classes, recursion; Header files; Preprocessor; Pointers and arrays; Strings; Multidimensional array; User defined data types: structures, unions, enumerations; Input and Output: standard input and output, formatted input and output, file access; Variable length argument list; Command line parameters; Error Handling; Graphics; Linking; Library functions.

Recommended Books:

1. Kernighan and Ritchie : The C Programming Language
2. Gotfreid : Programming with C, Schaum's Outline Series, TMH
3. M. Keller : A first Course on Computer Programming using Pascal, McGraw-hill, 1987
4. D.E. Knuth : The Art of Computer Programming
5. H. Schieldt : The complete reference, Turbo C/C++
6. E. Balagurusamy : Programming with ANSI C

7. H. Schieldt : Teach yourself C
8. Cochan S G : Programming in C
9. Tondo & Gimped : C Answer book, 2nd Ed., PHE.
10. Balagurusamy E : Programming in ANSI C

Course Objectives

- To understand the complete knowledge of C programming.
- Students will be able to develop logics which will help them to create programs, applications in C. Also, by learning the basic programming constructs they can easily switch over to any other language in future.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. Know about different data types, operators and memory access techniques.
CLO 2. Reason about compile errors, common runtime errors and logical errors in given short code segments (1-10 lines)
CLO 3. Know about procedural coding and in-line coding, direction and indirection operators, call by value and call by reference.
CLO 4. Competence in using an industry-standard fully-featured modern IDE (e.g. Visual Studio, CodeBlocks) as a development tool.
CLO 5. Know how to analyze and solve a problem formally.

Table 1.18: CSE1108 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓		✓	
PLO 3: Problem Analysis	✓	✓			
PLO 4: Design			✓		
PLO 5: Problem Solving			✓	✓	✓
PLO 6: Implementation	✓	✓	✓		✓
PLO 7: Experiment and Analysis	✓	✓	✓	✓	✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓
PLO 10: Communication					
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

CSE 1109: Structured Programming Language LAB

Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE-1108

Course Objectives

- The course aims to provide exposure to problem-solving through programming.

- It aims to train the student to the basic concepts of the C-programming language.
- This course involves a lab component which is designed to give the student hands-on experience with the concepts.

Course Outcomes

Upon successful completion of this course, the student will be able to do the followings:

CLO 1. Makes students gain a broad perspective about the uses of computers in engineering industry.
CLO 2. Develops basic understanding of computer programming, the concepts of algorithm and algorithmic thinking.
CLO 3. Develops the ability to analyze a problem and solve it with algorithm.
CLO 4. Develops the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.
CLO 5. Able to solve programming contest problems.

Table 1.19: CSE1109 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓	✓			✓
PLO 2: Requirement Analysis	✓				
PLO 3: Problem Analysis	✓	✓	✓		✓
PLO 4: Design	✓		✓		
PLO 5: Problem Solving	✓	✓	✓		✓
PLO 6: Implementation		✓	✓	✓	✓
PLO 7: Experiment and Analysis		✓	✓	✓	✓
PLO 8: Community Engagement & Engg.				✓	
PLO 9: Teamwork				✓	✓
PLO 10: Communication					✓
PLO 11: Self-Motivated					✓
PLO 12: Ethics					✓

First Year Second Semester

CSE 1201: Data Structures

Credits: 3, Hours/Week: 3

Introduction: Basic Terminology, Elementary Data Organization, Data Structures, Algorithms, and Complexity of Algorithms
Arrays: Maximization, ordered lists, sparse matrices, representation of arrays.
Stacks, Queues and Recursion: Fundamentals of different types of stacks and queues: Circular, dequeues, etc; evaluation of expressions, multiple stacks and queues; Recursion: Direct and indirect recursion, depth of recursion; Simulation of Recursion: Removal of recursion; Towers of Hanoi.
Links Lists: singly linked lists, linked stacks and queues, the storage pool, polynomial addition, equivalence relations, sparse matrices, doubly linked lists and dynamic storage management, generalised lists, garbage collection and compaction.
Trees: Basic terminology, binary trees, binary tree representations, binary tree traversal; Extended binary trees: 2-trees, internal and external path lengths, Huffman codes/algorithms; threaded binary trees, binary tree representation of trees; Application of Trees: Set representation, decision trees, games trees: Counting binary trees.

Graphs: Introduction, definitions and terminology, graph representations, traversals, connected components and spanning trees, shortest path and transitive closure, activity networks, topological sort and critical paths, enumerating all paths.
Internal Sorting: Searching, bubble sort, shell sort, insertion sort, selection sort, quick sort, heap sort, 2-way merge sort, How fast can we sort? Sorting on several keys, practical considerations for internal sorting.

Recommended Books:

1. E. Horowitz and S. Sahni : Fundamentals of Data Structures, Galgotia, 1985.
2. Reingold : Data Structures.
3. Robert L. Kruse : Data Structures and Program Design, 3rd Edition.
4. Niklaus Wirth : Algorithms-Data Structures-Programs, Prentice Hall of India, 1992.
5. Lipshultz : Data Structures, Schaum's Outline Series, 1987.
6. E. Horowitz and S. Sahni : Computer Algorithms, Galgotia, 1985.
7. Goodman and Hedetnie : Introduction to Design and Analysis of Algorithms, McGraw-Hill, 1985
8. Taunenbaum, Langsam : Data Structure Using C

Course objective:

1) Basic understanding of memory allocation and manipulate data.
2) To emphasize of efficient of data structure and implementing algorithm.
3) To develop application using data structure.
4) To introduce various techniques for representation of the data in the real world.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO1. Understand of memory allocation for basic operation such as traversal, searching, insert and deletion etc. in computer using C/C++ programming language.
CLO2. Apply knowledge for arrays, link list, stack, queue, trees and graphs.
CLO3. Demonstrate different methods of traversing tree like binary tree traversal, extended binary tree traversal, decision tree, game tree.
CLO4. Implement different types of sorting.
CLO5. Analyze the efficiency of implementation choices on a group project work.

Table 1.21: CSE1201 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓			
PLO 4: Design			✓		
PLO 5: Problem Solving			✓	✓	✓
PLO 6: Implementation			✓	✓	✓
PLO 7: Experiment and Analysis				✓	✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork				✓	✓
PLO 10: Communication					✓
PLO 11: Self-Motivated					✓

PLO 12: Ethics					

CSE 1202: Data Structures LAB

Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE 1201.

Course objective:

1) Basic understanding of memory allocation and manipulate data.
2) To emphasize of efficient of data structure and implementing algorithm.
3) To develop application using data structure.
4) To introduce various techniques for representation of the data in the real world.

Course Intended Learning Outcomes *(CILOs)*

After studying this course, the student will able to:

CLO1. Understand of memory allocation for basic operation such as traversal, searching, insert and deletion etc. in computer using C/C++ programming language.

CLO2. Apply knowledge for arrays, link list, stack, queue, trees and graphs.

CLO3. Demonstrate different methods of traversing tree like binary tree traversal, extended binary tree traversal, decision tree, game tree.

CLO4. Implement different types sorting.

CLO5. Analyze the efficiency of implementation choices on a group project work.

Table 1.22: CSE1202 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓			
PLO 4: Design			✓		
PLO 5: Problem Solving			✓	✓	✓
PLO 6: Implementation			✓	✓	✓
PLO 7: Experiment and Analysis				✓	✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork				✓	✓
PLO 10: Communication					✓
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

CSE 1203: Analog Electronics

Credits: 3, Hours/Week: 3

Energy Bands in Solids: The nature of the Atom, Atomic energy levels, Valence and conduction bands, Conductors, Semiconductors and Insulators.

Semiconductor Diode and Rectifiers: Semiconductors' characteristics and their types, P-N Junction Diodes and their V-I Characteristics; Zener Diode, Ideal Rectifier Concept, P-N Junction Diode as a Rectifier; Half-wave and Full-wave Rectifiers; Rectifier Filters and Ripple Factor, Voltage Regulator Using Zener Diode, Clipper, Clamper.

Transistor: PNP and NPN Junction Transistors; CB, CE and CC Configurations and their V_c-I_c Characteristics; Transistor Action; Different Types and Biasing; Bias Stabilisation; Operating Point; DC and AC Load Lines; Dynamic Transfer Curve, Current, Voltage and Power Gains. Transistor as a Circuit Element, Transistor Hybrid Parameters.

Transistor Amplifiers: Transistor DC Amplifiers; CE, CB and CC Amplifiers, their Equivalent Circuits and Computation of Current, Voltage and Power Gains; Class A, Class B and Class C Amplifiers, class AB pushpull Amplifier.

Feedback Amplifiers: Feedback Principles and Characteristics; Current and Voltage Feedback Amplifiers; Positive and negative feedback.

Oscillators: Oscillators and Conditions for Sustained Oscillations; RC Phase Shift, Collpit and Crystal Oscillators.

MOS devices: Introduction to JFET, MOSFET, PMOS, NMOS & CMOS: biasing & application in switching circuits.

Recommended Books:

1.	A. Mottershead	:	Electronic Devices and Circuits
2.	Milman and Helkias	:	Integrated Electronics
3.	B. L. Theraja	:	Basic Electronics
4.	B. Grob	:	Basic Electronics
5.	V. K. Mehta	:	Principles of Electronics
6.	Illiot	:	Microelectronics Fabrication Technology
7.	Boylestad and Nashelsky	:	Network Lines and Fields
8.	B. L. Theraja	:	Basic Electricity and Magnetism
9.	Boylestad and Nshelsky	:	Electronic Devices and Circuit Theory
10.	Gupta and Kumar	:	Hand Book of Electronics

Course objectives:

1) To study basic fundamental of semiconductor diode and rectifiers.
2) To study different types of transistor.
3) Interpret Transistor amplifiers and feedback amplifiers.
4) To study oscillators and MOS device.

Course Intended Learning Outcomes *(CILOs)*

After studying this course, the student will able to:

CLO1. Ability to identify, formulate, research through relevant literature review, and solve engineering problem searching substantiated conclusions.

CLO2. Express that, a Zener diode is an inverse operating P-N junction type and explains its incorruption.

CLO3. Develop the ability to analyze and design analog electronic circuits using discrete component.

CLO4. Evaluate different types of transistor.

CLO5. Demonstrate practical skills in the construction and testing of simple electrical and electronic circuits.

Table 1.23: CSE1203 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓			
PLO 4: Design			✓		
PLO 5: Problem Solving			✓		✓
PLO 6: Implementation			✓	✓	✓
PLO 7: Experiment and Analysis				✓	✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓
PLO 10: Communication					
PLO 11: Self-Motivated				✓	✓
PLO 12: Ethics					

CSE 1204: Analog Electronics LAB

Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE 1203.

Course objectives:

1) To study basic fundamental of semiconductor diode and rectifiers.
2) To study different types of transistor.
3) Interpret Transistor amplifiers and feedback amplifiers.
4) To study oscillators and MOS device.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO1. Ability to identify, formulate, research through relevant literature review, and solve engineering problem searching substantiated conclusions.
CLO2. Express that, a Zener diode is an inverse operating P-N junction type and explains its incorruption.
CLO3. Develop the ability to analyze and design analog electronic circuits using discrete component.
CLO4. Evaluate different types of transistor.
CLO5. Demonstrate practical skills in the construction and testing of simple electrical and electronic circuits.

Table 1.24: CSE1204 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓			
PLO 4: Design			✓		
PLO 5: Problem Solving			✓		✓
PLO 6: Implementation			✓	✓	✓
PLO 7: Experiment and Analysis				✓	✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓
PLO 10: Communication					
PLO 11: Self-Motivated				✓	✓
PLO 12: Ethics					

PHY 1205: Physics

Credits: 2, Hours/Week: 2

Heat and Thermodynamics: Principle of temperature measurements: platinum resistance thermometer, thermo-electric thermometer, pyrometer; Kinetic theory of gases: Maxwell's distribution of molecular speeds, mean free path, equipartition of energy, Brownian motion, Van der Waal's equation of state, review of the First Law of thermodynamics and its application, reversible and irreversible processes, Second Law of thermodynamics.
Waves and Oscillations: Differential equation of a simple harmonic oscillator, total energy and average energy, combination of simple harmonic oscillations, Lissajous' figures, spring-mass system, calculation of time period of torsional pendulum, damped oscillation, determination of damping co-efficient, forced oscillation, resonance, two-body oscillations.
Physical Optics: Theories of light; Interference of light, Young's double slit experiment; Displacements of fringes and its uses; Fresnel Bi-prism, interference at wedge shaped films, Newton's rings, interferometers; Diffraction of light.
Electromagnetism: The Magnetic Field: Definition of B, Effect of magnetic force on current, Torque on a current Loop, Hall effect; Ampere's Law: B near a long wire, Magnetic lines of induction, Two parallel conductors, B for a solenoid, The Biot-Savart's Law.

Recommended Books:

1. **David Halliday, Robert Resnick**, Physics Part-II, Wiley Eastern Limited, 1992.
2. **D. K. Cheng**, Field and Wave Electromagnetics, Pearson Education, 2001.
3. **D. N. Vasudeva**, Fundamentals of Magnetism and Electricity, S. Chand and Company Limited, 1998.
4. **K. K. Tewari**, Electricity and Magnetism with Electronics, S. Chand and Company Limited, 1995.

Course objectives:

1) The fundamental knowledge of physics.
2) To study Heat and Thermodynamics.
3) To study the wave and oscillator.
4) To study physical optics.

5) To study Electromagnetism.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. Demonstrate conceptual understanding of fundamental physics principles.
CLO 2. Analyze wave and oscillator and apply real life.
CLO 3. Implement different types of experiment like young's double slit experiment, Newton's ring.
CLO 4. Evaluate different types of equations and solve problems.
CLO 5. Conduct independent research or work successfully in a technical position.

Table 1.25: PHY1205 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓		✓	
PLO 3: Problem Analysis	✓	✓		✓	
PLO 4: Design			✓		
PLO 5: Problem Solving			✓	✓	✓
PLO 6: Implementation			✓		✓
PLO 7: Experiment and Analysis					✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓
PLO 10: Communication					
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

MATH 1206: Differential Equations and Vector Analysis

Credits: 3, Hours/Week: 3

Ordinary Differential Equation (ODE): Degree and order of ordinary differential equations; Formation of differential equations; Solution of first order differential equations by various methods; Solution of first order but higher degree ordinary differential equations; Solution of general linear equations of second and higher orders with constant coefficients; Solution of homogeneous linear equations and its applications; Solution of differential equations of higher order when dependent and independent variables are absent; Solution of differential equation by the method based on factorization of operators.
Partial Differential Equations (PDE): Four rules for solving simultaneous equations of the form; Lagrange method of solving PDE of order one; Integral surfaces passing through a given curve; Nonlinear PDE of order one (complete, particular, singular and general integrals): standard forms $f(p, q) = 0$, $z = px + qy + f(p, q)$, $f(p, q, z) = 0$, $f_1(x, p) = f_2(y, q)$; Charpit method; Second order PDE: its nomenclature and classifications to canonical (standard)- parabolic, elliptic, hyperbolic; Solution by separation of variables. Linear PDE with constant coefficients.
Vector Spaces: Definition and properties, subspaces, basis and dimension, change of basis; Linear Transformation (LT): definition and properties, linear operator matrix, geometry of LT, standard plane LT.

Vector Algebra: Scalars and vectors, equality of vectors; Addition and subtraction of vectors; Multiplication of vectors by scalars; Scalar and vector product of two vectors and their geometrical interpretation; Triple products and multiple products; Linear dependence and independence of vectors.
Vector Calculus: Differentiation and integration of vectors together with elementary applications; Definition of line, surface and volume integrals; Gradient, divergence and curl of point functions, various formulae, Gauss theorem, Stoke theorem, Green theorem.

Recommended Books:

1. S L Ross : Introduction to Ordinary Diff. Equations
2. F Ayres : Differential Equations
3. B D Sharma : Differential Equations
4. M.D. Raisingha Mia : Ordinary and Partial Differential Equations

Course objectives

1) Evaluate first order differential equations including separable, homogeneous, exact, and linear.
2) Create and analyze mathematical models using first order differential equations to solve application problems such as circuits, mixture problems, population modeling, orthogonal trajectories, and slope fields
3) Solve second order and higher order linear differential equations.
4) To study the matrices calculation.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. Find general solutions to first-order, second-order, and higher-order homogeneous and nonhomogeneous differential equations by manual and technology-based methods.
CLO 2. Identify, analysis and subsequently solve physical situations whose behavior can be described by ordinary differential equations.
CLO 3. Determine solutions to second order linear homogeneous differential equations with constant coefficients.
CLO 4. Evaluate different types of method of partial differential equation.
CLO 5. Different types of matrices calculation.

Table 1.26: MATH1206 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓		✓	
PLO 4: Design			✓		
PLO 5: Problem Solving			✓		✓
PLO 6: Implementation			✓	✓	✓
PLO 7: Experiment and Analysis					✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓

PLO 10: Communication					
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

ACCT 1207: Financial and Managerial Accounting

Credits: 2, Hours/Week: 2

Financial Accounting: Objectives and importance of accounting; Accounting as an information system; computerized system and applications in accounting; Recording system: double entry mechanism; Accounts and their classification; Accounting equation; Accounting cycle: journal, ledger, trial balance; Preparation of financial statements considering adjusting and closing entries; Accounting concepts (principles) and conventions. Financial statement analysis and interpretation: ratio analysis. Long-term investment decisions: capital budgeting, various techniques of evaluation of capital investments.
Management Accounting: Cost concepts and classification; Overhead cost: meaning and classification; Distribution of overhead cost; Overhead recovery method/rate; Job order costing: preparation of job cost sheet and quotation price; Inventory valuation: absorption costing and marginal/variable costing technique; Cost-Volume-Profit analysis: meaning, breakeven analysis, contribution margin approach, sensitivity analysis.
Short-term investment decisions: relevant and differential cost analysis.

Recommended Books:

1. **J. J. Weygandt, D. E. Kieso**, Principles of accounting 8th ed. 2006.
2. **H. Chakrabarty**, Advanced accounting.
3. **R.E. Ross Claudia, B Gilbertson, Mark W. Lehman, O.D. Manson**, Fundamentals of Accounting of Course 7th Ed.
4. **Narayanaswamy**, Financial Accounting for Business Managers. 3rd Ed. PHI
5. **Kieso and Kimmel**, Basic Accounting.
6. **Md. Hafiz Uddin**, Basic Accounting.

Course Objectives

- Demonstrate an appropriate mastery of the knowledge, skills and tools of financial accounting principles and managerial accounting principles.
- Demonstrate an appropriate mastery of the knowledge, skills and tools of cost accounting.
- Demonstrate an appropriate mastery of the knowledge, skills and tools of intermediate and advanced financial accounting topics.
- Demonstrate an appropriate mastery of the knowledge, skills and tools of auditing and systems.
- Demonstrate an appropriate mastery of the knowledge, skills and tools of federal income taxation

Course Intended Learning Outcomes *(CILOs)*
Upon completion of the course, students should be able to:

CLO 1. Develop competency in the functional areas of accounting.
CLO 2. Identify and evaluate accounting problems and arrive at reasoned conclusions.
CLO 3. Utilize financial and other authoritative databases and effectively present findings in written format.
CLO 4. Recognize and respond appropriately to professional, ethical, and regulatory issues in accounting.

Table 1.27: ACCT1207 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4
PLO 1: Knowledge	✓	✓		
PLO 2: Requirement Analysis				
PLO 3: Problem Analysis				

PLO 4: Design				
PLO 5: Problem Solving		✓		
PLO 6: Implementation		✓		
PLO 7: Experiment and Analysis				
PLO 8: Community Engagement & Engg.				
PLO 9: Teamwork				
PLO 10: Communication			✓	
PLO 11: Self-Motivated				
PLO 12: Ethics				✓

STAT 1208: Probability and Statistics

Credits: 2, Hours/Week: 2

Introduction: Definition and characteristic features of the science of statistics, Main divisions of statistical theory.

Frequency Distribution and Measures of Location: Frequency distributions, Graphical Representation of Frequency distributions, Forms of Frequency Curves, Caparison of frequency distribution, Measures of Location or Measures of central tendency, Requisites for an ideal measure of central tendency.

Measures of Dispersions, Skewness & Kurtosis, Moment of Frequency distribution: Measures of dispersion, characteristics of an ideal measure of dispersion, moments, Sheppard's corrections to moments of grouped frequency distributions, symmetrical and skewness, kurtosis, Pearson's β-and γ -coefficients, Factorial and absolute moments.

Theory of Probability: Random experiments, Sample Space, Events, Algebra of events, Types of events, Mathematical and statistical definition of probability, Theorem of total probability, its generalization and geometrical interpretation, Boole's inequality; Theorem of compound probability; Conditional Probability, Independence of events, Bayes theorem.

Random Variables: Discrete random variable; Probability mass function and distribution function; Mathematical expectation; Covariance; Conditional expectation, Conditional variance, Moments generating function, Cumulants.

Discrete Probability Distributions: Binomial distributions, First four moments of the binomial distribution, Moment generating and cumulative functions of the binomial distribution, Poisson distribution, Derivation of Poisson distribution from Binomial distribution, Moment generating and cumulative functions of the Poisson distribution Mean and variance of the Poisson distribution, Mode of the Poisson distribution, Negative Binomial distribution.

Recommended Books:

1. **Kapur, J. N. and Saxena, H. C.,** Mathematical Statistics
2. **Weatherburn, C. E.,** A First Course in Mathematical Statistics
3. **Marek Fisz,** Probability and Mathematical Statistics
4. **Gupta, S. C. and Kapoor V. K.,** Fundamentals of mathematical Statistics
5. **Manindra Kumar Roy,** Fundamentals of Probability & Probability Distributions

Course objectives

1) Basic knowledge of statistics.
2) To cultivate statistical thinking among students.
3) To understand measures of dispersions, skewness and kurtosis.
4) To develop skill in handling complex problem.
5) To study of probability,

Course Intended Learning Outcomes *(CILOs)*

After studying this course, the student will able to:

CLO 1. Review the fundamental concept of a statistics.

CLO 2. Compute and interpret empirical and theoretical probabilities and explain the role of probability in statistics.
CLO 3. To solve correlation and regression problems.
CLO 4. Difference between discrete probability distribution and continuous probability distribution.

Table 1.28: STAT 1208 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4
PLO 1: Knowledge	✓			✓
PLO 2: Requirement Analysis	✓	✓		
PLO 3: Problem Analysis	✓	✓		✓
PLO 4: Design			✓	
PLO 5: Problem Solving			✓	✓
PLO 6: Implementation			✓	
PLO 7: Experiment and Analysis				
PLO 8: Community Engagement & Engg.				
PLO 9: Teamwork				
PLO 10: Communication				
PLO 11: Self-Motivated				
PLO 12: Ethics				

ECO 1209: Economics

Credits: 2, Hours/Week: 2

Definition of Economics; Economics and engineering; Principles of economics.
Micro-Economics: Introduction to various economic systems capitalist, command and mixed economy; Fundamental economic problems and the mechanism through which these problems are solved; Theory of demand and supply and their elasticities; Theory of consumer behavior; Cardinal and ordinal approaches of utility analysis; Price determination; Nature of an economic theory; Applicability of economic theories to the problems of developing countries; Indifference curve techniques; Theory of production, production function, types of productivity; Rational region of production of an engineering firm; Concepts of market and market structure; Cost analysis and cost function; Small scale production and large scale production; Optimization; Theory of distribution; Use of derivative in economics: maximization and minimization of economic functions, relationship among total, marginal and average concepts.
Macro-Economics: Savings; investment, employment; National income analysis; Inflation; Monetary policy; Fiscal policy and trade policy with reference to Bangladesh; Economics of development and planning.

Recommended Books:

1. **Case & Fair;** Principles of Economics, Pearson – Prentice Hall, Seventh or 8th Edition.
2. **William Boys & M Melvin,** Fundamentals of Economics, 2005.
3. **D. Salvatore,** Introduction to Intern. Economics, 2008.

Course Objectives

- The course offers two core classes – Introductory Macroeconomics and Introductory Microeconomics. Along with acquiring content knowledge, students in each course will practice critical thinking skills, communication skills, quantitative reasoning, and economic citizenry.

Course Intended Learning Outcomes *(CILOs)*
Upon completion of the course, students should be able to:

CLO 1. Explain the concepts of opportunity cost, trade-offs, and the benefits of exchange.
CLO 2. Demonstrate knowledge of the laws of supply and demand and equilibrium; and apply the supply and demand model to analyze responses of markets to external events.
CLO 3. Explain the concepts of gross domestic product, inflation and unemployment, and how they are measured.
CLO 4. Explain the circular flow model and use the concepts of aggregate demand and aggregate supply to analyze the response of the economy to disturbances.
CLO 5. Identify the causes of prosperity, growth, and economic change over time and explain the mechanisms through which these causes operate in the economy.

Table 1.29: ECO 1209 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓		✓	✓	
PLO 2: Requirement Analysis		✓	✓	✓	✓
PLO 3: Problem Analysis		✓	✓	✓	✓
PLO 4: Design		✓			
PLO 5: Problem Solving					
PLO 6: Implementation					
PLO 7: Experiment and Analysis					✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					
PLO 10: Communication					
PLO 11: Self-Motivated					
PLO 12: Ethics					

Viva-voce

Credits: 1.0

At the end of first year final examinations, interview in front of the board of examiners based on the courses of the corresponding year.

Second Year First Semester

CSE 2101: Algorithm Analysis and Design

Credits: 3, Hours/Week: 3

Introduction to Algorithm and Mathematical Induction: Introductory concepts and definitions related to algorithms, notation for describing algorithms, introduction to mathematical induction, examples, counting regions in the plane, simple colouring problem, simple inequality, Euler's formula, finding edge-disjoint paths in a graph, Arithmetic versus geometric means, loop invariant etc.

Analysis of Algorithms' Complexity and Design of Algorithms by Induction: The O notation, time and space complexity, recurrence relations: intelligent guesses, divide and conquer relations, recurrence relation with full history, design by induction: evaluation polynomials, maximal induced subgraph. finding one-to-one mappings, the Celebrity Problem, The skyline problem, computing balance factors in binary trees, finding the maximum consecutive subsequence, strengthening the induction hypothesis, dynamic programming: the Knapsack problem, etc.

Algorithms Involving Sequences and Sets: introduction, Binary search and variations, Interpolation search, sorting: Bucket sort, Radix sort, Insertion sort, Selection sort, Merge sort, Quicksort, Heapsort, order statistics, data compression, string matching, sequence comparisons, probabilistic algorithms, finding a majority, etc.

Graph and Geometric Algorithms: introduction, Eulerian graphs, graph traversals: Depth-First Search, Breadth-First Search, Topological Sorting, minimum-cost Spanning trees, network flows, Hamiltonian tours, decomposition of graphs, construction polynomials, convex hulls, closest pair, intersection of horizontal and vertical line segments, etc.

Reductions and NP-Completeness: introduction, examples of reductions, reductions involving linear programming, reductions for lower bounds, polynomial-time reductions, nondeterminism and Cook's Theorem, examples of NP-completeness Proofs, techniques for dealing with NP-complete problems, etc.

Parallel Algorithms: introduction, models of parallel computation, algorithms for shared-memory machines, algorithms for interconnected networks, systolic computation, etc.

Recommended Books:

1.	D. E. Knuth	:	The Art of Computer Programming, Vol. 1, Fundamental Algorithms.
2.	D. E. Knuth	:	The Art of Computer Programming, Vol. 2, Seminumerical Algorithms.
3.	D. E. Knuth	:	The Art of Computer Programming, Vol. 3, Sorting and Searching.
4.	Goodman	:	Introduction to Design and Analysis of Algorithms.
5.	Robert Sedgewick	:	Algorithms.
6.	E. Horowitz and S. Sahni	:	Fundamentals of Computer Algorithms.
7.	Thomas H. Kormen	:	Introduction to Algorithms
8.	Horowitz and Shahny	:	Analysis of Algorithms
9.	Udi Manber	:	Introduction to Algorithms: A Creative Approach (Hardcover), Addison Wesley (January 1, 1989).
10.	Leendert Ammeraal	:	Algorithms and Data Structures in C++, Wiley.
11.	T.H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein	:	Introduction to Algorithms, 2nd edition, McGraw-Hill, New York, 2001.
12.	M.R. Garey and D.S. Johnson	:	Computers and Intractability: A Guide to the Theory of NP-Completeness, W.H. Freeman, San Francisco, CA, 1979.
13.	Anany V. Levitin	:	Introduction to the Design and Analysis of Algorithms *(Paperback)*, Addison Wesley; 1st edition (October 30, 2002).
14.	Timothy Budd	:	Data Structures in C++: Using the Standard Template Library *(STL)*, Addison Wesley.

Course Objectives

The main goal of this course is to study the fundamental techniques to design efficient algorithms and analyze their running time. After a brief review of prerequisite material (search, sorting, asymptotic notation), we will discuss efficient algorithms for basic graph problems and solving various problems through divide and conquer algorithms, dynamic programming and greedy algorithms. We will consider also randomized algorithms, proofs of NP-completeness, approximation algorithms, partial recursive functions, and proofs of undecidable problems.

Course Intended Learning Outcomes (CILOs)

CLO1 Ability to apply knowledge of Computing and Mathematics appropriate to the discipline.
Students will be able to:
1. Use mathematical induction to prove asymptotic bounds for time complexity.
2. Prove the correctness of algorithms using loop invariants or more general types of proofs.
3. Use asymptotic notation to formulate the time and space requirements of algorithms.
4. Prove the tight asymptotic lower bound for the running time of any comparison-based sorting algorithm.
5. Prove that a problem is P, NP, or NP-Complete.

CLO2 Ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.
Students will be able to:
1. Use the Master Theorem to analyze the asymptotic time complexity of divide and conquer algorithms.
2. Use the theory of NP-completeness to determine whether a computational problem can be solved efficiently.

CLO3 Ability to design, implements, and evaluate a computer-based system, process, component or program to meet desired needs.
Students will be able to:
1. Design, implement, and test an efficient algorithmic solution for a given computational problem.

CLO4 Ability to use current techniques, skills, and tools necessary for computing practices.
Students will be able to:
1. Apply the divide-and-conquer, greedy, and dynamic programming techniques to the design and analysis of algorithms.

CLO5 Ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design choices.

Students will be able to:
1. Comparatively evaluate sorting algorithms.
2. Apply algorithmic principles to determine whether a given a set of requirements for a computational problem can be met.
3. Compare the implementation choices of specific data types, such as priority queues or graphs, and justify which is the most appropriate one for a given application.
4. Produce an algorithmic approach that meets a given a set of requirements for a computer based system

Table 2.11: CSE2201 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓		✓	
PLO 4: Design			✓		
PLO 5: Problem Solving			✓	✓	✓
PLO 6: Implementation			✓	✓	✓

PLO 7: Experiment and Analysis					✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓
PLO 10: Communication					
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

CSE 2102: Algorithm Analysis and Design LAB

Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE-2101

Course Objectives:

To understand the basic foundation of Algorithm and its application areas; Complexity analysis of Algorithm; Fundamentals of Divide & Conquer method, implementation of merge sort, quick sort in programming; Fundamentals of Greedy algorithm, implementation of Huffman codes, Knapsack problem in programming; Traversal techniques, Implementation of BFS, DFS, Prims, Kruskal algorithm in programming; Implementation of Dijkstra's algorithm, and Bellman-Ford algorithm in programming.

Course Intended Learning Outcomes (CILOs): Upon successful completion of this course a student will be able to:

CO1 Understand and explain the basic design principles for algorithms,
CO2 Learn the basic concepts of algorithms with solid foundations,
CO3 Apply a substantial number of basic algorithms by problem solving,
CO4 Know the tools for implementing algorithms in programming languages and use them to analyze complex problems,
CO5 Select and design algorithms which are appropriate for problems that they might encounter.

Table 2.12: CSE2102 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓		✓	
PLO 4: Design			✓		
PLO 5: Problem Solving			✓	✓	✓
PLO 6: Implementation			✓	✓	✓
PLO 7: Experiment and Analysis					✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓
PLO 10: Communication					
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

CSE 2103: Object-Oriented Programming Language

Credits: 3, Hours/Week: 3

Introduction to object oriented programming (OOP); Advantages of OOP over structured programming; C++ as an object oriented language; Declaration and constants, expression and statements, data types, operator, Functions; Classes: Base, Derived, virtual class; Encapsulation, objects, access specifiers, static and non-static members; Constructors, destructors and copy constructors; Array of objects, object pointers, and object references; Inheritance: single and multiple inheritance; Polymorphism: overloading, abstract classes, virtual functions and overriding; Exceptions; Object Oriented I/O; Template functions and classes; Streams, titles, C++ binary functions, exception handling, Multi-threaded Programming.

Recommended Books:

1. H. Schidt : Teach yourself C++
2. Schildt, H : Turbo C/C++: The Complete Reference
3. N. Barkakati : Object Oriented Programming with C++
4. Balagurusamy, E : Object Oriented Programming with C++
5. B. Stroustrap : The C++ programming Language, 2nd ed.
6. D. Ravichandran : Programming with C++

Course Objective:

1. Covers theoretical and practical issues related to the techniques of Object-Oriented programming.
2. Provide the necessary knowledge on the programming of computer and Internet systems using object-oriented programming language.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will be able to:

CLO 1. Perform object-oriented programming to develop solutions to problems, demonstrating usage of control structures, modularity, I/O and other standard language constructs.
CLO 2. Develop solutions to problems by demonstrating usage of data abstraction, encapsulation, and inheritance.
CLO 3. Use the basic object-oriented design principles in computer problem solving.
CLO 4. Analyze and understand the functionality of program code written in an object-oriented language such as C++ or Java.
CLO 5. To learn the basic principles of object-oriented design and software engineering in terms of software reuse and managing complexity.
CLO 6. Work independently or collaborate within a team to develop software applications and services

Table 2.13: CSE 2103 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
PLO 1: Knowledge	✓			✓		
PLO 2: Requirement Analysis						
PLO 3: Problem Analysis		✓	✓			
PLO 4: Design		✓		✓		
PLO 5: Problem Solving		✓	✓			
PLO 6: Implementation		✓	✓	✓		
PLO 7: Experiment and Analysis			✓	✓	✓	
PLO 8: Community Engagement & Engg.						
PLO 9: Teamwork						✓
PLO 10: Communication						✓

PLO 11: Self-Motivated					✓	✓
PLO 12: Ethics						

CSE 2104: Object-Oriented Programming Language LAB

Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE 2103

Course Objective:

Developing real world applications/software using object-oriented programming knowledge.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will be able to:

CLO 1. Perform object-oriented programming to develop solutions to problems, demonstrating usage of control structures, modularity, I/O and other standard language constructs.
CLO 2. Develop solutions to problems by demonstrating usage of data abstraction, encapsulation, and inheritance.
CLO 3. Use the basic object-oriented design principles in computer problem solving.
CLO 4. Analyze and understand the functionality of program code written in an object-oriented language such as C++ or Java.
CLO 5. To learn the basic principles of object-oriented design and software engineering in terms of software reuse and managing complexity.
CLO 6. Work independently or collaborate within a team to develop software applications and services

Table 2.14: CSE 2104 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
PLO 1: Knowledge	✓			✓		
PLO 2: Requirement Analysis						
PLO 3: Problem Analysis		✓	✓			
PLO 4: Design		✓		✓		
PLO 5: Problem Solving		✓	✓			
PLO 6: Implementation		✓	✓	✓		
PLO 7: Experiment and Analysis			✓	✓	✓	
PLO 8: Community Engagement & Engg.						
PLO 9: Teamwork						✓
PLO 10: Communication						✓
PLO 11: Self-Motivated					✓	✓
PLO 12: Ethics						

CSE 2105: Digital Logic Design

Credits: 3, Hours/Week: 3

Fundamentals of Digital Logic System: Number Systems and Codes, Logic Gates and Boolean Algebra, Logic Circuit Design, Minimization Techniques: Algebraic Simplification, Karnaugh Map Method, Quine-McCluskey method, Consensus method.
Switching Devices: Switching concepts of Diodes, Transistors and FETs.
Integrated Circuit Logic Families: DTL & TTL logic family, standard TTL series characteristics, other TTL series, TTL loading rules, TTL open-collector outputs, tristate TTL. The ECL family. Digital MOSFET circuits, characteristics, CMOS circuits, CMOS tristate logic, TTL driving CMOS, CMOS driving TTL.
Flip-Flops and related Devices: Transistor Latch, NAND gate latch, NOR gate latch, D latch. Clock signals and Clocked F.Fs: Clocked S-C, J-K and D Flip-Flops. F.F timing considerations, Master/Slave F.Fs. F.F T-F.F. applications, Frequency division and counting. Schmitt Trigger devices, Monostable and Astable Multivibrators.
SSI Logic Circuits: BCD to decimal decoders, BCD to 7 segment decoder/drivers. Encoders, Multiplexers and their applications. Demultiplexers. Trouble shooting case studies.
Introduction to sequential circuits: formal representation of sequential circuits, Moore and Mealy models, analysis and synthesis of synchronous and asynchronous sequential circuits. Counters and Registers: Asynchronous (Ripple) up and down counters, Synchronous up and down Counters. Counters with MOD number $<2^N$. Propagation delay in Ripple counters. Presettable counters. The 74193 counters. Counter applications. Shift registers. IC shift-registers, shift-register counters.
Conversion: Analog to digital conversion, digital ramp, successive approximation, flash and tristate ADC. digital to analog conversion: circuits, specifications, applications, Sample and hold circuits. Analog multiplexers. Data acquisition, digital voltmeter.

Recommended Books:

1. R.J. Tocci : Digital Systems, 5th edition, PHI
2. D.V. Hall : Digital Circuits and Systems, McGraw-Hill, 1989
3. F.P. Prosser and D.E. Einkel : The Art of Digital Design, Prentice-Hall
4. V. K. Jain : Switching Theory and Digital Electronics
5. Moris Manno : Digital Logic and Computer Design
6. Malvino & Leach : Digital Principles and Applications
7. Jain R.P. : Modern Digital Electronics

Course Objective:

Understand the principles and methodology of digital logic design at the gate and switch level, including both combinational and sequential logic elements.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will be able to:

CLO 1. Understand the principles and methodology of digital logic design at the gate and switch level, including both combinational and sequential logic elements.
CLO 2. Understand clocking methodologies used to control the flow of information and manage circuit state.
CLO 3. Design and build practical digital logic circuits and apply it to solve real life problems.
CLO 4. Design, describe and explain the operation of fundamental digital gates.
CLO 5. Analyze, design and implement sequential logic circuits.
CLO 6. Analyze and design the operation of medium complexity standard combinational circuits like the encoder, decoder, multiplexer, de-multiplexer, full-adder, half adder, flip-flop and examine relevant timing diagrams.
CLO 7. Build and analyze the operation of counters and shift registers.
CLO 8. Understand the basic software tools for the design and implementation of digital circuits and systems

Table 2.15: CSE 2105 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO7	CO8
PLO 1: Knowledge	✓							
PLO 2: Requirement Analysis	✓	✓					✓	
PLO 3: Problem Analysis			✓	✓	✓			
PLO 4: Design	✓	✓						
PLO 5: Problem Solving							✓	✓
PLO 6: Implementation	✓					✓		
PLO 7: Experiment and Analysis		✓					✓	
PLO 8: Community Engagement & Engg.								✓
PLO 9: Teamwork								
PLO 10: Communication								
PLO 11: Self-Motivated								
PLO 12: Ethics								

CSE 2106: Digital Logic Design LAB

Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE 2105

Course Objective:

1. Learn the design process of modeling, simulation and synthesis of simple digital designs.
2. Learning the implementation tools of digital logic gate.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will be able to:

CLO 1. Design and build practical digital logic circuits and apply it to solve real life problems.
CLO 2. Design, describe and explain the operation of fundamental digital gates.
CLO 3. Analyze, design and implement sequential logic circuits.
CLO 4. Analyze and design the operation of medium complexity standard combinational circuits like the encoder, decoder, multiplexer, de-multiplexer, full-adder and half adder.
CLO 5. Analyze and identify the operation of a flip-flop and examine relevant timing diagrams.
CLO 6. Build and analyze the operation of counters and shift registers.
CLO 7. Understand the basic software tools for the design and implementation of digital circuits and systems.
CLO 8. Simulate and implement combinational and sequential circuits using VHDL systems.

Table 2.16: CSE 2106 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO7	CO8
PLO 1: Knowledge	✓							
PLO 2: Requirement Analysis	✓	✓					✓	
PLO 3: Problem Analysis			✓	✓	✓			
PLO 4: Design	✓	✓						
PLO 5: Problem Solving							✓	✓
PLO 6: Implementation	✓					✓		
PLO 7: Experiment and Analysis		✓					✓	
PLO 8: Community Engagement & Engg.								✓
PLO 9: Teamwork								
PLO 10: Communication								
PLO 11: Self-Motivated								

PLO 12: Ethics								

LAW 2107: Cyber Law and Engineering Ethics

Credits: 2, Hours/Week: 2

Cyber laws and rights in today's digital age; IT Act, Intellectual Property Issues connected with use and management of Digital Data The similar Acts of other countries Information Warfare: Nature of information warfare, including computer crime and information terrorism; Threats to information resources, including military and economic espionage, communications eavesdropping, computer break-ins, denial-of-service, destruction and modification of data, distortion and fabrication of information, forgery, control and disruption of information How, electronic bombs, and sops and perception management. Countermeasures, including authentication, encryption, auditing, monitoring, intrusion election, and firewalls, and the limitations of those countermeasures. Cyberspace law and law enforcement, information warfare and the military, and intelligence in the information age. Information warfare policy and ethical Issues.

Privacy, Security, Cybercrime, Intellectual Property, Commerce and Free Speech, The Digital Divide, Digital Identity and Digital Communities, Our Dependence on Cyber technology.

Recommended Books:

1. Jeff Koseff : Cybersecurity Law
2. Hon C Graff : Cryptography and E-Commerce - A Wiley Tech Brief, Wiley Computer Publisher, 2001
3. Michael Cross, Norris L Johnson, Tony Piltzecker, : Security
4. Bangladesh Gazette : Digital Security Act 2018

Course Objectives

Ethics in Information Technology is designed to educate existing and future business managers and IT professionals on the tremendous impact ethical issues play in the use of information technology in the modern business world. The topics covered in this course are extremely current and relevant to anyone preparing to enter the field of IT. The course will give students the foundation they need to make appropriate decisions when faced with difficult situations and make a positive impact in the field of information technology.

Course Intended Learning Outcomes (CILOs):

CLO 1. Students will be aware of intellectual property rights, including: copyrights and patents.
CLO 2. Students will understand issues associated with privacy.
CLO 3. Students will be aware of methods and tools of analysis (ethical frameworks): Identify and evaluate ethical choices.
CLO 4. Students will understand professional and ethical responsibilities, including those defined in the ACM/IEEE Professional Code of Ethics.
CLO 5. Students will understand the emerging issues related to ethics in cyberspace.

Table 2.17: LAW 2107 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓	✓	✓	✓	✓
PLO 2: Requirement Analysis	✓				
PLO 3: Problem Analysis	✓	✓	✓	✓	✓
PLO 4: Design					
PLO 5: Problem Solving		✓		✓	

PLO 6: Implementation	✓				
PLO 7: Experiment and Analysis				✓	✓
PLO 8: Community Engagement & Engg.		✓		✓	✓
PLO 9: Teamwork				✓	✓
PLO 10: Communication		✓		✓	
PLO 11: Self-Motivated					
PLO 12: Ethics		✓	✓	✓	✓

MATH 2108: Algebra, Trigonometry and Vector Analysis

Credits: 3, Hours/Week: 3

Elements of Set Theory: Introduction to sets. Set Algebra. Types of sets: Finite, infinite, countable and uncountable sets. Relations and Functions.
Theory of equations: Relation between roots and coefficients. De Carte's rule of sign. Solution of cubic and biquardratic equations. Symmetric functions of the roots.
Trigonometry: Complex number. De-Moiver's Theorem and it applications. Functions of complex arguments. Gregory's series. Summation of trigonometric series. Hyperbolic functions.
Vector Space: Definition and properties, subspaces, basis and dimension, change of basis; Linear Transformation (LT): definition and properties, linear operator matrix, geometry of LT, standard plane LT.
Vector Algebra: Scalars and vectors, equality of vectors; Addition and subtraction of vectors; Multiplication of vectors by scalars; Scalar and vector product of two vectors and their geometrical interpretations; Triple product and multiple products; Linear dependence and independence of vectors.
Vector Calculus: Differentiation and Integration of vectors together with elementary applications; Definition of line, surface and volume integrals; Gradient, divergence and curl of point functions, various formulae, Gauss theorem, Stoke theorem, Green theorem.

Recommended Books:

1. F Ayres : Theory and problems of Matrices
2. McDuffe : Theory of Matrices
3. M L Khanna : Matrices
4. Shahidullah and Bhattacharjee : Higher Algebra and Trigonometry
5. Bernard and Child : Higher Algebra
6. Hall and Knight : Higher Trigonometry
7. Das and Mukherjee : Higher Trigonometry

Course Objective:

Apply mathematical methods involving algebra, trigonometry, and vector analysis to represent mathematical information, interpret and analyze of numerical data and mathematical concepts, and identify patterns to formulate and validate reasoning and solve problems.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. Apply the principles of analytical geometry and vector analysis to determine the equations of the straight lines and planes in three dimensional spaces.
CLO 2. Critically analyze and construct mathematical arguments that relate to the study of introductory linear algebra.
CLO 3. Use technology, where appropriate, to enhance and facilitate mathematical understanding, as well as an aid in solving problems and presenting solutions.
CLO 4. Verify and apply trigonometric identities and solve trigonometric equations numerically, graphically, and algebraically
CLO 5. Demonstrate an understanding of vectors, their graphical representation and vector algebra.

CLO 6. Apply the principles of vector space, vector algebra and vector calculus to solve a variety of basic problems in engineering and applied science.

Table 2.18: MATH 2108 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
PLO 1: Knowledge	✓					
PLO 2: Requirement Analysis					✓	
PLO 3: Problem Analysis		✓				✓
PLO 4: Design				✓	✓	
PLO 5: Problem Solving			✓		✓	✓
PLO 6: Implementation		✓				✓
PLO 7: Experiment and Analysis		✓		✓		
PLO 8: Community Engagement & Engg.						
PLO 9: Teamwork						
PLO 10: Communication						
PLO 11: Self-Motivated						
PLO 12: Ethics						

BDS 2109: Liberation War and Bangladesh Studies

Credits: 2, Hours/Week: 2

Location, Geomorphic Characteristics of Bangladesh: The setting, climate, river system, physiographic division, forest, natural disaster;
Settlements and Growth of Bengal: Origin of the name – "Bangla", ancient Bengal (750 – 1203 A.D), medieval Bengal (1204 – 1757 A.D), modern Bengal (1757 – present);
Liberation War of Bangladesh: Nationalism, background of liberation war and emergence;
Bangladesh Society: Characteristics, culture, factors and forces of change, ethnic groups;
Politics of Bangladesh: Political culture, political parties and their role;
Economy of Bangladesh: Major economic sectors, government's strategy;
Bangladesh: Constitution, organs of government, government structure (central government, local government);
E-Governance and Bangladesh: Concept and components, implications, prerequisites.

Recommended Books:

1. **A F Salahuddin Ahmed and Bazlul Mobin Chowdhury**, Bangladesh National Culture and Heritage.
2. **Sirajul Islam**, History of Bangladesh.
3. **Kazi S. M. Khasrul Alam Quddusi**, E-governance: Interpretations, Implications & Imperatives.
4. **Salimul & Atiq Rahman**, Environmental Profile of Bangladesh.

Course Objectives: The objectives of this course are:

- Introduce students with rich history, culture and heritage of Bangladesh.
- To providing them in-depth knowledge on the major political events that shaped Bangladesh as an independent sovereign state.
- Improve their understanding on political, economic and social development of Bangladesh.
- Help them think critically and comprehensively about foreign policy of Bangladesh, its relationship with other countries and its important roles in the international organizations like UN, Commonwealth and SAARC etc.
- Increase understanding on the challenges and potentials of Bangladesh in shaping its peaceful and sustainable future.

Course Intended Learning Outcomes (CILOs):

By the end of the course, students should be able to

CO1 Identify specific stages of Bangladesh's political history, through the ancient, medieval, colonial and post-colonial periods and critically analyse plurality of cultural identities of Bangladesh.

CO2 Critically analyse and present cogent argument on why tensions and contestations between and among social groups may emerge within and among states both in written and oral form.

CO3 Critically analyse how different constitutional bodies and socio-political institutions operate and how their behavior impact on political governance.

CO4 Explain the economy and patterns of economic changes through qualitative and quantitative analysis. This will increase their awareness on global issues of development processes and the nature of environmental challenges including ways to address them effectively.

Table 2.19: BDS 2109 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4
PLO 1: Knowledge	✓			✓
PLO 2: Requirement Analysis	✓	✓		
PLO 3: Problem Analysis	✓	✓		
PLO 4: Design			✓	
PLO 5: Problem Solving			✓	
PLO 6: Implementation			✓	
PLO 7: Experiment and Analysis				
PLO 8: Community Engagement & Engg.				
PLO 9: Teamwork				
PLO 10: Communication				
PLO 11: Self-Motivated				
PLO 12: Ethics				

Second Year Second Semester

CSE 2201: Database Management System

Credits: 3, Hours/Week: 3

Introduction to database system: Overview, File system VS database system, Advantage of a DBMS, Describing and storing in a DBMS, Queries in a DBMS, Transaction management, Structure of a DBMS, Applications.
The Entity-Relationship model: Basic concept, Design issue, Mapping constraints, Keys, E-R diagram, Weak entity sets, Extended E-R features, Design of an E-R database schema, Reduction of a E-R schema to tables.
Relational model: Structure of relational databases, The relational algebra, The tuple relational calculus, the domain relational calculus, relational algebra operations, modification of the database, introduction to views.
Structured Query Language: The form of a basic SQL query, UNION, INTERSECTION and EXCEPT, nested queries, aggregate operations, null values, embedded SQL, cursors, dynamic SQL, ODBC and JDBC, triggers and active database.
Relational database design: Pitfalls in relational database design, Decomposition, normalization using functional dependencies, normalization using multivalued dependencies, normalization using join dependencies, domain-key normal form.
Object oriented and object relational databases: The object-oriented data model, nested relations, complex types and object orientation, querying with complex types, creation of complex values and objects.
An introduction to parallel and distributed database: Oracle: introduction to SQL plus, PL/SQL, triggers, forms, reports, query, procedures, and project builder.
Case study: MS SQL server, My SQL server.

Recommended Books:

1. A. Silberschatz : Database System Concepts.
2. R. Ramakrishnan : Database Management System
3. James Martin : Principles of Database Management.
4. Uillman : Database Management systems.
5. Abey : Oracle 8i a Beginners Guide

Course Objectives

- The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS.

Course Intended Learning Outcomes *(CILOs)*
Upon completion of the course, students should be able to:

CLO 1. Describe the fundamental elements of relational database management systems.
CLO 2. Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
CLO 3. Design ER-models to represent simple database application scenarios.
CLO 4. Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.
CLO 5. Improve the database design by normalization.
CLO 6. Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

Table 2.21: CSE 2201 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
PLO 1: Knowledge	✓					✓
PLO 2: Requirement Analysis		✓				
PLO 3: Problem Analysis		✓				

PLO 4: Design			✓			
PLO 5: Problem Solving			✓			
PLO 6: Implementation			✓			
PLO 7: Experiment and Analysis				✓	✓	
PLO 8: Community Engagement & Engg.						✓
PLO 9: Teamwork						
PLO 10: Communication						
PLO 11: Self-Motivated	✓	✓	✓	✓	✓	✓
PLO 12: Ethics	✓	✓	✓	✓	✓	✓

CSE 2202: Database Management System LAB

Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE 2201

Course Objectives

- To provide a sound introduction to the discipline of database management as a subject in its own right, rather than as a compendium of techniques and product-specific tools.
- To familiarize the participant with the nuances of database environments towards an information-oriented data-processing oriented framework.
- to give a good formal foundation on the relational model of data.
- to present SQL and procedural interfaces to SQL comprehensively.
- to introduce systematic database design approaches covering conceptual design, logical design and an overview of physical design.
- to motivate the participants to relate all these to one or more commercial product environments as they relate to the developer tasks.
- to present the concepts and techniques relating to query processing by SQL engines
- to present the concepts and techniques relating to ODBC and its implementations.
- to introduce the concepts of transactions and transaction processing
- to present the issues and techniques relating to concurrency and recovery in multi-user database environments

Course Intended Learning Outcomes *(CILOs)*
Upon completion of the course, students should be able to:

CLO 1. Understand, appreciate and effectively explain the underlying concepts of database technologies
CLO 2. Design and implement a database schema for a given problem-domain
CLO 3. Normalize a database
CLO 4. Populate and query a database using SQL DML/DDL commands.
CLO 5. Declare and enforce integrity constraints on a database using a state-of-the-art RDBMS

Table 2.22: CSE 2202 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓				
PLO 2: Requirement Analysis	✓				✓
PLO 3: Problem Analysis	✓				✓
PLO 4: Design		✓			

PLO 5: Problem Solving		✓	✓		
PLO 6: Implementation		✓	✓	✓	
PLO 7: Experiment and Analysis				✓	
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					
PLO 10: Communication					
PLO 11: Self-Motivated					
PLO 12: Ethics					

CSE 2203: Computer Architecture and Organization

Credits: 3, Hours/Week: 3

The evolution of computers: The nature of computer, the first generation, the latter generation, recent development.
Processor Design: Introduction: Processor organization, information representation, number formats; Fixed Point Arithmetic: Addition, subtraction, multiplication, division; ALU Design: Basic ALU organization, floating point arithmetic.
Control Design: Hardwired control: Design methods, multiplier control unit, CPU control unit; Basic concept of Micro programmed Control, Control memory optimization.
Memory Devices and its Organization: Different types of semiconductor memory, magnetic memory, optical memory, virtual memory, memory hierarchies; High-speed Memories: Interleaved memories, caches, associative memories.
System Organization: Communications: Introduction, bus control; IO Systems: Programmed IO, DMA and interrupts, IO processors.
Parallel Processing: Basic Concepts: Introduction to parallel processing. RISC processor, introduction, data dependency, addressing modes, condition codes, register sets, brief study of standard RISC processor.

Recommended Books:

1 V. Hamacher, Z. Vranesic and S. Zaky : Computer Organization. 3rd ed., McGraw-Hill, 1988.
2 J.P. Hayes : Computer Architecture and Organization, 2nd ed., McGraw-Hill, 1992.
3 K. Hwang and F.A. Briggs : Computer Architecture and Parallel Processing, McGraw-Hill, 1986.
4 W. Stallings : Computer Organization and Architecture.

Course Objectives: The objectives of this course are:

- To understand aspects of computer architecture and program performance
- To provide essential understanding of different subsystems of modern computer system and design aspects these subsystems
- To understand the stages in instruction life cycle
- To understand performance enhancement methods in instruction execution

Course Intended Learning Outcomes (CILOs):

On completion of the course, student will be able to:

CO1 Demonstrate computer architecture concepts related to design of modern processors, memories and I/Os.

CO2 Analyze the performance of commercially available computers.
CO3 To develop logic for assembly language programming

Table 2.23: CSE2203 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3
PLO 1: Knowledge	✓		
PLO 2: Requirement Analysis	✓	✓	
PLO 3: Problem Analysis	✓	✓	
PLO 4: Design			✓
PLO 5: Problem Solving			✓
PLO 6: Implementation			✓
PLO 7: Experiment and Analysis			
PLO 8: Community Engagement & Engg.			
PLO 9: Teamwork			
PLO 10: Communication			
PLO 11: Self-Motivated			
PLO 12: Ethics			

CSE 2204: Java Technologies

Credits: 3, Hours/Week: 3

An Introduction to Java. The Java Programming Environment, Fundamental Programming Structures in Java, Object and classes, Inheritance. Interfaces and Inner Classes Graphics Programming, User Interface Components with swing, Applets, Exceptions and Debugging, Streams and Files. Controlling Program Flow, Initialization & Cleanup, Hiding the implementation. Ressing classes, Polymorphism, Interfaces & Inner Classes, holding your objects, error handling with exceptions, The Java I/O system, Run-time type Identification, Creating windows & Applets, Multiple Threads, Distributed Computing, Enterprise Java frame work, application model, multi-tier application, Java servlets, Java server pages and Beans.

Recommended Books:

1. H. M. Deitel P. J. Deitel : Java How To Program
2. Sun Press : Core Java(Vol-1&2)
3. Ivor Horton : Beginning Java 2, Wrox
4. H. Schildt : Java 2 Complete Reference, Jessey
5. Joshua Blouch : Effective Java

Course Objectives:
This course introduces object-oriented programming (OOP) using the Java programming language. Its main objective is to teach the basic concepts and techniques which form the object-oriented programming paradigm.

Course Intended Learning Outcomes (CILOs):

Students completing the course should know:

CO1 The model of object-oriented programming: abstract data types, encapsulation, inheritance and polymorphism
CO2 Fundamental features of an object-oriented language like Java: object classes and interfaces, exceptions and libraries of object collections
CO3 How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java
CO4 How to test, document and prepare a professional looking package for each business project using javadoc.

Table 2.24: CSE2204 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4
PLO 1: Knowledge	✓			✓
PLO 2: Requirement Analysis	✓	✓		
PLO 3: Problem Analysis	✓	✓		
PLO 4: Design			✓	
PLO 5: Problem Solving			✓	
PLO 6: Implementation			✓	
PLO 7: Experiment and Analysis				
PLO 8: Community Engagement & Engg.				
PLO 9: Teamwork				
PLO 10: Communication				
PLO 11: Self-Motivated				
PLO 12: Ethics				

CSE 2205: Java Technologies LAB

Credits: 1.5 , Hours/Week: 3

Laboratory works based on CSE 2204

Course Intended Learning Outcomes (CILOs):

Students completing the course should know:

CO1 The model of object-oriented programming: abstract data types, encapsulation, inheritance and polymorphism
CO2 Fundamental features of an object-oriented language like Java: object classes and interfaces, exceptions and libraries of object collections
CO3 How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java, how to test, document and prepare a professional looking package for each business project using javadoc.

Table 2.25: CSE2205 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3
PLO 1: Knowledge	✓		
PLO 2: Requirement Analysis	✓	✓	
PLO 3: Problem Analysis	✓	✓	
PLO 4: Design			✓
PLO 5: Problem Solving			✓
PLO 6: Implementation			✓
PLO 7: Experiment and Analysis			
PLO 8: Community Engagement & Engg.			
PLO 9: Teamwork			
PLO 10: Communication			
PLO 11: Self-Motivated			
PLO 12: Ethics			

CSE 2206: Data Communication

Credits: 3, Hours/Week: 3

Introduction: Data and signal, Basic data communication system, Transmission impairments, Data rate, Bandwidth and channel capacity.
Transmission media: Two-wire cable, coaxial cable, optical fiber. Radio waves, satellite communication.
Data encoding techniques: AM, FM, PM. ASK, FSK, PSK, QPSK. PCM, DM. NRZL, NRZI, Bipolar AMI, Pseudotemetry, Manchester and differential Manchester encoding.
Data transmission techniques and multiplexing: Asynchronous and synchronous transmission. Simplex, Duplex, Full duplex transmission. Frequency division and time division multiplexing. Carrier system.
Error detection techniques: Parity check, Longitudinal Redundancy check and CRC. Data link and error control protocol: Basic characteristics, Flow and error control techniques, Framing. Stop and wait ARQ, HDLC protocol.
Telecommunication: Introduction, simple telecommunication system. Basic of a switching system.
Telecommunication network: Major telecommunication network, Data transmission and data rates in PSTN. Switching techniques of PSTN, Public Telecommunication network, Cellular telephony and Satellite network.
ISDN: Motivation and protocol for ISDN, ISDN standard, Expert system in ISDN. ISDN channel and broadband ISDN. Transmission channel, Signaling, Numbering and addressing of ISDN.
Antenna: Radiation from a current element, Antenna equivalent circuit, Dipole antenna.

Recommended Books:

1. **Stallings W**, Data Communications and Computer Networks
2. **William A Shay**, Understanding Data Communication & Networks
3. **S. E. Matter & A. G Chynoweth**, Optical fibre telecommunication
4. **M. S. Roden**, Analog and Digital communication Systems
5. **Roddy and Coolen**, Electronic Communications

Course Objectives

- Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.
- In-depth understanding of specialist bodies of knowledge within the engineering discipline.
- Application of established engineering methods to complex engineering problem solving.
- Application of systematic engineering synthesis and design processes.

Course Intended Learning Outcomes *(CILOs)*
Upon completion of the course, students should be able to:

CO1 Represent information as time-domain or frequency-domain functions as the problem requires, with an understanding of the equivalence between these domains. Both analogue and digital information will be considered.
CO2 Describe the operation of analogue and digital communication systems in time-domain or frequency-domain.
CO3 Describe the basic theory and operation of analogue communication systems, especially AM and FM modulation.
CO4 Describe the fundamentals of digital communication systems, especially baseband signaling, digital modulation techniques (e.g. FSK, PSK, QAM), inter-symbol interference and error rates.
CO5 Analyze and design simple optical fiber communications systems.

Table 2.26: CSE 2206 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓				
PLO 2: Requirement Analysis	✓				✓
PLO 3: Problem Analysis	✓				✓
PLO 4: Design		✓		✓	
PLO 5: Problem Solving					
PLO 6: Implementation			✓		
PLO 7: Experiment and Analysis		✓	✓	✓	
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					
PLO 10: Communication					
PLO 11: Self-Motivated					
PLO 12: Ethics					

CSE 2207: Data Communication LAB

Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE 3106

Course Objectives

- Analyze, plan and apply the acquired knowledge in basic sciences and mathematics in solving Electronics and Communication Engineering problems with technical, economic, environmental and social contexts.
- Design, build and test analog & digital electronic systems for given specifications.
- Architect modern communication systems to meet stated requirements.
- Work in a team using technical knowhow, common tools and environments to achieve project objectives.
- Communicate effectively, demonstrate leadership qualities and exhibit professional conduct in their career.
- Engage in lifelong learning, career enhancement and adapt to changing professional and societal needs.

Course Intended Learning Outcomes *(CILOs)*

Upon completion of the course, students should be able to:

COL 1. Apply basic science and mathematics to analyze complex engineering problems.
COL 2. Gather requirement specifications, design and test electronic systems.
COL 3. Apply EDA tools to design linear and digital IC systems.
COL 4. Specify, design and test power supplies for electronic systems including battery management, and power amplifiers.
COL 5. Analyze and design noise free analog and digital communication systems.

Table 2.27: CSE 2207 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge					
PLO 2: Requirement Analysis					
PLO 3: Problem Analysis		✓			✓
PLO 4: Design		✓	✓	✓	
PLO 5: Problem Solving	✓				
PLO 6: Implementation	✓			✓	
PLO 7: Experiment and Analysis	✓	✓	✓		✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					
PLO 10: Communication					
PLO 11: Self-Motivated					
PLO 12: Ethics					

MATH 2208: Complex Variables and Geometry

Credit: 3, Hours/Week: 3

Complex Variable: Complex number system; General functions of a complex variable; Limits and continuity of a function of complex variable and related theorems; Complex differentiation and the Cauchy Riemann Equations; Mapping by elementary functions; Line integral of a complex function; Cauchy Integral Theorem; Cauchy Integral Formula; Liouville Theorem; Taylor Theorem and Laurent Theorem. Singular points; Residue; Cauchy Residue Theorem. Evaluation of residues; Contour integration; Conformal mapping.
Co-ordinate Geometry: Transformation of co-ordinates axes and its uses; Equation of conics and its reduction to standard forms; Pair of straight lines; Homogeneous equations of second degree; Angle between a pair of straight lines; Pair of lines joining the origin to the point of intersection of two given curves, circles; System of circles; Orthogonal circles; Radical axis, radical center, properties of radical axes; Coaxial circles and limiting points; Equations of parabola, ellipse and hyperbola in cartesian and polar co-ordinates; Tangents and normals, pair of tangents; Chord of contact; Chord in terms of its middle points; Pole and polar parametric co-ordinates; Diameters; Conjugate diameters and their properties; Director circles and asymptotes.

Recommended Books:

1. Complex variable (S. series).
2. **M.L. Khanna**, Complex variable.
3. **Rahman and Bhattacharjee**, A text book on co-ordinate geometry.

Course Objectives:
The aim of this course is to introduce complex functions and their applications. Students learn about analytical functions, complex integration, classification of singularities etc. They would also learn conformal mappings. Some special functions and their applications will also be introduced.

Course Intended Learning Outcomes (CILOs):

At the end of the course, the student will be able to:

CO1	To know about general equation of second degree
CO2	To enhance understanding to solve problems on sphere
CO3	Solve linear differential equations using power-series methods.
CO4	Approximate polynomials in terms of legendre, bessel, chebyshev.
CO5	Solve real definite integrals using cauchy's residue theory.

Table 2.28: MATH-2208 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓			
PLO 4: Design			✓		
PLO 5: Problem Solving			✓		✓
PLO 6: Implementation			✓		✓
PLO 7: Experiment and Analysis					✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓

PLO 10: Communication					
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

Viva voce

Credits: 1.0

At the end of second year final examinations, interview in front of the board of examiners based on the courses of the corresponding year.

Third Year First Semester

CSE 3101: Numerical Methods
Credits: 3, Hours/Week: 3

Approximations and Errors: Accuracy and Precision, Error Definitions, Round-Off Errors, Truncation Errors.
Roots of Equations: Graphical Methods, The Bisection Method, The False-Position Method, Simple One-Point Iteration, The Newton-Raphson Method, The Secant Method.
Systems of linear algebraic equations: Gauss Elimination, Solving Small Numbers of Equations, Naive Gauss Elimination, Pitfalls of Elimination Methods, Matrix Inversion and Gauss –Seidel, The Matrix Inverse, Error Analysis and System Condition.
Curve Fitting: Linear Regression, Polynomial Regression, Multiple Linear Regression, Newton's Divided-Difference Interpolating Polynomials, Lagrange Interpolating Polynomials, Coefficients of an Interpolating Polynomials, Curve Fitting with sinusoidal Functions.
Numerical Differentiation and Integration: The Trapezoidal Rule, Simpson's Rules, Integration with Unequal Segments, Romberg Integration, Gauss Quadrature, High-Accuracy Differentiation Formulas, Richardson Extrapolation, Derivatives of Unequally Spaced Data.
Numerical Solutions of Ordinary Differential Equations: Euler's Method, Modifications and Improvements of Euler's Methods, Runge-Kutta Methods, Adaptive Runge-Kutta Methods.

Recommended Books:

1. Chopra : Numerical Methods for Engineers.
2. S. S. Kuo : Computer Application of Numerical Methods
3. S. S. Sastry : Introductory methods of Numerical Analysis.
4. Rajaraman, V. : Computer Oriented Numerical Methods
5. Robert J. Schilling and Sandra L Harries : Applied Numerical Method for Engineers, Thomson Books, 2002
6. Kendall Atkison : Elementary Numerical Analysis, John Wiley & Sons, 1986
7. S. Balachandra & C.K. Shantha : Numerical Methods, 2000

Course Objective:

1. Emphasizes the development of numerical methods and the application of the computer to solve engineering problems.
2. Develop problem solving skills by applying the appropriate numerical techniques for the problem.

Course Intended Learning Outcomes (CILOs)
After studying this course, the student will able to:

CLO 1. Understand basics of accuracy and finite precision, round of errors, truncation errors, and stability of numerical algorithms.
CLO 2. Be able to model engineering systems using first and second order differential equations and solve the equations both analytically and numerically.
CLO 3. Be able to approximate functions with polynomials.
CLO 4. Understand and apply appropriate techniques for numerical methods and calculate the computational cost.
CLO 5. Be able to employ the Taylor Series for approximation and error analysis.
CLO 6. Be able to formulate and apply numerical techniques for root finding, curve fitting, differentiation, and integration.

Table 3.11: CSE 3101 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
PLO 1: Knowledge	✓					
PLO 2: Requirement Analysis				✓		
PLO 3: Problem Analysis					✓	✓
PLO 4: Design		✓				✓
PLO 5: Problem Solving		✓		✓		✓
PLO 6: Implementation			✓	✓		
PLO 7: Experiment and Analysis		✓		✓	✓	
PLO 8: Community Engagement & Engg.						
PLO 9: Teamwork						
PLO 10: Communication						
PLO 11: Self-Motivated						
PLO 12: Ethics						

CSE 3102: Numerical Methods LAB
Credits: 1.50, Hours/Week: 3
Laboratory works based on CSE 3205

Course Objective:
Develop student's understanding through laboratory activities to solve problems related to key concepts taught in the classroom.

Course Intended Learning Outcomes (CILOs)
After studying this course, the student will able to:

CLO 1. Understand the elements of error analysis for numerical methods and certain proofs.
CLO 2. Be able to write computer programs to solve engineering problems with MATLAB and C++ object-oriented capabilities depending upon the nature of the problem.
CLO 3. Ability to use approximation algorithm in real world problem.

Table 3.12: CSE 3102 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3
PLO 1: Knowledge	✓		
PLO 2: Requirement Analysis	✓	✓	
PLO 3: Problem Analysis			✓
PLO 4: Design			✓
PLO 5: Problem Solving		✓	
PLO 6: Implementation		✓	✓
PLO 7: Experiment and Analysis	✓		
PLO 8: Community Engagement & Engg.			
PLO 9: Teamwork			
PLO 10: Communication			
PLO 11: Self-Motivated			
PLO 12: Ethics			

CSE 3103: Theory of Computation

Credits: 3, Hours/Week: 3

The Central Concepts: Introduction to Finite State Machines and Finite State Automata; Alphabets, Strings and Languages.
Finite Automata: Deterministic Finite Automata, Non-deterministic Finite Automata, and their applications; Finite Automata with Epsilon-Transitions.
Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions, and Algebraic Laws for Regular Expressions.
Properties of Regular Languages: The Pumping Lemma for Regular Languages and its applications; Closure Properties and Decision Properties of Regular Languages; Equivalence and Minimization of Automata.
Context-Free Grammars and Languages: Context-Free Grammars; Parse Trees; Applications of Context-Free Grammars; Ambiguity in Grammars and Languages.

Pushdown Automata: Definition and the languages of a PDA; Equivalence of PDA's and CFG's; Deterministic Pushdown Automata.
Properties of Context-Free Languages: Chomsky and Greibach Normal forms for CFG's; The Pumping Lemma for CFL's; Closure and Decision properties of CFL's.
Computability Theory: The Church-Turing thesis, Turing machines, variants of Turing machines, the definition of algorithm- Hilbert's problems, etc.; Decidability: decidable languages, the Halting problem, etc.; Turing reducibility, a definition of information, etc.

Recommended Books:

1. Introduction to Automata Theory, Languages & Computation, **Hopcropt, J.E. & Ullman , J.D.**
2. Introduction to Theory of Computation, Michael Sipser
3. Elements of the Theory of Computation, **Lewis Papadimitriou**
4. Introduction to Languages and Theory of Computation, **John C Martin**

Course Objectives

- Students will learn several formal mathematical models of computation along with their relationships with formal languages.
- In particular, they will learn regular languages and context free languages which are crucial to understand how compilers and programming languages are built.
- Also, students will learn that not all problems are solvable by computers, and some problems do not admit efficient algorithms.
- Throughout this course, students will strengthen their rigorous mathematical reasoning skills.

Course Intended Learning Outcomes (CILOs)
Upon completion of the course, students should be able to:

CLO 1. Demonstrate knowledge of basic mathematical models of computation and describe how they relate to formal languages.
CLO 2. Understand that there are limitations on what computers can do, and learn examples of unsolvable problems.
CLO 3. Learn that certain problems do not admit efficient algorithms, and identify such problems.

Table 3.13: CSE 3103 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3
PLO 1: Knowledge		✓	✓
PLO 2: Requirement Analysis			
PLO 3: Problem Analysis			
PLO 4: Design	✓		
PLO 5: Problem Solving	✓	✓	
PLO 6: Implementation	✓		
PLO 7: Experiment and Analysis			✓
PLO 8: Community Engagement & Engg.			
PLO 9: Teamwork			
PLO 10: Communication			
PLO 11: Self-Motivated			
PLO 12: Ethics			

CSE 3104: Microprocessor and Assembly Language
Credits: 3, Hours/Week: 3

Microprocessor Fundamentals, Architecture of a microprocessor, Data bus, address bus, control bus, I/O units and memory, Review of some important components, Decoder, Encoder, Multiplexer, Demultiplexer.

Architecture of Intel 8085 Microprocessor, Demultiplexing of Lower-order address-bus. Generating control signals, Timing diagram of memory read /write operation Address decoding, Partial and absolute Address decoding, I/O port design for simple application.

Architecture of Intel 8086 Microprocessor, its execution unit and bus-interface unit, its registers and flags. Comparison between Intel 8085 and 8086 Microprocessor.

Programming model of 8086 processor, segment-offset address and physical address calculations, even and odd addressing, introduction of different addressing modes, Operating systems and BIOS, Memory organization of PC.

Introduction to IMB PC Assembly Language, Assembly Language syntax, Program Data, Variables, named constants, program structure, memory models, Input/output instruction, Running program, Program Segment Prefix.

The processor status and the Flag register, Overflow condition, Debugging a program.

Flow control instructions, Conditional jumps, signed versus unsigned jumps, High-level language structures, branching and looping structures.

Logic, Shift and Rotate Instruction, some common applications of Shift and Rotate operations.

The Stack and Introduction to Procedures, Basic stack operations, Procedures Declaration, Communication between procedures, calling a procedure.

Multiplication and Division Instructions, signed versus unsigned multiplications, divide overflow, Signed Extension of Dividend.

Arrays and related addressing modes, DUP operator, register indirect modes, Based and Indexed Addressing modes, PTR operator, Based-indexed addressing modes, XLAt instruction.

The string instructions, director flag, moving a string, storing a string, loading a string, scanning a string, comparing strings, substring operation.

Text display and keyboard programming, the monitor, Video adapter and display modes, text mode programming, keyboard buffer and operation, scan codes.

Recommended Books:

1. Rafiquzzaman : Microprocessor and Microcomputer based system design
2. D. V. Hall : Microprocessors and Interfacing, McGraw-Hill, 1987.
3. Y. Liu and G. A. Gibson : Microcomputer Systems: 8086/8088 Family, Prentice-Hall, 1991.
4. Artwick : Microcomputer Interfacing
5. Ramesh Goanker : Microcomputer Interfacing
6. James E. Powell : Designing User Interfaces

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Course Objectives

- understand the main components and working principals of the Intel 80x86 microprocessor and Intel 80x51 microcontroller.
- program and debug in assembly language.
- understand the memory organization and memory interfacing.
- Interface a microprocessor to external input/output devices and perform input/output device programming in assembly.
- understand the hardware and software interrupts and their applications.
- understand the properties and interfacing of the parallel and serial ports.

Course Intended Learning Outcomes *(CILOs)*
Upon completion of the course, students should be able to:

COL 1. Solve basic binary math operations using the microprocessor. / microcontroller.
COL 2. Demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor /microcontroller.
COL 3. Use the capabilities of the stack, the program counter, and the status register and show how these are used to execute a machine code program.
COL 4. Apply knowledge of the microprocessor's internal registers and operations by use of a PC based microprocessor simulator.

Table 3.14: CSE 3104 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4
PLO 1: Knowledge			✓	
PLO 2: Requirement Analysis				
PLO 3: Problem Analysis				
PLO 4: Design		✓		✓
PLO 5: Problem Solving	✓			✓
PLO 6: Implementation		✓		✓
PLO 7: Experiment and Analysis		✓		
PLO 8: Community Engagement & Engg.				
PLO 9: Teamwork				
PLO 10: Communication				
PLO 11: Self-Motivated				
PLO 12: Ethics				

CSE 3105: Microcontroller and Assembly Language LAB
Credits: 1, Hours/Week: 2

Laboratory Works based on CSE-3104 and Microcontroller

Course Objectives

- Teach principles of instruction set architecture, assembly language and microcontroller programming
- Teach basic procedures of how a compiler translates C/C++ code to assembly language and perform simple optimizations
- Teach basic principles of interrupt/exception handling
- Explore in detail microcontroller programming; introduce students to computer organization
- Show how C/C++ constructs use hardware resources, and introduce concepts of efficiency and performance below the algorithmic level

Course Intended Learning Outcomes *(CILOs)*

Upon completion of the course, students should be able to:

COL 1. Apply C/C++ code into assembly language
COL 2. Perform simple optimizations of microcontroller and other hardware
COL 3. Analyze and debug at the assembly level and microcontroller
COL 4. Understand and extend simple CPU implementations
COL 5. Understand basic interrupt/exception handling
COL 6. Apply simple performance estimates for assembly and microcontroller code

Table 3.15: CSE 3105 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
PLO 1: Knowledge				✓	✓	
PLO 2: Requirement Analysis			✓			
PLO 3: Problem Analysis			✓			
PLO 4: Design						
PLO 5: Problem Solving	✓	✓		✓		✓
PLO 6: Implementation	✓	✓				✓
PLO 7: Experiment and Analysis		✓				
PLO 8: Community Engagement & Engg.						
PLO 9: Teamwork		✓			✓	✓
PLO 10: Communication						
PLO 11: Self-Motivated				✓	✓	✓
PLO 12: Ethics						

CSE 3106: Computer Networks
Credits: 3, Hours/Week: 3

Introduction: Introduction to Computer Networks, Network Goals and Applications, Network Architectures, OSI reference model, TCP/IP model and terminology, Connectionless and Connection Oriented services, Network Topologies, Service primitives, Public Networks, The ARPANET, SNA.
Physical Layer: Circuit switching and Packet switching, X-25 protocol, ISDN, BISDN, Frame relay and Cell relay.
Medium Access Sublayer: Static and Dynamic channel allocation in LAN and MAN, LAN Cables, Pure and slotted ALOHA, Persistent and Non-persistent CSMA, CSMA with collision detection and collision free protocols, IEEE standard 802.3 and Ethernet, Token Bus and Token Ring, FDDI, Fibernet II, DATAKIT.
Data Link Layer: Service provided to the network layer, Framing, Flow control, Error detecting and Correcting Codes, Stop-and-Wait protocol, Sliding Window protocol, Go Back n protocol, Selective Repeat protocol, Performance of Stop-and Wait and Sliding Window protocol, Data Link layer in Public network and ARPANET.
Network Layer: Service provided to the Transport layer, Internal organization of Network layer, Routing algorithms, Internetworking, Router, Bridge, Gateway, Network layer in Public network and ARPANET.
Transport Layer: Services provided to the Session layer, Quality of service, Transmission Controls protocols, Connection management, Addressing, Establishing and Releasing Connection, Flow control and Buffering, Multiplexing, Transport layer in Public network and ARPANET.
Session Layer: Services provided to the Presentation layer, Data exchange, Synchronization, Dialog and Activity management, OSI session service primitives.

Presentation Layer: Data Compression techniques, Frequency Dependent Coding, Context Dependent Encoding, Cryptography, Traditional Cryptography, Data Encryption Standard, Public key cryptography, MIT algorithm.
Application Layer: File transfer Access and management, Electronic Mail, Virtual Terminal, Client Server, Other applications, OSI service elements.
Internet: Introduction to internet and intranets, internet protocols, Internet services and goals, Domain Name System (DNS) and Addresses, FTP, Gopher and Telnet, World Wide Web (WWW), Internet Relay Chat (IRC), USENET, DHCP and BOOTP.

Recommended Books:

1. A.S. Tanenbaum : Computer Networks
2. G. H. Cady, Pat McGregor : Mastering The Internet
3. Barry Nance : Introduction to Networking
4. W. Stallings, Macmillan : Data and Computer Communications
5. F. Halsall : Data Communications, Computer Networks and Open Systems
6. Sydni Feit : TCP/IP

Course Objectives

- Acquire the computer networking knowledge as well as the existing connectivity technologies and the required infrastructure which comprises the key steps involved in the communication process.
- Identify the key issues for the realization of the LAN/WAN/MAN network architectures and the hybridized existing form in the business environment and enterprise.
- Establish a solid knowledge of the layered approach that makes design, implementation and operation of extensive networks possible. To learn the 7-layer OSI network model (each layer and its responsibilities) and understand the TCP/IP suite of protocols and the networked applications supported by it.
- Establish a solid knowledge of the layered approach that makes design, implementation, and operation of extensive networks possible. Acquire the knowledge of the basic protocols involved in wired/wireless communication process. These include the characteristics of the required infrastructure for Local Area Networks (MAC CSMA-CD/Ethernet, Token Ring, FDDI, and others) as well as the Wide Area Networks using the TCP/IP (visualizing TCP/IP mechanisms and variations), and UDP/IP. Additionally, the Voice over IP (VoIP) technology in the business communications world will be examined.

Course Intended Learning Outcomes (CILOs)
Upon completion of the course, students should be able to:

CLO 1. Explain the way protocols currently in use in the Internet work and the requirements for designing network protocols;
CLO 2. Capture and analyses network traffic;
CLO 3. Apply the theory of basic network performance analysis;
CLO 4. Analyze soundness or potential flaws in proposed protocols;
CLO 5. Describe the current architecture of the Internet and the entities involved with the day to day running of the Internet and the process involved with development of policy and new protocols;
CLO 6. Explain and identify security and ethical issues in computer networking.;
CLO 7. Implement key networking algorithms in simulation;

Table 3.16: CSE 3106 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
PLO 1: Knowledge	✓				✓	✓	
PLO 2: Requirement Analysis		✓		✓		✓	
PLO 3: Problem Analysis		✓		✓		✓	
PLO 4: Design			✓		✓		✓

PLO 5: Problem Solving			✓				✓
PLO 6: Implementation			✓				✓
PLO 7: Experiment and Analysis		✓		✓		✓	
PLO 8: Community Engagement & Engg.							
PLO 9: Teamwork						✓	
PLO 10: Communication							
PLO 11: Self-Motivated	✓				✓		
PLO 12: Ethics							

CSE 3107: Computer Networks LAB
Credits: 1.5, Hours/Week: 3
Laboratory works based on CSE 3106.

Course Objectives

- To make students aware about various types of cables used in guided media like coaxial cable, optical fiber cable, twisted pair cables and its categories.
- To understand the working difference between straight cable and cross over cable.
- To understand and work with practical lab client-server-based network, switched based network
- To understand and work with practical lab domain hosting create and configurations
- To understand and work with various routing algorithm and VLAN and implement it through packet tracer.
- To use the packet tracer to simulate various networks.

Course Intended Learning Outcomes (CILOs)
Upon completion of the course, students should be able to:

CLO 1. Understand different types of networks
CLO 2. Design 'Switched based Network', 'Peer-to-Peer Network', and 'Client-Server Network' using packet tracer simulator software and implement it practically.
CLO 3. Create 'Windows Server 2012 Domain Controller' in a domain and connect client computer with that domain through Switched Network using packet tracer simulator software and implement it practically.
CLO 4. Configure a Network using Routing Information Protocol (RIP) using packet tracer simulator software.
CLO 5. Design Router based Network using packet tracer simulator with various routing command.

Table 3.17: CSE 3107 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓		✓		
PLO 2: Requirement Analysis	✓				✓
PLO 3: Problem Analysis	✓		✓	✓	✓
PLO 4: Design		✓			
PLO 5: Problem Solving		✓	✓	✓	✓
PLO 6: Implementation		✓	✓	✓	✓
PLO 7: Experiment and Analysis		✓	✓	✓	✓
PLO 8: Community Engagement & Engg.			✓	✓	✓
PLO 9: Teamwork		✓		✓	✓
PLO 10: Communication					

PLO 11: Self-Motivated					
PLO 12: Ethics					

CSE 3108: E-commerce
Credits: 2, Hours/Week: 2

E-Commerce Basics: E-Commerce Definition, Internet History and E-Commerce Development, Business-to-Business E-Commerce, Business-to-Consumer E-Commerce, E-Commerce Stages and Processes, E-Commerce Challenges, Ecommerce Opportunities.
E-Commerce Options: Internet Access Requirements, Web Hosting Requirements, Entry-Level Options, Storefront and Template Services, E-Commerce Software Packages, E-Commerce Developers, E-Business Solutions.
Marketing Issues: Online and Offline Market Research, Data Collection, Domain Names, Advertising Options, E-Mail Marketing, Search Engines, Web Site Monitoring, Incentives.
Planning and Development: Web Site Goals, International Issues, Planning Stages, Resource Allocation, Content Development, Site Map Development, Web Site Design Principles, Web Site Design Tools, Web Page Programming Tools, Data-Processing Tools.
E-Commerce Components: Navigation Aids, Web Site Search Tools, Databases, Forms, Shopping Carts, Checkout Procedures, Shipping Options.
Payment Processing: Electronic Payment Issues, E-Cash, Credit Card Issues, Merchant Accounts, Online Payment Services, Transaction Processing, Taxation Issues, Mobile Commerce (M-Commerce).
Security Issues: Security Issues and Threats, Security Procedures, Encryption, Digital Certificates, SSL and SET Technologies, Authentication and Identification, Security Providers, Privacy Policies, Legal Issues.
Customer Service: Customer Service Issues, E-Mail Support, Telephone Support, Live Help Services, Customer Discussion Forums, Value-Added Options.

Recommended Books:

1. **Jeffrey F., Rayport, Bernard J. Jaworsk :** E-Commerce, Mc Graw-Hill, ISBN-0072465212, 1st Edition.
2. **David Kosiur :** Understanding Electronic Commerce, Microsoft Press.
3. **Jeffrey F. Rayport, et al. :** Introduction to E-Commerce, Mc Graw-Hill, 1st Edition Aug-13, 2001.
4. **Debra Cameron :** E-Commerce Security Strategies: Protection the Enterprise, Computer Technology Research Corp. Aug-1998.
5. **Charles Trepper :** E-Commerce Strategies

Course Objectives

- Acquaint students with a fundamental understanding of the environment and strategies in the New Economy.
- Provide analytical tools to understand opportunities in unserved or underserved New Economy markets.
- Provide a fundamental understanding of the different types and key components on business models in the New Economy.
- Provide guiding principles behind the design and strategy of the customer web interface.
- Understand the traditional and new communication/marketing approaches that create competitive advantage in the New Economy.
- Provide insights on how to implement strategy in the New Economy.
- Understand the metrics that New Economy firms to use to measure progress, customer satisfaction, and financial performance.
- Understand the fundamentals of financially valuing New Economy companies.
- Provide an overview of the hardware, software, servers, and the parts that make up the enabling "railroad" for the New Economy.

Course Intended Learning Outcomes (CILOs)
Upon completion of the course, students should be able to:

CLO 1. Explain the components and roles of the Electronic Commerce environment.
CLO 2. Explain how businesses sell products and services on the Web.
CLO 3. Describe the qualities of an effective Web business presence and E-Commerce payment systems.
CLO 4. Explain how to meet the needs of Web site visitors.
CLO 5. Identify and reach customers on the Web.
CLO 6. Understand Web marketing approaches and elements of branding.
CLO 7. Explain the client/server infrastructure that supports electronic commerce.
CLO 8. Understand legal and ethical issues related to E-Commerce.

Table 3.18: CSE 3108 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7	CO 8
PLO 1: Knowledge	✓	✓		✓			✓	
PLO 2: Requirement Analysis	✓	✓			✓		✓	
PLO 3: Problem Analysis			✓		✓			
PLO 4: Design								
PLO 5: Problem Solving								
PLO 6: Implementation								
PLO 7: Experiment and Analysis			✓		✓			
PLO 8: Community Engagement & Engg.						✓		✓
PLO 9: Teamwork								
PLO 10: Communication								
PLO 11: Self-Motivated						✓		✓
PLO 12: Ethics								

CSE 3109: Database Management System Based Project (LAB)
Credits: 1.5, Hours/Week: 3

Students will have to complete a short project work under the supervision of an appointed supervisor based on CSE 2201.

Course Objectives

- Graduates are effective team members, aware of cultural diversity, who conduct themselves ethically and professionally.
- Graduates use effective communication skills and technical skills to assure production of quality software, on time and within budget.
- Graduates build upon and adapt knowledge of science, mathematics, and engineering to take on more expansive tasks that require an increased level of self-reliance, technical expertise, and leadership.

Course Intended Learning Outcomes (CILOs)
Upon completion of the course, students should be able to:

CO1 Graduates shall have strong foundation in science, mathematics, and engineering, and can apply this fundamental knowledge to software engineering tasks.
CO2 Graduates can effectively apply software engineering practice over the entire system lifecycle. This includes requirements engineering, analysis, prototyping, design, implementation, testing, maintenance activities and management of risks involved in software and embedded systems.
CO3 Graduates know classical and evolving software engineering methods, can select and tailor appropriate methods for projects, and can apply them as both team members and managers to achieve project goals.

CO4 Graduates are knowledgeable of the ethics, professionalism, and cultural diversity in the work environment.

CO5 Graduates can apply basic software quality assurance practices to ensure that software designs, development, and maintenance meet or exceed applicable standards.

Table 3.19: CSE 3109 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓		✓		
PLO 2: Requirement Analysis	✓		✓		
PLO 3: Problem Analysis	✓		✓		
PLO 4: Design		✓			✓
PLO 5: Problem Solving					✓
PLO 6: Implementation		✓			✓
PLO 7: Experiment and Analysis					
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					
PLO 10: Communication					
PLO 11: Self-Motivated					
PLO 12: Ethics				✓	

Third Year Second Semester

CSE 3201: Operating Systems
Credits: 3, Hours/Week: 3

Introduction: Evolution, Goals and Components of OS, Types of OS. Operating System Services
Process management: Process states and state transition, Process Control Blocks, Job and Process scheduling, Process Communication, Threads
CPU Scheduling: Scheduling levels, Objectives and criteria, CPU scheduling algorithms, Algorithm Evaluation
Process Synchronization: Process co-ordination, Critical section problems, Semaphores, Monitors, Classical problems of process synchronization.
Deadlock: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock prevention, avoidance, and detection, Recovery form deadlock, Deadlock handling.
Memory management: Logical and Physical Address Space, Swapping, Memory allocation schemes, Paging and Segmentation, Segmentation with Paging
Virtual memory: Demand paging, Performance of Demand Paging, Page replacement algorithms, Allocation of frames, Demand Segmentation
Secondary storage management: Disk structure; Disk scheduling, Disk management, Swap-space management, Disk reliability, Stable storage implementation
File-System: File and Directory concept, File system structure, Allocation method, Free space Management, Directory Implementation.
Protection and Security: Goals of protection, principle of protection, Access matrix, Access Control, Security problems and Threats, Computer Security, Implements Security Defenses,
Unix O/S: Overview, system structure, user perspective, O/S services, Introduction to the kernel and buffer cache, internal representation of files, Compiler, Loader, Linker, System call, Remote procedure call, Unix socket, Multithreading.

Recommended Books:

1. **Silberschatz and Galvin**, Operating System Concepts
2. **Stalling, William**, Introduction to Operating System
3. **Milenkoviæ, Milan**, Operating Systems: Concepts and Design

4. **Tanenbaum, Andrew S.**, Modern Operating Systems
5. **Terrence**, Unix System Programming in C++

Course Objectives

- To learn the fundamentals of Operating Systems.
- To learn the mechanisms of OS to handle processes and threads and their communication
- To learn the mechanisms involved in memory management in contemporary OS
- To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
- To know the components and management aspects of concurrency management
- To learn programmatically to implement simple OS mechanisms

.

Course Intended Learning Outcomes (CILOs)
Upon completion of the course, students should be able to:

CLO 1. Analyze the structure of OS and basic architectural components involved in OS design
CLO 2. Analyze and design the applications to run in parallel either using process or thread models of different OS
CLO 3. Analyze the various device and resource management techniques for timesharing and distributed systems
CLO 4. Understand the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system
CLO 5. Interpret the mechanisms adopted for file sharing in distributed applications
CLO 6. Conceptualize the components involved in designing a contemporary OS

Table 3.21: CSE 3201 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
PLO 1: Knowledge				✓		✓
PLO 2: Requirement Analysis	✓	✓	✓			
PLO 3: Problem Analysis	✓	✓	✓			
PLO 4: Design				✓	✓	
PLO 5: Problem Solving					✓	
PLO 6: Implementation					✓	
PLO 7: Experiment and Analysis	✓	✓	✓			
PLO 8: Community Engagement & Engg.						
PLO 9: Teamwork						
PLO 10: Communication						
PLO 11: Self-Motivated						✓
PLO 12: Ethics						

CSE 3202: Operating Systems LAB
Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE 3201.

Course Objectives

- To learn the fundamentals of operating systems; designing and implementing components within commercial operating systems: system calls, CPU scheduling, context switching, process management, memory management, file systems.

Course Intended Learning Outcomes (CILOs)
Upon completion of the course, students should be able to:

CLO 1. Analyze the structure of OS
CLO 2. Design components within commercial operating systems, system calls, CPU scheduling, context switching, process management, memory management, file systems.

Table 3.22: CSE 3202 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2
PLO 1: Knowledge		
PLO 2: Requirement Analysis	✓	
PLO 3: Problem Analysis	✓	
PLO 4: Design		✓
PLO 5: Problem Solving		✓
PLO 6: Implementation		✓
PLO 7: Experiment and Analysis	✓	✓
PLO 8: Community Engagement & Engg.		
PLO 9: Teamwork		✓
PLO 10: Communication		
PLO 11: Self-Motivated		✓
PLO 12: Ethics		

CSE-3203: Software Engineering and Information System Design
Credits: 3, Hours/Week: 3

Software Engineering Paradigms: Definition of S/W Engineering; The classical life cycle; Prototyping fourth generation technique; The product and the process, measurement, matrices.

Requirements Analysis Fundamentals: Analysis principle; Software prototyping specification; Requirement analysis methodologies; Structured and object-oriented analysis; Data flow-oriented analysis methods.

Software Design Fundamentals: Design process; Design fundamentals: S/W architecture program structure; data structure, S/W procedure, modularity, abstraction; Effective modular design; Procedural design; Data flow-oriented Design; Top-down and bottom-up design; Design process considerations; Transform analysis; Transaction analysis; Data structure-oriented design: Logical construction of programs and systems, Data structured systems development; object-oriented design; Design concepts; Methods; Strategy; Real-time Design; Coding style: Code documentation, Data declaration, Statement construction, Input/output.

Software Testing Techniques and Strategies: Testing fundamentals; White box testing; Basis path testing; Loop testing; Black Box testing; Verification and validation; Organization for software testing; Credit testing; Integration testing; Validation testing; System testing; The art of debugging.

Formal Methods and Specification Language: Formal specification rationale; Introduction to predicate calculus; Formal specification techniques; Pre/post conditions, Algebraic specification; Format (Signature, axioms); Steps in definition; Structured algebraic specification; Introduction to specification language Z; Steps in Z; Logic.

Recommended Books:

1. **Ian Sommerville**, Software Engineering, 5th Edition, LPE, Edition Wesley Publishing Company, 2000.
2. **Roger S. Pressman**, Software Engineering, McGraw=Hill International Edition, 2001.
3. **David Alex Lamb**, Software Engineering, Prentice-Hall International Editions, 1998.

Course Objectives

- Be successful professionals in the field with solid fundamental knowledge of software engineering
- Utilize and exhibit strong communication and interpersonal skills, as well as professional and ethical principles when functioning as members and leaders of multi-disciplinary teams
- Apply their foundations in software engineering to adapt to readily changing environments using the appropriate theory, principles and processes.

Course Intended Learning Outcomes (CILOs)

Upon completion of the course, students should be able to:

CO1 Apply the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment.
CO2 Ability to work in one or more significant application domains;
CO3 Work as an individual and as part of a multidisciplinary team to develop and deliver quality software;
CO4 Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle
CO5 Demonstrate an ability to use the techniques and tools necessary for engineering practice.

Table 3.23: CSE 3203 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge				✓	
PLO 2: Requirement Analysis					
PLO 3: Problem Analysis					
PLO 4: Design				✓	✓
PLO 5: Problem Solving	✓	✓			✓
PLO 6: Implementation	✓	✓			✓

PLO 7: Experiment and Analysis	✓	✓			
PLO 8: Community Engagement & Engg.			✓		✓
PLO 9: Teamwork			✓		
PLO 10: Communication					
PLO 11: Self-Motivated					
PLO 12: Ethics					

CSE 3204: Software Engineering Based Project (LAB)
Credits: 1.50, Hours/Week: 3

Students will have to complete software oriented short project work under the supervision of an appointed supervisor based CSE 3203.

Course Objectives

- To learn the fundamentals of software development systems..

Course Intended Learning Outcomes (CILOs)
Upon completion of the course, students should be able to:

CLO 1. Acquire the skills to edit, test and implement software for a client-server environment;
CLO 2. Develop programs to retrieve data from forms and files to produce user displays and reports;
CLO 3. Learn programming constructs and develop programs that use strings, dates, arrays, functions, classes and objects;
CLO 4. Design and develop user interfaces to collect and present data and information;
CLO 5. Develop code to use regular expressions, handle exceptions and validate data for file and database storage;
CLO 6. Implement measures to create secure web sites;
CLO 7. Design, create, and process a database;
CLO 8. Design and develop pages for a typical web application

Table 3.24: CSE 3204 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7	CO 8
PLO 1: Knowledge	✓		✓					
PLO 2: Requirement Analysis								
PLO 3: Problem Analysis								
PLO 4: Design		✓		✓			✓	✓
PLO 5: Problem Solving		✓	✓	✓				✓
PLO 6: Implementation		✓	✓	✓	✓	✓	✓	✓
PLO 7: Experiment and Analysis								
PLO 8: Community Engagement & Engg.								
PLO 9: Teamwork								✓
PLO 10: Communication								
PLO 11: Self-Motivated	✓		✓					
PLO 12: Ethics								

CSE 3205: Introduction to Data Science
Credits: 3.00, Hours/Week: 3

Introduction: Examples of applications of probability in computer science. Preview of the course in a worked-out example. Sample spaces (discrete), probability, random variables.
Likelihood: Maximum likelihood estimation of the parameters of a discrete distribution. Applications to Computer Science problems. Histograms and other tools for data visualization.
Continuous sample spaces: Density. Non-parametric density estimation and the bias-variance trade-off. Applications to data visualization.
Parametric density estimation: The (univariate) normal distribution.
Probability Distribution: Conditional probability, independent events, Bayes' formula. Random variables. Expectations. Mean and variance. Two dependent variables: Conditional and marginal distributions. The bivariate normal distribution.

Classification: the problem, models and algorithms for classification.
Clustering: The K-means algorithm, the likelihood view, quality measures. Applications in Computer Science. A Computer Science application (for example data mining, information retrieval, probabilistic reasoning).

Recommended Books:

1. “An introduction to statistical methods and data analysis” by Book by Lyman Ott
2. “A modern introduction to probability and statistics" by F.M. Dekking, C. Kraaikamp, H.P. Lopuhaa, L.E. Meester
3. "Introduction to Probability" by Dimitri P. Bertsekas and John N. Tsitsiklis
4. "Pattern classification" by R. O. Duda, P. E. Hart and D. G. Stork
5. "Pattern Recognition and Machine Learning" by C. M. Bishop
6. "The elements of statistical learning: Data mining, inference and prediction" by T. R. Hastie, R. Tibshirani, J. H. Friedman

Course Objective:

1. Introduce statistics and its applications for data analysis.
2. Help students to develop skills in thinking and analyzing problems from a probabilistic and statistical point of view. This will help to choose and apply the appropriate statistical methodology and tools for the problem

Course Intended Learning Outcomes (CILOs)

After studying this course, the student will able to:

CLO 1. Implement and apply appropriate statistical methodology and tools in the engineering problem solving process.

CLO 2. Implement a variety of mathematical, statistical, and data analysis techniques to model and analyze complex problems, and demonstrate competence in analyzing data using methods embedded in their courses.

CLO 3. Solve a real-world problem using appropriate statistical procedures with a focus on precision and accuracy.

CLO 4. Use computational and statistical software platforms to develop and execute various statistical procedures and statistical computing algorithms.

CLO 5. Communicate statistical ideas clearly, in verbal form, using appropriate statistical terminology and generate reports that show statistical expertise in writing and model implementation.

Table 3.25: CSE 3205 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge		✓		✓	
PLO 2: Requirement Analysis	✓	✓		✓	
PLO 3: Problem Analysis		✓	✓		
PLO 4: Design	✓	✓	✓		
PLO 5: Problem Solving			✓		
PLO 6: Implementation		✓			
PLO 7: Experiment and Analysis			✓	✓	
PLO 8: Community Engagement & Engg.					✓
PLO 9: Teamwork					✓

PLO 10: Communication					✓
PLO 11: Self-Motivated				✓	✓
PLO 12: Ethics					

CSE 3206: Compiler Design
Credits: 3, Hours/Week: 3

Introduction: Phases of a compiler (lexical analyzer, syntax analyzer, semantic analyzer, intermediate code generator, code optimizer, code generator, symbol-table manager & error handler).
Lexical analysis: role, finite automata, from regular expression to NFA, from NFA to DFA, design of a lexical anlyzer generator using LEX.
Syntax analysis: role, CFG, writing a grammar, top-down parsing, bottom-up parsing, operator precedence parsing, LR parser, using ambiguous grammar, parser generators (YACC).
Symbol table, structure and management.
Intermediate code generation: intermediate languages, declarations, assignment statement, Boolean expression, case statements, backpatching, procedure calls.
Code optimization: principle of source optimization, optimization of basic blocks, loop in flow graphs, global data flow analysis, iterative solution of data flow equations.
Code generation: Issues in the design of a code generator, target machine, runtime storage management, basic blocks and flow graphs, register allocation and assignment, dag representation of basic blocks, peephole optimizations, generating code from DAGs.

Recommended Books:

1. Hopcroft and Ullman, Introduction to Automata Theory, Languages and Computation
2. Adamek, Automata and Algebra
3. Aho and Ullman, Principles of Compiler Design
4. Lewis and Stern, Compiler Design Theory.

Course Objective:

1. To introduce the major concept areas of language translation and compiler design.
2. To enrich the knowledge in various phases of compiler ant its use, code optimization techniques, machine code generation, and use of symbol table.
3. To extend the knowledge of parser by parsing LL parser and LR parser.
4. To provide practical programming skills necessary for constructing a compiler.

Course Intended Learning Outcomes (CILOs)
After studying this course, the student will able to:

CLO 1. Describe the design of a compiler including its phases and components.
CLO 2. Develop a large, complex, but well-structured software system that implements various phases of a compiler such as the scanner, parser, code generator, and optimizer.
CLO 3. Work with peers on a group project.
CLO 4. Describe current developments in compiler design and implementation.
CLO 5. Identify the similarities and differences among various parsing techniques and grammar transformation techniques.
CLO 6. Describe the role of the compiler in ensuring the security, privacy and integrity of data.
CLO 7. Implement the major phases of a simple compiler, including scanning, parsing, intermediate code generation, and a few program optimizations.

Table 3.26: CSE3206 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6	CO 7
PLO 1: Knowledge	√		√				
PLO 2: Requirement Analysis			√	√		√	√
PLO 3: Problem Analysis	√			√			
PLO 4: Design							√

PLO 5: Problem Solving		√			√		
PLO 6: Implementation					√		
PLO 7: Experiment and Analysis		√				√	√
PLO 8: Community Engagement & Engg.							
PLO 9: Teamwork							√
PLO 10: Communication							
PLO 11: Self-Motivated						√	
PLO 12: Ethics							

CSE 3207: Compiler Design LAB
Credits: 1.50, Hours/Week: 3

Laboratory works based on CSE 3207.

Course Objectives:

- ✓ To enlighten the student with knowledge base in compiler design and its applications

Course Intended Learning Outcomes (CILOs)
After studying this course, the student will able to:

CLO 1. Demonstrate a working understanding of the process of lexical analysis, parsing and other compiler design aspects.
CLO 2. Analyze the data flow and control flow
CLO 3. Construct the intermediate representation

Table 3.27: CSE3207 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3
PLO 1: Knowledge	√	√	
PLO 2: Requirement Analysis	√		
PLO 3: Problem Analysis	√	√	√
PLO 4: Design	√	√	√
PLO 5: Problem Solving	√	√	√
PLO 6: Implementation	√	√	√
PLO 7: Experiment and Analysis	√	√	√
PLO 8: Community Engagement & Engg.			
PLO 9: Teamwork			
PLO 10: Communication			
PLO 11: Self-Motivated			
PLO 12: Ethics			

CSE 3208: Technical Writing
Credits: 1.50, Hours/Week: 3

The fundamentals of technical communication using oral, written and visual means are presented as practised in industry and academia. Clarity of thought, organisational skills and systematic approaches are emphasised. Students engage in exercises that focus on technical writing, public speaking, graphic design and giving presentations. They apply their skills across a broad range of activities, including critique of presentations and writing of proposals, reports, memoranda, user manuals, instructional modules, and technical specifications. Techniques presented are intended to create an appreciation for format and content and to better prepare students for project documentation and formal presentations.

Recommended Books:

1. Daniel G. Riordan "Technical Report Writing", Houghton Mifflin Company, 8th edition, 2001.

Course Objective:

Viva-voce
Credits: 1.0

At the end of third year final examinations, interview in front of the board of examiners based on the courses of the corresponding year.

Fourth Year First Semester

CSE-4101: Artificial Intelligence and Neural Network
Credit: 3, Hours/Week: 3

Introduction: Introduction to AI and intelligent agents, General Concept of Knowledge.
Symbolic Knowledge and Reasoning: Building a Knowledge Base Agent, Propositional logic, First order logic, Inference in First order Logic.
Uncertain Knowledge and Reasoning: Inconsistencies and uncertainties, probabilistic reasoning, Structured knowledge, Fuzzy Logic.
Knowledge Organization and manipulation: Search strategies, Game planning, Knowledge Organization and management.
Knowledge acquisition: Introduction, Types of learning, general model, learning automata, Genetic algorithm, Learning by Induction.
Introduction to Natural Language Processing: Overview of Linguistics, Grammars and Languages, Basic Parsing Techniques, Semantic Analysis & Structures, Natural Language generation and Systems.
Expert System: Expert consultation, Development of Expert Systems, Computer vision, Robotics.
Logic programming: Background, Representation and reasoning, Logic programs and programming styles, Programming in PROLOG. List processing, arithmetic, I/O and memory operations and databases in PROLOG. User interface and interface engine of AI.
Introduction to Neural Networks: The Basic Neuron, The Multi-layer Perception, Applications of Neural Network, Kohonen Self-Organizing Networks, Hopfield Networks, Adaptive Resonance Theory, Associative Memory. Pattern Recognition by Neural Network theory

Recommended Books:

1. **Dan w. Patterson,** Introduction to Artificial Intelligence and Expert System
2. **Stuart Russell and Peter Norving**, Artificial Intelligence: A Modern Approach
3. **E. Rich and K. Knight**, Artificial Intelligence.

Course Objective:

1. Learning basic concepts of artificial intelligence
2. Developing simple applications using artificial intelligence tools

Course Intended Learning Outcomes (CILOs)

After studying this course, the student will able to:

CLO 1. Knowledge of what constitutes "Artificial" Intelligence and how to identify systems with Artificial Intelligence.

CLO 2. Explain how Artificial Intelligence enables capabilities that are beyond conventional technology, for example, chess-playing computers, self-driving cars, robotic vacuum cleaners.

CLO 3. Implement classical Artificial Intelligence techniques, such as search algorithms, minimax algorithm, neural networks, tracking, robot localization.

CLO 4. Ability to apply Artificial Intelligence techniques for problem solving.

CLO 5. Explain the limitations of current Artificial Intelligence techniques.

Table 4.11: CSE4101 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	√				
PLO 2: Requirement Analysis	√	√			
PLO 3: Problem Analysis	√		√	√	√
PLO 4: Design	√	√	√	√	
PLO 5: Problem Solving	√	√	√	√	
PLO 6: Implementation		√	√	√	√
PLO 7: Experiment and Analysis		√	√		√
PLO 8: Community Engagement & Engg.			√		
PLO 9: Teamwork				√	
PLO 10: Communication				√	
PLO 11: Self-Motivated				√	
PLO 12: Ethics		√			√

CSE 4102: Artificial Intelligence and Neural Networks LAB

Credits: 1.5, Hours/Week: 3 Laboratory works based on CSE 4101

Course Objective:

- Learning the implementation tools of AI
- Developing simple real-world applications using artificial intelligence tools

Course Intended Learning Outcomes (CILOs)

After studying this course, the student will able to:

CLO1: Analyze and understand rule base reasoning.

CLO 2: Represent Knowledge base.

CLO 3: Apply prolog structures to represent rule base.

CLO 4: Program and debug Prolog codes.

CLO 5: Implement real world problems.

Table 4.12: CSE4102 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	√		√		
PLO 2: Requirement Analysis	√	√			
PLO 3: Problem Analysis	√	√	√		
PLO 4: Design	√	√	√		
PLO 5: Problem Solving		√	√	√	
PLO 6: Implementation		√	√	√	√
PLO 7: Experiment and Analysis			√	√	√
PLO 8: Community Engagement & Engg.					√
PLO 9: Teamwork					
PLO 10: Communication					
PLO 11: Self-Motivated					√
PLO 12: Ethics					√

CSE 4103: Web Engineering
Credits: 3, Hours/Week: 3

Information and Distributed Systems Infrastructure: Basic Terminology, Networks, Internet, Intranet and Extranet, Client/Server Computing Paradigm, Open Systems and Communication Protocols, Middleware: Views, Definitions, Functions, Client/Server Working Mechanism: Application Programming Interface (API), Sockets, Client and Server Implementation.
Web and Programming: Web Elements: Browser and Web Document. Static, Active and Dynamic pages, Programming paradigms and Web programming. Object-oriented vs. Object-based programming, what should and should not be programmed on the Web, Tasks suitable for programming on the Web, Choice of programming language for Web programming.
Client-side Programming: JavaScript for Web Programming: Introduction to the Language, JavaScript: Object Hierarchy and working with objects, JavaScript: Event-Driven Programming.
Server-side Programming: Approaches to running Server Programs, The Classic Technology: Common Gateway Interface (CGI): Definition, Characteristics, CGI Programming Mechanism: GET and POST methods, Simple examples using Perl, Introduction to PHP Programming Language. PHP for Web Programming.

Recommended Books:

1. A. Berson: Client/Server Architecture, 2nd ed., McGraw-Hill Series on Computer Communication.
2. Chris Bates: Web Programming. Building Internet Applications, 2nd ed., John Wiley & Sons, Ltd., 2002.
3. Douglas E. Comer: Computer Networks and Internets with Internet Applications, 3rd ed., Prentice Hall International, Inc., 2001.

Course Objective:
The goals of the course are as follows:

1. to be able to analyze and design comprehensive systems for the creation, dissemination, storage, retrieval, and use of electronic records and documents.
2. to learn and use some of the client side and server-side languages used to manipulate information on the World Wide Web – i.e. PHP, and Javascript.
3. to learn techniques and evaluation metrics for ensuring the proper operability, maintenance and security of a web application.

Course Intended Learning Outcomes (CILOs)

After studying this course, the student will able to:

CO1 Employ techniques to analyze and evaluate software architectures on a real-world large-scale web-based software system.

CO2 Create and document a reference architecture for a non-trivial Web-based technological product.

CO3 Present findings of case study analysis of software architectures of a family of large-scale web-based software systems.

CO4 Envision an innovative product for a wicked problem and develop an architecture for the product that utilizes service-oriented computing technologies

CO5 Write a research-in-progress paper on a Web engineering topic that utilizes Design Science

Table 4.13: CSE4103 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	√				
PLO 2: Requirement Analysis	√	√			
PLO 3: Problem Analysis	√	√	√	√	√
PLO 4: Design	√	√	√		
PLO 5: Problem Solving	√		√	√	√
PLO 6: Implementation	√	√	√	√	√
PLO 7: Experiment and Analysis		√	√	√	√
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork				√	√
PLO 10: Communication				√	
PLO 11: Self-Motivated					√
PLO 12: Ethics					

CSE 4104: Web Engineering LAB
Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE 4107.

Course Objective:

- ✓ The objective of this lab is to develop an ability to design and implement static and dynamic website.

Course Intended Learning Outcomes (CILOs)

After studying this course, the student will able to:

CO1 Design and implement dynamic websites with good aesthetic sense of designing and latest technical know-how's.

CO2 Have a Good grounding of Web Application Terminologies, Internet Tools, E – Commerce and other web services.

CO3 Get introduced in the area of Online Game programming.

Table 4.14: CSE4104 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3
PLO 1: Knowledge	√		√
PLO 2: Requirement Analysis	√		√
PLO 3: Problem Analysis	√	√	√
PLO 4: Design	√	√	√
PLO 5: Problem Solving	√	√	√
PLO 6: Implementation	√	√	√
PLO 7: Experiment and Analysis		√	√
PLO 8: Community Engagement & Engg.			
PLO 9: Teamwork			√
PLO 10: Communication			
PLO 11: Self-Motivated			
PLO 12: Ethics			

CSE 4105: Computer Graphics
Credits: 3, Hours/Week: 3

Introduction: A survey of Computer Graphics, Overview on basic components of Computer Graphics, Graphics Input devices, Architecture of Graphics display devices, Video memory.
Fundamental Graphics Algorithms: Scan Conversion of Points and Lines, Line drawing algorithm, DDA algorithm, Bresenham's Line algorithm, Bresenham's circle drawing algorithm, Loading the frame buffer, circle generating algorithm, Midpoint circle algorithm, Ellipse generating algorithm, Midpoint Ellipse algorithm, pixel addressing, Region Filling algorithms.
Clipping Operations: Point clipping, line clipping, polygons clipping, curve clipping, text clipping
Implementation of Computer Graphics: Co-ordinates Transformations, Two and Three dimensional Transformation, Viewing and Clipping, Projections, 3D object representations, Curves and Surface Design, Elimination of Hidden surfaces, Z-buffer algorithm, Painters algorithm, scan-line algorithm, Vector mathematics method, Raster graphics systems, Image synthesis methods, Ray tracing, Shadow mapping, color and shading models.

Recommended Books:

1. Steven Haringtron : Computer Graphics a Programming Approach, Second Edition, 1987.
2. Hearn and Baker : Computer Graphics.
3. F. S. Hill : Fundamentals of Computer Graphics.
4. Plastock and Kalley : Computer Graphics.
5. Zhigang Xiang & Roy Plastock : Computer Graphics.

Course Objective:

1. To introduce the use of the components of a graphics system and become familiar with building.
2. Approach of graphics system components and algorithms related with them.
3. To learn the basic principles of 3-dimensional computer graphics.
4. Provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
5. Provide an understanding of mapping from a world coordinates to device coordinates, clipping, and projections.
6. To be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.
7. To comprehend and analyze the fundamentals of animation, virtual reality, underlying technologies, principles, applications.

Course Intended Learning Outcomes (CILOs)
After studying this course, the student will able to:

CO1	Understand the structure of modern computer graphics systems
CO2	Understand the basic principles of implementing computer graphics primitives
CO3	Familiarity with key algorithms for modeling and rendering graphical data
CO4	Develop design and problem-solving skills with application to computer graphics
CO5	Gain experience in constructing interactive computer graphics programs using OpenGL

Table 4.15: CSE4105 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	√	√			
PLO 2: Requirement Analysis	√	√			
PLO 3: Problem Analysis	√	√	√	√	
PLO 4: Design	√	√	√	√	
PLO 5: Problem Solving	√	√	√	√	
PLO 6: Implementation	√	√		√	
PLO 7: Experiment and Analysis				√	√
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					√
PLO 10: Communication					
PLO 11: Self-Motivated					
PLO 12: Ethics					

CSE 4106: Computer Graphics LAB
Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE 4105.

Course Objective:

1. Understand the need of developing graphics application
2. Learn algorithmic development of graphics primitives like: line, circle, polygon etc.
3. Learn the representation and transformation of graphical images and pictures.

Course Intended Learning Outcomes (CILOs)

After studying this course, the student will able to:

CO1	Draw Geometric primitives using OpenGL
CO2	Execute scan line polygon filling using OpenGL
CO3	Implement basic transformations on objects using OpenGL
CO4	Implement clipping algorithm on lines using OpenGL

Table 4.16: CSE4106 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4
PLO 1: Knowledge	√			
PLO 2: Requirement Analysis	√	√		
PLO 3: Problem Analysis		√	√	√
PLO 4: Design	√		√	√
PLO 5: Problem Solving		√	√	√
PLO 6: Implementation		√	√	√
PLO 7: Experiment and Analysis		√	√	√
PLO 8: Community Engagement & Engg.				
PLO 9: Teamwork			√	
PLO 10: Communication				
PLO 11: Self-Motivated			√	√
PLO 12: Ethics				

CSE 4107: Digital Signal Processing
Credits: 3, Hours/Week: 3

Introduction to Signals: Concepts of signals, systems and signal processing; classification of signals; Digital signals and systems; Classification of discrete time signals; Sampling theorem; Fourier series and Fourier transform; Autocorrelation.
The Z-Transform: The Z-Transform and its properties; The inverse Z-Transform.
The Discrete Fourier Transform (DFT): The Discrete Fourier Transform (DFT), redundancy in the DFT; The Fast Fourier Transform (FFT); the FFT decimation in time & decimation in frequency; Interrelationship between the DFT & Z-transform; Convolution of sequences & sectioning.

Digital Filter: Digital Filter characterization; Digital filter structures; Design of Digital Filters; Recursive Filter design; Effects of finite word length; Simple models for quantization noise in recursive systems; Non-recursive filter design via the DFT computational techniques; Other radix formulations; Other radix formulations; Spectral analysis using the FFT; Speech processing algorithms;

Recommended Books:

1. Digital Signal Processing, Proakis & Manolakis
2. Digital Image Processing, R Gonzalez, E Woods
3. Discrete Time Signal Processing, Oppenheim & Schafer
4. Elements of Image Processing, Anil

Course Objective:

1. Identify the signals and systems
2. Apply the principles of discrete-time signal analysis to perform various signal operations
3. Apply the principles of z-transforms to finite difference equations.
4. Apply the principles of Fourier transform analysis to describe the frequency characteristics of discrete-time signals and systems
5. Apply the principles of signal analysis to filtering
6. Use computer programming tools to process and visualize signals

Course Intended Learning Outcomes *(CILOs)*

After studying this course, the student will able to:

CLO 1. Ability to apply current knowledge and applications of mathematics, science, engineering and technology

CLO 2. Ability to creatively design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

CLO 3. Ability to identify, formulate, analyze and solve technical and engineering problems

CLO 4. Ability to use the techniques, skills and modern technical tools necessary for technical or engineering practice

Table 4.17: CSE4107 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4
PLO 1: Knowledge	√			
PLO 2: Requirement Analysis		√		
PLO 3: Problem Analysis	√		√	
PLO 4: Design		√		
PLO 5: Problem Solving	√	√	√	
PLO 6: Implementation		√	√	
PLO 7: Experiment and Analysis		√		√
PLO 8: Community Engagement & Engg.				√
PLO 9: Teamwork				
PLO 10: Communication				√
PLO 11: Self-Motivated				
PLO 12: Ethics				

CSE 4108: Digital Signal Processing LAB
Credits: 1.5 , Hours/Week: 3

Laboratory works based on CSE 4105.

Course Objective:

1. Design and implement a DSP system using tools like LabVIEW, C and MATLAB
2. Analyze and describe the functionality of a real world DSP system
3. Work in teams to plan and execute the creation of a complex DSP system
4. Apply DSP system design to real world applications

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. Develop and Implement DSP algorithms in software using a computer language such as C with TMS320C6713 floating point Processor.
CLO 2. Develop various DSP Algorithms using MATLAB Software package.
CLO 3. Analyze and Observe Magnitude and phase characteristics (Frequency response Characteristics) of digital IIR-Butterworth, Chebyshev filters.
CLO 4. Analyze and Observe Magnitude and phase characteristics (Frequency response Characteristics) of digital FIR filter using window techniques.
CLO 5. Design and Analyze Digital Filters using FDA Tool

Table 4.18: CSE4108 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	√		√		
PLO 2: Requirement Analysis	√		√		
PLO 3: Problem Analysis		√			
PLO 4: Design	√				
PLO 5: Problem Solving				√	
PLO 6: Implementation		√	√	√	√
PLO 7: Experiment and Analysis		√	√	√	
PLO 8: Community Engagement & Engg.					√
PLO 9: Teamwork			√		√
PLO 10: Communication					
PLO 11: Self-Motivated				√	
PLO 12: Ethics					√

CSE 4109: Research Project (Part-I)

Credits: 1, Hours/Week: 2

Under the supervision of an appointed supervisor, students will start a research project through literature review/case study, generate ideas, prepare proposals and at the semester final examination, they will present and defend their submitted proposal.

Course Objective:

1. Knowledge and application of research methods appropriate to the field of study
2. Critical thinking and problem-solving skills
3. Application of knowledge and skills to plan and execute a substantial research project
4. Communication skills to justify and interpret theoretical propositions, methodologies, conclusions and decisions to technical and non-technical audiences
5. Application of skills and knowledge with personal autonomy and accountability

Course Intended Learning Outcomes (CILOs)

After studying this course, the student will able to:

CO1 Conduct an independent research project under supervision

CO2 Adhere to responsible laboratory or field practice regarding data collection and recording, and laboratory/field safety

CO3 Demonstrate time and project management in the successful identification of a research project, development of an experimental design, collection of accurate and precise data, critical analysis and interpretation of results, retrieval of information, and critical reading of scientific literature

CO4 Prepare a minor thesis (draft, edit, format, check for errors), and understand confidentiality issues regarding medical sciences, biological sciences, OHS, and/or environmental research

CO5 Present a seminar on the results of a research project.

Table 4.19: CSE4109 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	√		√		
PLO 2: Requirement Analysis		√	√		
PLO 3: Problem Analysis		√	√		
PLO 4: Design		√	√		
PLO 5: Problem Solving		√	√		
PLO 6: Implementation		√	√		
PLO 7: Experiment and Analysis			√	√	
PLO 8: Community Engagement & Engg.				√	
PLO 9: Teamwork	√				
PLO 10: Communication				√	√
PLO 11: Self-Motivated	√			√	√
PLO 12: Ethics	√			√	√

Fourth Year Second Semester

CSE 4203: Human Computer Interaction
Credits: 3 Hours/Week: 3

CSE 4204: Human Computer Interaction LAB
Credits: 1.5 Hours/Week: 3

This laboratory course is based on CSE 4203.

CSE 4205: Digital Image Processing
Credits: 3, Hours/Week: 3

Fundamentals of Image processing: What is Digital Image processing? Origins of image processing, Fundamental steps in image processing, Components of image processing, Elements of visual perception, Digital Image representation or simple image formation model, Problems and Applications of image processing, Image sampling and quantization, zooming and Shrinking digital image, Basic relationships between pixels, Neighbours of a pixel, adjacency, connectivity, regions and boundaries, distance measures, Linear and non-linear operations.
Image enhancement: Image enhancement is special domain: Image negative, log transformations, power-law transformations, Piecewise-linear transformation functions, contrast stretching, gray-level slicing, bi-plan slicing, Histogram processing, Histogram equalization, Histogram specification, Image subtraction, Image averaging, Basics of spatial filtering, smoothing special filters, Sharpening Special filters, Combining special enhancement methods.
Image enhancement in frequency domain: Introduction to the Fourier transform and the frequency domain, the two-dimensional DFT and its inverse, Filtering in the frequency domain: some basic properties of frequency domain, some basic filters and their properties, Correspondence between filtering in special and frequency domains, Smoothing frequency domain filters: ideal low-pass filter Butterworth low-pass filters, Gaussian low-pass filters, Sharpening frequency domain filters: ideal high pass filter, Butterworth high-pass filters, Gaussian high-pass filters, the laplacian in the frequency domain, Implementation.
Image Restoration: Model of the image degradation/ restoration process, Noise models.
Color Image processing: Color fundamentals, Color models: RGB color model, CMY and CMYK color model, HIS color model, converting colors from HIS to RGB, Pseudo-color Image processing, Intensity slicing, Gray-level to color transformations, Basics of full color image processing, Color Transformation, Smoothing and Sharpening, Color segmentation, color edge detection, Noise in color images, Color image compression
Image Compression: Preview, fundamentals, coding redundancy, inter-pixel redundancy, psycho-visual redundancy, Fidelty criteria, Image compression models, Error free compression, Huffman coding, Variable length coding, bit-plane coding. Morphological image processing: Preliminaries, Dilations and Erosion, Some basic morphological algorithms. Image segmentation: detection of discontinuous, point detection, line detection, edge detection, thresholding, region-based segmentation.
Matlab: Introduction, Interactive computing, Programming in MATLAB; Script and functions, Applications. Matlab toolboxes (User of); Digital Signal Processing and Image Processing.

Course objective

1) Basic knowledge of image processing.
2) To study the image processing.
3) To study image restoration.
4) To study the image compression**.**

Course Intended Learning Outcomes (CILOs)
After studying this course, the student will able to:

1) Review the fundamental concepts of a digital image processing.
2) Analyze image in the frequency domain using various transforms.
3) Evaluate the technique image enhancement and image restoration.
4) Comparison different color image processing,
5) Interpret image compression.

Table 4.25: CSE4205 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓			
PLO 4: Design			✓		
PLO 5: Problem Solving			✓		✓
PLO 6: Implementation			✓		✓
PLO 7: Experiment and Analysis					✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓
PLO 10: Communication					
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

Recommended Books:

1. Rafeal C. Gonzalez & Richard E. Woods : Digital Image Processing
2. Gordon E. Carlson : Signal and Linear System Analysis
3. Rudra Pratap : Getting Started with Matlab V6

CSE 4206: Digital Image Processing LAB
Credits: 1.50, Hours/Week: 3

Laboratory works based on CSE 4205.

Course Objective:

- Learning the implementation tools of DIP
- Developing simple real-world applications using DIP tools

Course Intended Learning Outcomes (CILOs)
After studying this course, the student will able to:

CLO1: Analyze and understand Image Processing tools.
CLO 2: Analyze real world images to implement application-based work.
CLO 3: Use MATLAB to analyse images.
CLO 4: Program and debug MATLAB codes.
CLO 5: Implement real world problems.

Table 4.26: CSE4206 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	√		√		
PLO 2: Requirement Analysis	√	√			
PLO 3: Problem Analysis	√	√	√		
PLO 4: Design	√	√	√		
PLO 5: Problem Solving		√	√	√	

PLO 6: Implementation PLO 7: Experiment and Analysis PLO 8: Community Engagement & Engg. PLO 9: Teamwork PLO 10: Communication		√	√ √	√ √	√ √ √
PLO 11: Self-Motivated					√
PLO 12: Ethics					√

CSE 4207: Machine Learning
Credits: 3, Hours/Week: 3

Introduction to Machine Learning: Introduction to machine learning, Supervised, unsupervised and reinforcement learning, Unsupervised learning algorithms, Concept Learning, Decision Tree Learning, Attribute based and relational supervised learning algorithms, Artificial Neural network based learning algorithms, Bayesian Learning, Evaluating Hypothesis, Genetic algorithm and genetic programming, Reinforcement learning algorithms, Computational learning theory.

Recommended Books:

1. **Christopher M. Bishop,** Pattern Recognition and Machine Learning
2. **Igor Aleksander and Helen Morton,** An Introduction to Neural Computing
3. Machine Learning, **Tom Michael Mitchell**
4. Introduction to Machine Learning, **Ethem Alpaydin**

Course objectives

1) Basic knowledge of Machine Learning.
2) To study the different types of machine learning method.
3) To study the neural network.

Course Intended Learning Outcomes (CILOs)

After studying this course, the student will able to:

CLO 1. Review the fundamental concepts of machine learning.
CLO 2. Analyze different types of machine learning method.
CLO 3. Implement basic training/learning.
CLO 4. Basic knowledge of neural network.
CLO 5. Interpret different types of neural network.

Table4.27: CSE4207 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓			
PLO 4: Design			✓		
PLO 5: Problem Solving			✓		✓
PLO 6: Implementation			✓		✓
PLO 7: Experiment and Analysis					✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓

PLO 10: Communication					
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

CSE 4208: Machine Learning LAB
Credits: 1.5, Hours/Week: 3
Laboratory works based on CSE 4207.

Course Objective:

1. Design and implement Machine Learning system using different tools.
2. Analyze and implement the functionality of Machine Learning system
3. Design and implement Neural Net using different tools.
4. Analyze and understand the functionality of different Neural Networks.

Course Intended Learning Outcomes (CILOs)
After studying this course, the student will able to:

CLO 1. Develop and Implement Machine Learning & Neural Network Algorithms.
CLO 2. Develop various Machine learning & Neural Network Algorithms using Python.
CLO 3. Analyze and Observe characteristics of Machine Learning algorithms.
CLO 4. Analyze and Observe characteristics of Neural Network algorithms.
CLO 5. Design and Analyze Real world problems.

Table 4.28: CSE4208 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	√		√		
PLO 2: Requirement Analysis	√		√		
PLO 3: Problem Analysis		√			
PLO 4: Design	√				
PLO 5: Problem Solving				√	
PLO 6: Implementation		√	√	√	√
PLO 7: Experiment and Analysis		√	√	√	
PLO 8: Community Engagement & Engg.					√
PLO 9: Teamwork			√		√
PLO 10: Communication					
PLO 11: Self-Motivated				√	
PLO 12: Ethics					√

CSE 4209: Network Security
Credits: 3, Hours/Week: 3

Overview, Terminology, Substitution and Transposition ciphers, One time pads, Symmetric Ciphers, classical Encryption Technique, Block Ciphers and the Data Encryption Standard, Introduction to Finite Fields, Advanced Encryption Standard, Contemporary, Symmetric Ciphers Confidentiality Using Symmetric

Encryption Public, Key Encryption, One way functions and Hash Functions, Introduction to Number Theory, Prime number generation, Public-Key Cryptography and RSA, Key Management, Key exchange algorithm; Other Public-key Cryptosystems, Message Authentication and Hash Functions, Hash Algorithms, MD5, SHA, Digital Signatures and Authentication Protocols, DSA, Kerberos, Network Security Practice, Authentication Digital certificates and Public key infrastructure, X.500, Application Electronic Mail Security, IP Security, Web Security, System Security, Intruders, Malicious Software, Firewalls.

Recommended Books:

1. Bruce Schneier : Applied Cryptography, John Wiley & Sons, Inc.
2. Dieter Gollmann : Computer Security; ISBN: 0-471-97844-2; Edition: 1999; Publisher: John Wiley and Son Ltd.
3. Edward Amoroso : Fundamentals of Computer Security Technology; ISBN: 0-13-108929-3; Publisher: Prentice Hall.
4. W. Stallings : Cryptography and Network Security Principles and Practice, Prentice Hall, New Jersey, 1999.
5. E. Biham and A. Shamir : Differential Crypt analysis of the data encryption standard, Springer Verlag, 1993.
6. D. Denning : Cryptography and data security, Addison Wesley, 1982.
7. N. Kobliz : A course on Number theory and Cryptography, Springer Verlag, 1994.

Course Objectives:

- Describe various communications networks and their main components.
- Identify the advantages and disadvantages of a network.
- Define the terminology associated with computer networks.
- Identify the components associated with computer networks.
- Develop a networking plan for yourself or a client.
- Distinguish and explain the concepts of: hacking and cracking; authorization, and attacks.
- Identify the function of a firewall, and how it keeps a computer secure and safe from viruses.
- Prepare a plan for anti-virus protection.

Course Intended Learning Outcomes (CILOs):

After studying this course, you should be able to:

CO1 identify some of the factors driving the need for network security
CO2 identify and classify particular examples of attacks
CO3 define the terms vulnerability, threat and attack
CO4 identify physical points of vulnerability in simple networks
CO5 compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems.

Table 4.29: CSE4209 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓			
PLO 4: Design			✓		
PLO 5: Problem Solving			✓		✓
PLO 6: Implementation			✓		✓
PLO 7: Experiment and Analysis					✓
PLO 8: Community Engagement & Engg.					

PLO 9: Teamwork					✓
PLO 10: Communication					
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

CSE 4210: Network Security LAB
Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE-4209

Course Objective:

1. Analyze network security on different OS.
2. Analyze and implement network security issues on different environments.
3. Analyze vulnerabilities of network security using different tools.
4. Analyze and understand the potential attacks and recovery process.

Course Intended Learning Outcomes (CILOs)
After studying this course, the student will able to:

CLO 1. Develop and Implement Network security process.

CLO 2. Develop various network security system using modern tools.

CLO 3. Analyze and Observe characteristics of different network-based attacks.

CLO 4. Analyze and capture the network-based attackers.

CLO 5. Design and Analyze Real world Network Security issues.

Table 4.30: CSE4210 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	√		√		
PLO 2: Requirement Analysis	√		√		
PLO 3: Problem Analysis		√			
PLO 4: Design	√				
PLO 5: Problem Solving				√	
PLO 6: Implementation		√	√	√	√
PLO 7: Experiment and Analysis		√	√	√	
PLO 8: Community Engagement & Engg.					√
PLO 9: Teamwork			√		√
PLO 10: Communication					
PLO 11: Self-Motivated				√	
PLO 12: Ethics					√

CSE 4211: Parallel and Distributed Systems
Credits: 3, Hours/Week: 3

Introduction: Trends towards Parallel processing, Parallel processing mechanism, Multiprogramming and Time sharing, Parallel Computer Structures, Parallelism and Pipelining, Parallel processing applications, Speedup Performance Laws, Parallel Random Access Machines (PRAM) and VLSI model.
Hardware Technology: Advanced processor Technology, Superscalar and Vector processor, Shared memory organization, Design of Linear and Non linear Pipeline processor, Multiprocessor System Interconnects.
Pipelining and Vector Processing: Principles of Pipelining, Classification of pipelined processors, Instruction and Arithmetic pipeline design, Vector Processing principles, Vector processing requirements, Designing Pipelined processors, Compound Vector processing, Recent Vector processors, Vectorization and Optimization methods.

Parallel Programming: Parallel Programming models, Parallel Languages and Compilers, Code Optimization and Scheduling, Loop Parallelization and Pipelining, Parallel Programming Environments, Shared-variable program structures, mapping programs onto Multicomputers.
Distributed Processing: Introduction, Function distribution, Hierarchical and Horizontal distributed system, Strategies for distributed data processing, Data distribution, Conflict analysis, Distributed Database and applications. Transaction and distributed transaction, concurrency control, security in distributed system.
Parallel and distributed databases: Architecture of parallel databases, introduction to distributed databases, distributed DBMS architectures, storing data in a distributed DBMS, distributed catalog management, distributed query processing, updating distributed data, introduction to distributed transactions, distributed concurrency control, distributed recovery.

Recommended Books:

1. Kai Hwang (Senior Consulting Edition) : Advanced Computer Architecture Parallelism, Scalability, Programmability
2. Kai Hwang, Faye A. Briggs : Computer Architecture and Parallel Processing
3. R. J. Cypser : Communication Architecture for distributed system
4. James Martin : Design and Strategy for distributed data processing
5 R. Ramakrishnan : Database Management System

Course objectives

1) To understand the fundamental of cryptography.
2) To understand various key distribution.
3) To study how to deploy encryption techniques to secure data transmit across networks.
4) To study application email security, IP security, web security, system security etc.

Course Intended Learning Outcomes (CILOs)
After studying this course, the student will able to:

CLO 1. Review Basic concept of network security.
CLO 2. The role of cryptography in information security.
CLO 3. Evaluate the major types of cryptographic algorithm and typical application.
CLO 4. Interpret one-way function, Hash function, number theory, prime number generation.
CLO 5. Develop strategies to protect organizations information assets from common attacks**.**

Table 4.31: CSE4211 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓			
PLO 4: Design			✓		
PLO 5: Problem Solving			✓		✓
PLO 6: Implementation			✓		✓

PLO 7: Experiment and Analysis					✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓
PLO 10: Communication					
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

CSE 4212: Parallel and Distributed Systems LAB
Credits: 1.5, Hours/Week: 3

Laboratory Based on CSE 4211

Course objectives

1) To understand the fundamental of cryptography.
2) To understand various key distribution.
3) To study how to deploy encryption techniques to secure data transmit across networks.
4) To study application email security, IP security, web security, system security etc.

Course Intended Learning Outcomes (CILOs)

After studying this course, the student will able to:

CLO 1. Review Basic concept of network security.
CLO 2. The role of cryptography in information security.
CLO 3. Evaluate the major types of cryptographic algorithm and typical application.
CLO 4. Interpret one-way function, Hash function, number theory, prime number generation.
CLO 5. Develop strategies to protect organizations information assets from common attacks**.**

Table 4.32: CSE4212 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓			
PLO 4: Design			✓		
PLO 5: Problem Solving			✓		✓
PLO 6: Implementation			✓		✓
PLO 7: Experiment and Analysis					✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓
PLO 10: Communication					
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

CSE 4213: VLSI Design
Credits: 3, Hours/Week: 3

VLSI design methodology: top-down design approach, technology trends and design automation algorithms; Introduction to CMOS inverters and basic gates; Brief overview of CMOS fabrication process: layout and design rules; Basic CMOS circuit characteristics and performance estimation; Buffer circuit design; Complex CMOS gates, CMOS building blocks: adder, multiplier; data path and memory structures.

Hardware modeling: hardware modeling languages, logic networks, state diagrams, data-flow and sequencing graphs, behavioral optimization.
Architectural Synthesis: circuit specification, strategies for architectural optimization, data-path synthesis, control unit synthesis and synthesis of pipelined circuits. ASIC design using FPGA and PLDs.

Recommended Books:

1. K. Eshraghian & D. A. Pucknell : Basic VLSI design: System & Circuit
2. R. K. Brayton : Logic Minimization Algorithms for VLSI Synthesis.
3. F. Lombardi : Testing and diagnosable Design of VLSI and ULSI.
4. C. A. Mead and L. A. Conway : Introduction to VLSI Systems.

Course objectives

1) The fundamental concepts of parallel and distributed system.
2) To study the difference between Parallel and Distributed system.
3) Analyze pipelining and vector processing.
4) To study and implementation the parallel programming.
5) To study parallel and distributed database.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. To develop and apply knowledge of parallel and distributed computing techniques and methodologies.
CLO 2. Analyze and evaluate pipelining and Vector processing,
CLO 3. Fundamental concepts of parallel programming,
CLO 4. To gain experience in the design development and performance analysis of parallel and distributed application.
CLO 5. Comparison between parallel and distributed database.

Table 4.33: CSE4213 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓			
PLO 4: Design			✓		
PLO 5: Problem Solving			✓		✓
PLO 6: Implementation			✓		✓
PLO 7: Experiment and Analysis					✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓
PLO 10: Communication					
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

CSE 4214: VLSI Design LAB
Credits: 1.5, Hours/Week: 3

Laboratory works based on CSE 4213.

Course objectives

1) The fundamental concepts of parallel and distributed system.

2) To study the difference between Parallel and Distributed system.
3) Analyze pipelining and vector processing.
4) To study and implementation the parallel programming.
5) To study parallel and distributed database.

Course Intended Learning Outcomes *(CILOs)*
After studying this course, the student will able to:

CLO 1. To develop and apply knowledge of parallel and distributed computing techniques and methodologies.
CLO 2. Analyze and evaluate pipelining and Vector processing,
CLO 3. Fundamental concepts of parallel programming,
CLO 4. To gain experience in the design development and performance analysis of parallel and distributed application.
CLO 5. Comparison between parallel and distributed database.

Table 4.34: CSE4214 Program Learning Outcome and Course Outcome Mapping

	CO 1	CO 2	CO 3	CO 4	CO 5
PLO 1: Knowledge	✓			✓	
PLO 2: Requirement Analysis	✓	✓			
PLO 3: Problem Analysis	✓	✓			
PLO 4: Design			✓		
PLO 5: Problem Solving			✓		✓
PLO 6: Implementation			✓		✓
PLO 7: Experiment and Analysis					✓
PLO 8: Community Engagement & Engg.					
PLO 9: Teamwork					✓
PLO 10: Communication					
PLO 11: Self-Motivated					✓
PLO 12: Ethics					

CSE 4215: Wireless Sensor Network
Credits: 3 Hours/Week: 3

CSE 4216: Wireless Sensor Network LAB
Credits: 1.5 Hours/Week: 3

This laboratory course is based on CSE 4215.

CSE 4221: Research Project (Part-II)
Credits: 3, Hours/Week: 6

Student will have to complete a full-length project work or thesis under the supervision of an appointed supervisor.

Viva-voce
Credits: 1.0
At the end of fourth year final examinations, interview in front of the board of examiners based on the courses of the corresponding year.