Khulna University of Engineering & Technology (KUET)

Department of Computer Science and Engineering (CSE)

Syllabus for Undergraduate Study

(Effective from the Academic Session: 2021-2022)

Summary of 1st Year 1st Term Courses

Course No.	Course Title	Theory Hrs./week L	Laboratory Hrs./Week P	Credit
CSE 1101	Structured Programming	3		3
CSE 1102	Structured Programming Laboratory		3	1.5
CSE 1107	Discrete Mathematics	3		3
PHY 1107	Physics	3		3
PHY 1108	Physics Laboratory		3	1.5
HUM 1107	English and Human Communication	3		3
HUM 1108	English and Human Communication Laboratory		3/2	0.75
MATH 1107	Differential and Integral Calculus	3		3
Total		15	7.5	18.75

Weekly Contact Hour = 15L+7.5P= 22.5 Hrs/week

Syllabus of 1st Year 1st Term Courses

CSE 1101: Structured Programming

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Programming Concepts and Structured Programming Language: Data types, Variables, Operators, Type of expressions, Control structures.
Functions and Program Structures: Function basics, Parameter passing conventions, Scope rules and storage classes, Recursion, Header files, Preprocessor, Arrays.
String and Pointers: Pointers and memory addressing, Arrays and pointer arithmetic, Strings, Algorithms.
User Defined Data Type: Structure, Structure bit fields, Structure padding, Unions, Enumeration.
Input and Output: Standard input and output, Formatted input and output, File access, Dynamic memory allocation, Valgrind, Garbage collection, Variable length argument list, Command line parameters, Error handling, Introduction to graphics routines, Compiling, Make file, Debugging.

CSE 1102: Structured Programming Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Laboratory works based on CSE 1101

CSE 1107: Discrete Mathematics

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Set Theory: Properties of sets, Partitions of sets, Power sets and partial ordered sets.
Functions: Functions defined on sets, Compositions of functions, Inverse functions, Generating functions, Growth of functions.
Relations: Relations on sets, Equivalence relations, Partial order relations, Recurrence relations and recursive algorithms.
Mathematical Logic: Propositional calculus and predicate calculus.
Mathematical Reasoning: Induction, Contradictions, Recursion, Proof techniques.
Number Theory: Elementary number theory, Modular arithmetic and their applications, Sequence and summations.
Counting: Permutations, Combinatorics, Principles of inclusion and exclusion.
Algebraic Structures: Rings and groups.
Graph Theory: Graphs, Paths and trees.

PHY 1107: Physics

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Heat and Thermodynamics: Kinetic theory of gases: Fundamental assumption of kinetic theory, pressure excreted by a perfect gas, gas laws, Brownian movement, degrees of freedom, principle of equipartition of energy, mean free path of gas molecules, Maxwell's Law of distributions of velocities. Thermodynamics: Zeroth law of thermodynamics, Adiabatic and isothermal transformation; First law of thermodynamics and its application, Second law of thermodynamics, Carnot's engine, Entropy changes in reversible and an irreversible process, Third law of thermodynamics.
Wave and Oscillations: Simple harmonic motion, superposition of simple harmonic motions, Damped and forced oscillation, Power dissipation and power absorption, Interference of sound wave, phase velocity and group velocity.
LASER Physics: History of LASER, Population inversion and stimulated emission, Generation of coherent radiation, Time coherence, Spatial coherence, Ruby LASER, Model of Ruby LASER, Gas LASER, He-Ne LASER, Semiconductor LASER, Applications of LASER.
Quantum Mechanics: Inadequacy of classical concepts, History of quantum mechanics, Planck's quantum theory, Photoelectric effect, Compton effect, Wave-particle duality, De-Broglie waves, Uncertainty principle and its applications, Sommerfeld relativistic atomic model, Orbital angular momentum, Spin angular momentum, Total angular momentum, Orbital magnetic quantum number and spin magnetic quantum number, Magnetic moment of an electron, Pauli's exclusion principle; Time-dependent and time independent Schrodinger equation, Interpretation of wavefunction, Expectation values, Probability density and probability current density, energy eigen values and eigen functions, stationary states.
Optics: Aberrations: Spherical aberration, coma, distortion, astigmatism, curvature of the field, Chromatic aberration and dispersion.
Interference of light: Huygens's principle and construction of wave front, Young's double slit experiment, Fresnel's bi-prism, Interference due to multiple reflections, Newton's rings.

PHY 1108: Physics Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Laboratory works based on PHY 1107

HUM 1107: English and Human Communication

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Vocabulary building, Rules of syntax, Grammatical principles, Sentence structure, Correction of errors, Transformation of sentences, Phrases and idioms, Prefixes and suffixes, Notions/functions of language, Classes, Antonyms and synonyms.

Written Communication: Comprehension, Construction of paragraphs on scientific and other themes, Precis writing, Technical and official correspondence, Technical report writing, Research paper writing, Tender notice, Free composition, Personal filing system.

Oral Communication: Listening skills, Oral presentation, Audio-visual communication, Interviewing skills.

HUM 1108: English and Human Communication Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Grammar: Tense, Article, Preposition, Subject-verb agreement, Clause, Conditional and sentence structure.

Vocabulary Building: Correct and precise diction, Affixes, Level of appropriateness, Colloquial and standard, Informal and formal.

Developing Reading Skill: Strategies of reading – Skimming, Scanning, Predicting, Inferring, Analyzing and interpreting variety of texts, Practicing comprehension from literary and nonliterary texts.

Developing Writing Skill: Sentences, Sentence variety, Generating sentences, Clarity and correctness of sentences, Linking sentences to form paragraphs, Writing paragraphs, Essays, Reports, Formal and informal letters.

Listening Skill and Note Taking: Listening to recorded texts and class lectures and learning to take useful notes based on listening.

Developing Speaking Skill: Oral skills including communicative expressions for personal identification, Life at home, Giving advice and opinion, Instruction and directions, Requests, Complaints, Apologies, Describing people and places, Narrating events.

MATH 1107: Differential and Integral Calculus

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Differential Calculus: Limit, Continuity and differentiability, Significance of derivatives, Successive differentiation of various types of functions, Leibnitz's theorem, Rolle's theorem, Mean value theorem, Taylor's theorem in finite and infinite forms, Maclaurin's theorem in finite and infinite forms, Partial differentiation of different multi-variable functions, Evaluation of indeterminate forms, Tangents, Normals, Subtangents and subnormals in cartesian and polar coordinates, Determination of maximum and minimum values of functions, Points of inflection with applications, Curvature and radius of curvature, Asymptotes, Curve tracing.

Integral Calculus: Definitions of integration, Integration by the method of substitution, Integration by parts, Integration by the method of successive reduction, Definite integrals, Definite integral's properties and use in summing series, Walli's formulae, Improper integrals, Differentiation and integration under sign of integration, Beta function and gamma function, Jacobian, Multiple integrals and their applications. Area of the region enclosed by curve in Cartesian and polar co-ordinates, Are lengths of curve in Cartesian and polar coordinates.

Summary of 1st Year 2nd Term Courses

Course No.	Course Title	Theory Hrs./week L	Laboratory Hrs./Week P	Credit
CSE 1203	Digital Logic Design	3		3.0
CSE 1204	Digital Logic Design Laboratory		3	1.5
CSE 1205	Object Oriented Programming	3		3.0
CSE 1206	Object Oriented Programming Laboratory		3	1.5
CHEM 1207	Chemistry	3		3.0
CHEM 1208	Chemistry Laboratory		3/2	0.75
EEE 1207	Basic Electrical Engineering	3		3.0
EEE 1208	Basic Electrical Engineering Laboratory		3	1.5
MATH 1207	Coordinate Geometry and Differential Equations	3		3.0
Total		15	10.5	20.25

Weekly Contact Hour = 15L+10.5P= 25.5 Hrs/week

Syllabus of 1st Year 2nd Term Courses

CSE 1203: Digital Logic Design

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Digital systems, Codes, Code conversion, Boolean algebra and switching theory. Boolean functions, Canonical forms, Minimization of Boolean functions, Different types of logic gates.

Combinational Circuits: Combinational circuit design issues, Adder, Subtractors, Arithmetic and data handling logic circuits, Decoders, Encoders, Multiplexers and demultiplexers, Binary parallel adder, Combinational logic with MSI and LSI, ROM, EPROM and PLA, PAL design, Digital display, Fan-in, Fan-out, Propagation delay, Power dissipation, Hazards in combinational circuit.

Sequential Circuits: Flip flops, State diagram, Timing diagrams, Mealy and Moor machines, State minimization and assignments, Design of counters, Register and the memory unit, Asynchronous counters and synchronous counters and their applications, Synchronous and asynchronous logic circuit design, Race around problems and races in sequential circuits.

CSE 1204: Digital Logic Design Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Laboratory works based on CSE 1203

CSE 1205: Object Oriented Programming

Credits: 3.0 **Contact Hours: 3L+0P Hrs/Week**

Introduction: Philosophy of Object Oriented Programming (OOP), Features of OOP, Advantages of OOP over structured programming, Classes and objects, Array of objects, Object references, Memory allocation of objects, Constructors, Destructors and different types of constructors, Function overloading, Operator overloading and type conversion of objects.
Inheritance: Types of inheritance, Composition and aggregation.
Polymorphism: Abstract classes, Virtual and pure virtual functions overriding, Interface, Runtime type identification (RTTI), Exception handling.
Template: Function templates, Class templates.
Namespace: Name conflict problem, Ways of using namespace.
Standard Template Library: Generic programming, Generic algorithm, Containers and their types.

CSE 1206: Object Oriented Programming Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Laboratory works based on CSE 1205

CHEM 1207: Chemistry

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Crystal Symmetry: Different methods for the determination of structure of crystals, Structures of the metallic elements and certain compounds with three-dimensional lattices, Defects in solid.
Chemical Bonding: Valence bond theory, Molecular orbital theory, Metallic bonding, Theory of resonance.
Electrochemistry: Electrolytic solution, Nernst theory of electrode potential, Nernst equation, Electrode potentials, EMF, Measurement of EMF, Polarization and over potential, Transport number, Electrical double layer, Mechanism of electrode reactions, Lithium-ion battery, Ni-battery.
Spectroscopy: Quantization of energy, Basic elements of spectroscopy.
Photochemistry: Laws of photochemistry, Quantum yield, Photosensitized reaction.
Chemistry of Polymerization: Polymerization reaction, Some synthetic and natural polymers and their electrical and electronic properties, Polymers used as engineering materials, Conducting polymer and fiber, Synthesis, Structure and properties of polymer.
Environmental Chemistry: Concept and scope of environmental science, Environmental segment: Lithosphere, Hydrosphere, Biosphere and atmosphere, Composition of atmosphere, Chemical and photochemical reactions in the atmosphere, Greenhouse effect/global warming, Industrial hazards, Corrosion, Air and water pollutants, Sources and different kinds of pollutants, Toxicity of pollutants.

CHEM 1208: Chemistry Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CHEM 1207

EEE 1207: Basic Electrical Engineering

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Direct Current: Voltage and current, Resistance and power, Laws of electrical circuits and methods of network analysis, Principles of D.C. measuring apparatus.
Alternating Current: Instantaneous and r.m.s. current, Voltage and power, Average power for various combinations of R, L and C circuits, Phasor representation of sinusoidal quantities, Introduction to three phase circuits.
Magnetism: Laws of magnetic fields and methods of solving simple magnetic circuits.
Electrical Machines: DC generators and alternators, Introduction to transformer and its operating principles, Operating principles of DC and stepper motors.

EEE 1208: Basic Electrical Engineering Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Laboratory works based on EEE 1207

MATH 1207: Coordinate Geometry and Differential Equations

Credits: 3.0 ***Contact Hours: 3L+0P Hrs/Week***

Co-ordinate Geometry of Two Dimensions: Translation and rotation of axes, Identification of conics with their properties.
Co-ordinate Geometry of Three Dimensions: Cartesian, Cylindrical polar and spherical polar coordinates, Distance of two points, Section formula, Projection, Direction cosines and direction ratios, Angle between two lines, Distance from a point to a line, Planes: Different forms of the equation of a plane, Distance of a point from a plane, Equations of bisector of planes, Straight line: Different forms of equations of straight line, Angle between a line and plane, Coplanar lines, Shortest distance between two lines, Sphere: General equation of the sphere, Tangent plane, Angle of intersection of two spheres, Cone: Equation with cone with its properties, Standard equations of central conicoids
Ordinary Differential Equations: Order and degree of ordinary differential equations, Formation of differential equations, Solutions of first order first degree differential equations by various methods, Solutions of general linear equations of second and higher orders with constant coefficients, Solution of linear homogeneous equations.
Partial Differential Equations (PDE): Linear PDE with constant coefficients, Solution by separation of variables.
Series Solution: Solution of differential equations in series by the method of Frobenius, Bessel's and Legendre's differential equations and their solutions.

Summary of 2nd Year 1st Term Courses

Course No.	Course Title	Theory Hrs./week L	Laboratory Hrs./Week P	Credit
CSE 2103	Microprocessors and Microcontrollers	3		3.0
CSE 2104	Microprocessors and Microcontrollers Laboratory		3	1.5
CSE 2105	Data Structures and Algorithms	3		3.0
CSE 2106	Data Structures and Algorithms Laboratory		3	1.5
CSE 2113	Computer Architecture	3		3.0
CSE 2114	Computer Architecture Laboratory		3/2	0.75
EEE 2117	Analog Electronics	3		3
EEE 2118	Analog Electronics Laboratory		3/2	0.75
MATH 2107	Fourier Analysis and Linear Algebra	3		3
ME 2170	Computer Aided Design Laboratory		3/2	0.75
Total		15	10.5	20.25

Weekly Contact Hours = 15L+10.5P = 25.5 Hrs/week

Syllabus of 2nd Year 1st Term Courses

CSE 2103: Microprocessors and Microcontrollers

Credits: 3.0 ***Contact Hours: 3L+0P Hrs/Week***

Introduction: Microprocessors, Microcomputers and microcontrollers, Different types of microprocessors and its applications.
Microprocessors: 8086 internal architectures, Processor status and flag registers.
Machine and Assembly Language Programming: Instruction format, Instruction sets, Opcode, Addressing modes, Branching and looping, Traps and interrupts, I/O operation, Interrupt controller, An overview of Intel 80186, 80286, 80386 and Pentium processors, RISC processors, Parallelism in microprocessor, Bit-slice processor.
Co-processors and DMA: Arithmetic co-processor, I/O processor, Programmable timer, DMA data transfer, DMA Controller.
Microcontrollers: Introduction to micro-controllers, Overview/review of microcontroller architecture, Data representation and memory usage, Microcontroller programming.
Microcontroller Based System Design: Hardware design, Building, Debugging, Testing and linking program modules, Hardware implementation and I/O support.
Analysis of Application Examples: Recursion and stack usage, Traffic light controller, Input / output architecture, Analysis of timing and memory requirements, Real time operation.
ARM Architecture Family (Cortex-M3): Introduction, Architecture Assembly, Memory, Peripheral, Bus, Interrupts, Timers.

CSE 2104: Microprocessors and Microcontrollers Laboratory

Credits: 1.5 ***Contact Hours:* 0L+3P Hrs/Week**

Laboratory works based on CSE 2103

CSE 2105: Data Structures and Algorithms

Credits: 3.0 ***Contact Hours: 3L+0P Hrs/Week***

Introduction: Data types: primitive and non-primitive, Data structure: linear and nonlinear, Abstract date type.
Array: Representation of arrays, Applications of arrays, Sparse matrix and its representation.
Stack: Basic Concept of Stack, Operations on stacks, Applications of stacks, Polish expression, Reverse polish expression, Conversion from infix to postfix/prefix expression, Evaluation of postfix/prefix expressions, Recursion, Tower of Hanoi.
Queue: Basic concept of queue, Representation of queue, Circular queue, priority Queue, Array representation of priority queue, Double ended queue, Applications of Queue.
Linked List: Array implementation of linked list, Types of linked list: Singly linked list, Doubly linked list, Circular linked list, Basic operations in linked list: Node creation, Node insertion and deletion from beginning, end and specified position.
Tree: Definitions and concepts, Representation of binary tree, Binary Search Tree (BST), Insertion, Deletion, Traversals, Search in BST, AVL trees, 2-3 trees, Heap, B-Tree.
Graphs: Definition and representation of graphs, Graph traversal, BFS, DFS, Shortest path algorithms, Topological sorting.
Sorting: Bubble, Selection, Insertion, Merge, Quick, Heap, Radix sort.
Searching and Hashing: Search Algorithms: Linear search and binary search, Hashing: Hash function and hash tables, Collision resolution techniques, Storage management.

CSE 2106: Data Structures and Algorithms Laboratory

Credits: 1.5 ***Contact Hours:* 0L+3P Hrs/Week**

Laboratory works based on CSE 2105

CSE 2113: Computer Architecture

Credits: 3.0 ***Contact Hours:* 3L+0P Hrs/Week**

Introduction: Organization and architecture, Structure and function, Importance of studying computer architecture and organization.
Computer Function and Interconnection: Computer function, Interconnection structure, Bus interconnection.
Cache Memory: Cache memory principle, Elements of cache design.
Internal Memory: Semiconductor main memory, Error correction.
External Memory: Magnetic disk, RAID, Optical memory**.**
Input/Output Interface: I/O modules, I/O Bus and Interface Modules, I/O vs. Memory Bus.
Modes of Transfer: Programmed I/O, Interrupt-driven I/O, Direct memory Access, Universal serial bus (USB).
Computer Arithmetic: Arithmetic and logic unit, Integer representation, Floating-point representation.
Instruction Sets: Characteristics and functions, Addressing mode and formats.
CPU Structure and Function: Processor organization, Register organization, Instruction cycle, Instruction pipelining.
Reduced Instruction Set Computers: Reduced instruction set architecture, RISC pipelining, RISC versus CISC.

Instruction-Level Parallelism and Superscalar: Basic view, design issues.
Control Unit Operation: Micro-operations, Control of the processor.

CSE 2114: Computer Architecture Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 2113

EEE 2117: Analog Electronics

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction to Semiconductors: P-n Junction diode characteristics, Diode applications: Half and full wave rectifiers, Stabilizer and UPS.
Bipolar Junction Transistor: Operation principles, Characteristics, Small-signal low frequency h-parameter model, Hybrid pie model, Amplifiers, Switches, Darlington pairs,
Field Effect Transistor (FET): Introduction to different FETs such as JFET, MOSFET, NMOS, PMOS and CMOS, Biasing and applications.
Operational Amplifiers: Gain, Input and output impedances. Offset null adjustment, Frequency response and noise, Active filters, Linear and nonlinear applications of Op-Amps, Regulated power supply, Stabilizer and UPS, Introduction to oscillators, Basic ideas about IC fabrication techniques.
Power Semiconductor Devices: SCR, TRIAC, DIAC, UJT and their applications.

EEE 2118: Analog Electronics Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3P Hrs/Week**

Laboratory works based on EEE 2117

MATH 2107: Fourier Analysis and Linear Algebra

Credits: 3.0 *Contact Hours:* 3L+0P Hrs/Week

Fourier Analysis: Fourier series and Fourier co-efficient, Dirichlet's condition and Fourier expansion, Convergence of Fourier series, Exponential form of Fourier series, Change of interval, Half range series, Parseval's identity, Fourier integrals.
Fourier Transforms: General transforms, Fourier sine and cosine transforms and their use in boundary value problems.
Z-transform: Discrete transform and definition of Z-transform, Properties, Stability, Causality, Region of convergence, Inverse Z-transform.
Linear Algebra: Matrix Operations: Field and matrices over a field, Product of matrices by partitioning, Symmetric, Diagonal and other special types of matrices with their properties, Elementary transformations and equivalent matrices, Rank, Inverse of a square matrix by elementary row operation.
Systems of Linear Equations: Consistency of systems of linear equations, Solutions of systems of homogeneous linear equations, Existence of nontrivial solutions of set of homogeneous linear equations, Solution of non-homogenous equations using matrix.
Vector Spaces: General vector spaces, Column, Row and null Spaces, Basis and Dimension.
Eigen Systems: Eigen values and Eigen vectors, Estimation of the size of Eigen values.
Inner-Product Vector Spaces: Inner-product spaces, Orthogonality.

ME 2170: Computer Aided Design Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Introduction, Scale drawing, Isometric views, Orthographic view, Missing line, Solidworks, Project on engineering drawing and CAD using AutoCAD or contemporary packages.

Summary of 2nd Year 2nd Term Courses

Course No.	Course Title	Theory Hrs./week L	Laboratory Hrs./Week P	Credit
CSE 2200	Advanced Programming Laboratory		3	1.5
CSE 2201	Algorithm Analysis and Design	3		3.0
CSE 2202	Algorithm Analysis and Design Laboratory		3	1.5
CSE 2208	Numerical Methods Laboratory		3	1.5
CSE 2209	Theory of Computation	2		2.0
ECE 2213	Digital Electronics	3		3.0
ECE 2214	Digital Electronics Laboratory		3	1.5
HUM 2207	Economics and Accounting	3		3.0
MATH 2207	Complex Variable, Vector Analysis and Statistics	3		3.0
Total		14	12	20

Weekly Contact Hours = 14L+12P=26 Hrs/week

Syllabus of 2nd Year 2nd Term Courses

CSE 2200: Advanced Programming Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

JAVA concepts, Review of OOP concepts, Inheritance and exception handling, Packages & interfaces, Graphical user interface (GUI), Layout, Custom view, Scalable user interface, User experience (UX), Multithreading, Socket programming, Activity, Services, Broadcast receiver, Content provider, Basic networking, Database manipulation and advanced APIs, Parsing (JSON, XML etc.). Students will submit individual small projects using advanced programming knowledge.

CSE 2201: Algorithm Analysis and Design

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Analysis of Algorithms: Time and space complexity analysis, Correctness and loop invariants, Algebraic simplification and transformations Lower bound theory, NP-completeness, NP-hard and NP-complete problems.
Algorithmic Techniques: Divide-and-conquer, Greedy method, Dynamic programming, Backtracking, Branch and bound, Flow algorithms, Approximation algorithms, Introduction to parallel and randomized algorithms.

Search and Traversal Techniques: Basic search and traversal techniques, Topological sorting, Connected components, Spanning trees, Shortest paths.

CSE 2202: Algorithm Analysis and Design Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Laboratory works based on CSE 2201

CSE 2208: Numerical Methods Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Solution of Non-linear Equations: Bi-section method, Secant method, False position method, Newton-Raphson method.
Solution of Linear Equations: Algorithms for Gauss elimination, Gauss-Jordan elimination method, LU-factorization.
Interpolation and Approximation: Newton forward and backward interpolation formula with errors.
Numerical Integration: Simpson's rule, One-third rule, Simpson's three-eighths rule, Trapezium rule, Trapezoidal rule.
Numerical Differentiation: Differentiation based on equal-interval interpolation, Second order derivative, Differentiation based on Lagrange's interpolation.
Solution of Differential Equations: Runge–Kutta method, Matrix inversion
Curve Fitting: Least squares lines, Least square polynomials and Non-linear curve fitting.

CSE 2209: Theory of Computation

Credits: 2.0 ***Contact Hours:*** **2L+0P Hrs/Week**

Introduction: Formal language theory, Formal proof, Inductive proofs and Central concepts of automata theory.
Finite Automata: Deterministic finite automata, Nondeterministic finite automata, Finite automata with ε-transitions, Equivalence and conversion of deterministic and nondeterministic finite automata.
Regular Expressions and Languages: Regular expressions, Algebraic laws for regular expressions, Regular languages, Pumping lemma, Closure and decision properties of regular languages.
Context Free Grammar and Languages: Context free grammars, Parsing (or derivation) and parse trees, Ambiguity in grammars and languages, Normal forms for context-free grammars, Pumping lemma for CFL's, Closure and decision properties of CFL's.
Push Down Automata: Push down automata, Acceptance by empty store and final state, Equivalence between pushdown automata and context-free grammars, Deterministic push down automata.
Turing Machines: Turing machines, The church-Turing machine, Techniques for Turing machine construction, Configurations, Computing with Turing machines, Restricted Turing machines, Turing machines and computers, Combining Turing machines.

ECE 2213: Digital Electronics

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Logic Gates: Diode logic gates, Transistor gates, MOS gates.
Logic Families: TTL, ECL, IIL and CMOS logic with operation details, Propagation delay, Product and noise immunity, Open collector and high impedance gates, Electronic circuits for flip-flops, Counters and register, Memory system, PLAs, PLDs, ADC, DAC design with applications, S/H circuits, LED, LCD and optically coupled oscillators.
Wave Shaping: Diode wave shaping techniques, Clipping and clamping circuits, Comparator circuits, Switching circuits, Pulse transformers, Pulse transmission, Pulse generation, Monostable, Bistable and astable multivibrators, Schmitt trigger, Blocking oscillators and time base circuit, Timing circuits, Simple voltage sweeps, Linear current sweeps.
Instruments: Digital meters, DMM, VTVM, Q meters, Statistical methods in measurements.

ECE 2214: Digital Electronics Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Laboratory works based on EEE 2113

HUM 2207: Economics and Accounting

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Economics: Introduction: Definition of economics, Scope and importance of economics, Basic economic problems, Different economic systems, Production possibility frontier, Opportunity cost; Demand and Supply: Concept of demand and supply, Equilibrium of demand and supply, Application of equilibrium of demand and supply; Elasticity of Demand and Supply: Price elasticity, Cross price elasticity, Income elasticity, Calculation of elasticity, Application of elasticity; Consumer Behavior: Concepts of utility, Total, average and marginal utility, Law of diminishing marginal utility, Indifference curve, Budget line, Consumer equilibrium, Consumer's surplus; Producer Behavior: Concepts of production, Iso-quant and Iso-cost line, Factors of production, Total, average and marginal product, Laws of diminishing returns, Returns to scale, Producer's surplus, Total, average and marginal cost, Fixed and variable Cost, Short and long run cost, Externalities of economics; Basic Macroeconomics: National income, Investment, Inflation, Unemployment, Project analysis, NPV, IRR and their application, Cost benefit analysis; International Trade: Basic concepts of International trade, Theory of absolute and comparative advantage.
Accounting: Introduction: Definition of accounts, Its need and importance, Accounting and its environment, Users of accounting information, Generally accepted accounting principles (GAAP), Relationship of accounting with engineering education, Business transactions, Step in the recording process, Rules of debit and credit, Double entry system of accounting, The journal, The ledger, Cash book, The trial balance, Financial statement.
Cost Accounting: Concept of cost, Classification of cost, Statement of cost, Operating and service costing, Salary and wages/payroll account.

MATH 2207: Complex variable, Vector Analysis and Statistics

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Complex Variable: Complex number system, General functions of a complex variable, Limits and continuity of a function of complex variable and related theorems, Analytic functions, Complex differentiation, Sufficient condition for analyticity and Cauchy Riemann equations, Harmonic functions and conjugate harmonic functions, Construction of analytic functions when either part is given (Milne-Thomson method), Different types singularities, Line integral of a complex function, Cauchy's integral theorem and converse of Cauchy's theorem.

Vector Analysis: Transformation of vectors on a plane: Scaling, Rotation, Translation, Linear dependence and independence of vectors, Scalar and vector fields, Differentiation of vectors together with elementary applications, Gradient, Divergence and curl of point functions and related forms, Green's, Stokes' and Gauss' theorem and their applications.
Statistics: Moment, Skewness and kurtosis, Random variables, Probability mass functions and probability density functions.
Expectation: Expected value and variance with their properties.
Discrete Probability Distributions: The Bernoulli and Poisson process, Binomial and Poisson probabilities, Distribution and properties.
Continuous Probability Distributions: Normal variate and normal distribution, Properties of normal distribution, Standard normal variate and standard normal distribution, Properties of standard normal distribution, Uniform distribution and it's properties.

Summary of 3rd Year 1st Term Courses

Course No.	Course Title	Theory Hrs./week L	Laboratory Hrs./Week P	Credit
CSE 3100	Web Programming Laboratory		3	1.5
CSE 3101	Operating Systems	3		3.0
CSE 3102	Operating Systems Laboratory		3	1.5
CSE 3105	Embedded Systems and Internet of Things	3		3
CSE 3106	Embedded Systems and Internet of Things Laboratory		3/2	0.75
CSE 3107	Applied Statistics and Queuing Theory	3		3.0
CSE 3109	Database Systems	3		3.0
CSE 3110	Database Systems Laboratory		3	1.5
CSE 3119	Information Systems Design	3		3.0
CSE 3120	Information Systems Design Laboratory		3/2	0.75
Total		15	12	21.00

Weekly Contact Hours: 15(L) +12(P) =27 Hrs/W

Syllabus of 3rd Year 1st Term Courses

CSE 3100: Web Programming Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Internet communication protocols such as TCP/IP, FTP, SMTP and HTTP, Basic networking concepts, Advanced Web page development with dynamic HTML, JavaScript, AJAX, jQuery and Cascading Style Sheets, Server-side development technologies such as Perl, PHP, Laravel-PHP Framework, ASP.net, MVC Framework, Java Servlets, JSP and JSP.net, Basic SQL for database interaction.

CSE 3101: Operating Systems

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: The role of an operating system in computer systems, Operating system structure and operation.
Process Management: Process concept, Process scheduling, Process state, Process management, Co-operating processes, Inter-process communication (IPC), Kernel.
Threads: Multithreading models, Threading issues.
CPU Scheduling: Scheduling criteria, Scheduling algorithm, Algorithm evaluation.
Process Synchronization: Critical-section problem, Synchronization hardware, Semaphores, Classic problems of synchronization.
Deadlocks: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.
Storage Management: Swapping, Contiguous memory allocation, Paging, Segmentation and segmentation with paging.
Virtual Memory: Demand paging, Page replacement, Thrashing.
File Concept: File support, Access methods, Allocation methods, Directory systems, File protection, Free space management.
Distributed Systems: Types of distributed operating system, Communication protocols.
Distributed File Systems: Naming and transparency, Remote file access.
Protection and Security: Goals of protection, Domain of protection, Access matrix, Implementation of access matrix, The security problem, User authentication, Security system and facilities.
Case Studies: Study of a representative operating system, OS administration.

CSE 3102: Operating Systems Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Laboratory works based on CSE 3101

CSE 3105: Embedded Systems and Internet of Things

Credits: 3.0 **Contact Hours: 3L+0P Hrs/Week**

Introduction to Embedded Systems: Embedded systems' overview, Parts of an embedded system, Characteristics of embedded systems, Embedded systems' design challenges – Optimizing design metrics, Constraint driven design, IP based design, Design methodology, Embedded systems on chip (SOC) Technology.
Software Issues: Embedded programming, Designing, implementing and testing software for embedded systems, Embedded software development process and tools, Real-time operating system (RTOS).
Hardware Issues: Choice of: Processor, Memory, I/O, Interfacing to commonly used I/O devices, Types of interconnections, Sensors for measuring physical phenomena, Output devices such as power actuators and motors. Hardware and software co-design Issues.
Internet of Things (IoT): Introduction to IoT, IoT Devices, Trends in the adoption of IoT, Machine-to-machine communications, Interoperability in IoT, Programming with Arduino, Programming with raspberry Pi, Implementation of IoT with Arduino and raspberry Pi, Data handling and Analytics, Cloud computing, Fog computing, Industrial IoT.
Case Study: Healthcare, Agriculture, Connected vehicles, Wearables, Smart home, Smart city.

CSE 3106: Embedded Systems and Internet of Things

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 3105

CSE 3107: Applied Statistics and Queuing Theory

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Review of probability concepts, Bayes' theorem, Random variables, Probability distributions.

Distribution of Sampling Statistics: Sample, Population, Sample mean & variance, Distribution of sample mean, Central limit theorem.

Parameter Estimation: Estimation of population mean, Interval estimators & lower-upper bounds of population mean using known and unknown variance.

Hypothesis Testing: Test concerning the mean of a normal population, Testing equality of means of two normal populations, Test concerning the variance of normal population, Statistical significance, T-tests, Chi-Square tests, Chi-Square test of goodness-of-fit.

Correlation and Regression: Sample correlation coefficient, Rank correlation, Simple linear regression model, Estimation of the regression parameters, Method of least squares, Error of random variable, Regression to the mean, Coefficient of determination, Tests of independence and goodness of fit.

Analysis of Variance: One-way analysis of variance and two factor analysis of variance.

Stochastic Process: Poisson process, Discrete time Markov chains, Continuous time Markov chains, Steady-state behavior of a Markov chain, Birth-death process.

Queuing Systems: Queuing system's nomenclature, Kendall notation, Little's theorem.

Markovian and Semi-Markovian Queuing Models: Performance measures of M/M/1, M/M/C, M/M/1/S, M/G/1, M/D/1, G/M/1 queuing systems

Network of Queues: Open Queuing Network: Markovian queues in tandem, Burke' theorem, Jackson open network, Closed queuing network: Jackson closed network, Buzen's convolution algorithm, Phase-dependent arrival and service application of queuing models.

CSE 3109: Database Systems

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Database System Concepts: Data models, Schemas and instances, DBMS architectures.

Relational Model: Entity relationship model, Keys, Relationships, ER diagrams, Design issues, ER to relational mapping.

Relational Algebra: Basic relational algebra Operations, Additional relational operations. SQL, QBE, Query processing and optimization, Triggers and cursors, Database server administration.

Relational Constraints, Functional Dependencies: Relational constraints and relational database schema, Functional dependencies.

Normalization: Normal form based on primary keys, General definitions of second and third normal form, Boyce-Codd normal form.

Database Indexing and Index Structures: Types of single level ordered index, Multilevel indexes, Dynamic multilevel indexes, Dynamic multilevel indexes using B-trees and B^+ trees, Indexes on multiple keys.

Transaction Processing and Management: Introduction to transaction processing, Transaction and system concepts, Properties of transaction, Schedules and recoverability, Serializability of schedules.

Concurrency Control Techniques: 2PL, Serializability and recoverability, Lock management, Lock conversions, Dealing with deadlocks, Specialized locking techniques, Concurrency control without locking.

Database Security and Authorization: Introduction to database security, Access control, Discretionary access control, Mandatory access control, Security for internet applications.

Information Retrieval and XML Data: Introduction to information retrieval**,** Indexing for text search**,** Data model for XML, Querying XML data, Evaluation of XML queries.

CSE 3110: Database Systems Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Laboratory works based on CSE 3109

CSE 3119: Information Systems Design

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

System Analysis Fundamentals: Different types of information, Attributes of information, Roles, tasks and attributes of a system analyst, Systems and development methodologies, Understanding and modeling organizational system, System development life cycle, Project management.

Information Requirements Analysis: Requirement determination, Use Cases analysis, Interactive methods.

Information Gathering: Sources of information, Handling of missing information, Unobtrusive methods, Agile modeling and prototyping.

The Analysis Process: Feasibility analysis, Cost/benefit analysis, Data flow diagrams, Analyzing systems using data dictionaries, Process specifications and structured decisions, Object-oriented systems analysis and design using UML.

The Essentials of Design: Designing effective output, Designing effective input, Designing databases, Human-computer interaction.

Quality Assurance and Implementation: Designing accurate data entry procedures, Quality assurance, Implementation and testing.

Security: Disaster, recovery and ethics in system development.

CSE 3120: Information Systems Design Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 3119

Summary of 3rd Year 2nd Term Courses

Course No.	Course Title	Theory Hrs./Week L	Laboratory Hrs./Week P	Credit
CSE 3200	System Development Project		3	1.5
CSE 3209	Artificial Intelligence	3		3.0
CSE 3210	Artificial Intelligence Laboratory		3	1.5
CSE 3211	Compiler Design	3		3.0
CSE 3212	Compiler Design Laboratory		3/2	0.75
CSE 3217	Mobile Computing	3		3.0
CSE 3218	Mobile Computing Laboratory		3/2	0.75
CSE 3219	Software Engineering and Project Management	3		3.0
CSE 3220	Software Engineering and Project Management Laboratory		3/2	0.75
CSE 3230	Technical Writing and Seminar		3/2	0.75
HUM 3247	Engineers and Society	3		3.0
Total		15	12	21.00

Weekly Contact Hours: 15(L) + 12(P) =27 Hrs/Week

Syllabus of 3rd Year 2nd Term Courses

CSE 3200: System Development Project

Credits:1.5 ***Contact Hours:*** **0L+3PHrs/Week**

Students will work in groups or individually to develop a term project to solve complex engineering problems. It may include I/O drivers, operating systems modules, or software solutions of some practical problems involving complex engineering process. Students will develop a software system using recent technologies/programming maintaining software engineering principles with proper documentation.

CSE 3209: Artificial Intelligence

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Definition of Artificial Intelligence (AI), AI techniques, Applications.
Intelligent Agent: Introduction, Structure of intelligent agent, Agent programs, Goal-based agents, Environments.
Problem Solving: Solving problem by searching, Problem solving by agent, Formulating problems, Toy problems, Search strategies, Breadth-First, Bi-directional, Uniform cost, Depth-First, Depth-limited and iterative deepening search, Informed search methods**,** Best-First, Greedy and A* search, Heuristic functions, IDA* search, Iterative improvement algorithms, Hill-Climbing search, Simulated annealing, Introduction to game playing, Perfect decisions in two person games, Imperfect decisions, Alpha-Beta pruning, State-of-the-Art games programs: Chess, Checkers, Backgammon.
Knowledge and Reasoning: Knowledge-Based agent, Knowledge representation, Reasoning and logic, Propositional logic.
First-Order Logic: Syntax and semantics, Terms, Atomic and complex sentences, Quantifiers, Equality, Extensions and notational variants, Higher-order logic, Using first-order logic, Axioms, Definitions and theorems.
Inference in First-Order Logic: Inference rules involving quantifiers, Generalized modus ponens, Canonical form, Unification, Forward and backward chaining, Completeness, Resolution inference rule, Canonical forms for resolution, Resolution proofs, Conversion to normal form.
Uncertain Knowledge and Reasoning: Uncertainty**,** Acting under uncertainty, Basic probability notation, Conditional probability, Axioms of probability, Bayes rules and its use, Normalization.
Probabilistic Reasoning Systems: Representing knowledge in an uncertain domain, Knowledge engineering for uncertain reasoning, Default reasoning, Rule-based methods for uncertain reasoning, Dempster-Shafer theory, Fuzzy sets and fuzzy logic.
Communicating, Perceiving, Planning and Acting: Natural language understanding: Syntactic processing, Ambiguity resolution, Text understanding. Action: The situation calculus, A simple solution to the framework problem, Complex actions. Planning: Planning in the situation calculus, The STRIPS representation, Planning as a reasoning task.

CSE 3210: Artificial Intelligence Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Laboratory works based on CSE 3209

CSE 3211: Compiler Design

Credits: 3.0 ***Contact Hours:*****3L+0P Hrs/Week**

Introduction to Compiler: Phases of compilation and overview, Compiling techniques including parsing, Semantic processing and Optimization, Compliers and translator writing systems.
Lexical Analysis: The role of the lexical analyzer, Specification and recognition of tokens, Lexical analyzer generator.
Syntax Analysis (Parser): Top-down parsing, Bottom-up parsing, Operator-precedence parsing, Ambiguity, LL and LR parsers.
Semantic Analysis: Attribute grammar, Syntax directed definition, Evaluation and flow of attribute in a syntax tree.
Type Checking: Syntax directed translation, Error management, Error detection and recovery.
Symbol Tables: Data structures for symbol tables.
Run-Time Storage Management and Support: Parameter passing mechanisms, Stack storage organization and templates, Heap storage management, memory allocation and scope.
Intermediate Code Generation: Translation of different language features, Different types of intermediate forms, languages, declarations and assignment statements.
Code Improvement: Analysis: Control-flow, Data-flow dependence etc., Code improvement local optimization, global optimization, Garbage Collection, Loop optimization, Peep-hole optimization etc. Architecture dependent code improvement: Instruction scheduling, Loop optimization etc.
Code Generation: Register allocation and target code generation.

CSE 3212: Compiler Design Laboratory

Credits:0.75 ***Contact Hours:*** **0L+3/2PHrs/Week**

Laboratory works based on CSE 3211

CSE 3217: Mobile Computing

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Mobile Computing Overview: Mobile technologies, Anatomy of a mobile device, Survey of mobile devices, Applications of mobile computing.
Application Design: Context, Information architecture, Design elements, Mobile web versus native applications.
Development Environments: Introduction to Objective-C, The Model-View-Controller model, The Delegate pattern, The iPhone, Android & Blackberry SDKs.
Application Environments: Limited resource computing, Memory management, Low power computing, Fault tolerance and persistence, Security issues.
Wireless Communication Technologies: Cellular networks, Wireless (802.11), TCP/IP in the mobile setting, Geo-location and Global Positioning System (GPS).
Energy Efficient Computing: Energy-efficiency basics, SPEED: Processor, SLEEP: Full-system, Power management, Green ICT standard, Sustainability of ICT products.
User Experience: Small screen problem, Unified look and feel paradigm, iPhone human interface guidelines, Android user interface guidelines, Others user interface guidelines.
Distributed Computing: Consistency and reliability, Security issues, Ad hoc networks, Sensor networks.
Future of Mobile Computing: Upcoming technologies, Convergence of media and communication devices.

CSE 3218: Mobile Computing Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 3217

CSE 3219: Software Engineering and Project Management

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Design Patterns: GRASP patterns with general principles, GoF design patterns.
Software Testing Techniques and Strategies: White box and Black box testing, Basis path testing, Cyclomatic complexity, Unit testing, Mutation, Regression, Integration, System testing, Error seeding, Stress testing, Behavior driven test, Test automation, Debugging approaches.
Software Reliability and Quality Assurance: Reliability metrics, Growth modeling, Software quality, Quality management system, Release planning, Tools for software release ISO 9000, SEI CMM, Comparison between SEI CMM and ISO 9000.
Security: Disaster, recovery and ethics in system development.
Concepts of Software and Software Engineering: Software process models, Software project management, Requirement engineering.
Design and Analysis: Object-oriented analysis and models, SRS documentation, Design concepts and principles, Architectural design, Object-oriented design, Use case, UML diagrams, Software case tools.
Cost Model: Cost estimation techniques, Algorithmic cost modeling, COCOMO.
Software Metrics: Function-oriented metrics, Size-oriented metrics, Risk analysis and management, Software maintenance.
Principles of Software Project Management: Basic Project Management (PM) skills, SPM framework, Elements, stakeholders, boundaries and challenges of SPM Software.
Project Planning: Planning objective, Project plan, Project estimation, Estimation methods, Models and decision process.
PM Organization and Scheduling: Work Breakdown Structure (WBS), Types of WBS, Functions, Activities, Tasks, Life cycles, Phasing and purpose of phasing, Building project schedule, Network diagrams: PERT, CPM, Bar charts, Gantt charts.
Software Project Management Techniques: Use of methodologies, Managing risks and issues, Managing quality, Configuration, Change, Crisis, Documentation, Release.

CSE 3220: Software Engineering and Project Management Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 3219

CSE 3230: Technical Writing and Seminar

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Reading, writing and summarizing technical papers, Citation methodologies, Plagiarism issues, Presentation guidelines and techniques, Summarization and presentation of technical papers, Scientific report writing style and related software.

HUM 3247: Engineers and Society

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Introduction to profession and professional, Professional engineers, Engineer at public and private sectors.
Engineering Accreditation: Introduction to accreditation body (MQA, EAC), Why need accreditation?
Professional Codes of Ethics: CSE code of ethics, IEEE code of ethics, Problems with codes of ethics.
Engineers and Laws: Engineers acts, Civil laws, Crimes and constitutions.
Responsibilities of Engineers: Role of professional engineers in practice, Commitment to society, Sustainable development, Technology and society, Risk, Safety and Liability.
Rights of Engineers: Workplace rights, Whistle blowing, Professionalism for international engineers, Challenges of globalization.
Engineers and Research: R & D, Government and private research grant, Copyright, Innovations, Intellectual property etc.
Ethics: Goodness, Rightness, Consequentialism, Utilitarianism, Business ethics, Environmental and social ethics, Computer and information ethics, Developing the ethical analysis skills and professional values.
Cyber Crimes and Law: Overview of cyber law, Cyberspace, Cybercrimes against individuals, Institution and state, Hacking, Digital forgery, Cyber stalking/harassment, Identity theft & fraud, Cyber terrorism, Cyber defamation, Different offences under ICT Act, 2006, Digital security Act, 2018, Interface with copyright law, Interface with patent law.

Summary of 4th Year 1st Term Courses

Course No.	Course Title	Theory Hrs./Week L	Laboratory Hrs./Week P	Credit
CSE 4000	Capstone Project/Thesis		3	1.5
CSE 4101	Computer Graphics and Image Processing	3		3.0
CSE 4102	Computer Graphics and Image Processing Laboratory		3/2	0.75
CSE 4105	Computer Networks	3		3.0
CSE 4106	Computer Networks Laboratory		3	1.5
CSE 4115	Computer Security	3		3.0
CSE 4116	Computer Security Laboratory		3/2	0.75
CSE xxxx	Course from Optional-I (3.00 + 0.75)	3	3/2	3.75
CSE xxxx	Course from Optional-I (3.00 + 0.75)	3	3/2	3.75
Total		15	12	21.00

Weekly Contact Hours = 15L+12P=27 Hrs/week

Summary of Optional-I Courses

Optional-I should be selected from the following courses:

Course No.	Course Title	Theory Hrs./Week L	Lab. Hrs./Week P	Credit
CSE 4103	VLSI Design	3		3.0
CSE 4104	VLSI Design Laboratory		3/2	0.75
CSE 4107	Digital Signal Processing	3		3.0
CSE 4108	Digital Signal Processing Laboratory		3/2	0 .75
CSE 4111	Machine Learning	3		3.0
CSE 4112	Machine Learning Laboratory		3/2	0.75
CSE 4117	Modeling and Simulation	3		3.0
CSE 4118	Modeling and Simulation Laboratory		3/2	0.75
CSE 4121	Natural Language Processing	3		3.0
CSE 4129	Ubiquitous Computing	3		3.0
CSE 4130	Ubiquitous Computing Laboratory		3/2	0.75
CSE 4122	Natural Language Processing Laboratory		3/2	0 .75
CSE 4131	Pattern Recognition	3		3.0
CSE 4132	Pattern Recognition Laboratory		3/2	0 .75

Syllabus of 4th Year 1st Term Courses

CSE 4000: Capstone Project/Thesis

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Study and solution of complex engineering problems in the field of Computer Science and Engineering.
N.B.: The project/thesis topic selected in this term is to be continued in the next term.

CSE 4101: Computer Graphics and Image Processing

Credits: 3.00 ***Contact Hours:*** **0L+3P Hrs/Week**

Introduction: Display devices, Input devices, Graphics pipeline.
Scan Conversion: Basic rasterization algorithms, Polygon filling.
Geometric Object and Transformation: 3D Graphics primitives, Basic and composite transformations of 3D objects.
Viewing: Classical and computer viewing, 3D viewing and projective transform.
Lighting and Shading: Local and global illumination models, Polygon shading methods.
Surface Culling: Need for back-face removal, Hidden surface detection algorithms.
Digital Image Fundamentals: Different types of digital images, Sampling and quantization, Imaging geometry, Image acquisition systems, Image transformation.
Images Enhancement: Point processing, Spatial filtering, Frequency domain filtering, Image smoothing and sharpening.
Image Restoration: Degradation models, Inverse filtering, Wiener filtering.

CSE 4102: Computer Graphics and Image Processing Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3P Hrs/Week**

Laboratory works based on CSE 4101

CSE 4105: Computer Networks

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Network, Internet, Intranet, Communication basics, Delay and loss, Protocols.
Data Communications: Data and signals, Digital transmissions: Line coding methods, Block coding, Pulse Code Modulation (PCM), Delta Modulation (DM), Analog transmission: ASK, FSK, PSK, QAM, AM, FM, PM, Transmission Modes.
Physical Layer: Guided transmission media, Wireless transmission medium, Circuit switching and telephone network, High speed digital access.
Link Layer and Local Area Networks: Link layer services, Error detection and correction techniques, Multiple access protocols, CSMA, CSMA/CD, Slotted ALOHA, LAN address and ARP, Ethernet, Hub, Bridge and switch, Wireless links, Wi-Fi and WLAN architecture, Bluetooth, PPP.
Network Layer and Routing: Network layer services, Internet Protocol (IP): IPv4 addressing, IPv6, ICMP, DHCP and NAT; Routing principles, Distance vector and link state routing algorithms, Multicast routing, Router architecture.
Transport Layer: Transport layer services, Connectionless transport and UDP, Principles of reliable data transfer, Connection oriented transport and TCP, Principles of congestion control, Congestion and flow controls with TCP, Protocols for real-time interactive applications, RTP, RTCP.

Application Layer: Principles of application layer protocols, Web and HTTP, FTP, Electronic mail: SMTP, POP3, IMAP; DNS, P2P.

CSE 4106: Computer Networks Laboratory

Credits: 1.5 ***Contact Hours:*** **0L+3P Hrs/Week**

Laboratory works based on CSE 4105

CSE 4115: Computer Security

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction and Mathematical Foundations: Overview of modern cryptography, Number theory, Probability and information theory.
Cryptography: Mechanisms and cryptanalysis of classical cryptosystems, Shannon's theory, Symmetric key cryptography including AES and DES, Asymmetric key cryptography including RSA and ElGamal cryptosystems, Digital signature including RSA, ElGamal and DSA, Hash functions including MD and SHA, Message authentication codes.
Security Protocols: Key exchange, Authentication, Authentication and key exchange, Secret splitting and secret sharing.
Program Security: Attacks, Malware, Viruses and other malicious codes, Controls against program threats.
Networks Security: Network protocols, Kerberos, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Threats in networks, Network security controls, Firewalls, Intrusion detection system, Secure e-mail, Web security.
Access Control: Security models and access policies, Access control in operating systems and databases.

CSE 4116: Computer Security Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 4115

Syllabus of Optional-I Courses

CSE 4103: VLSI Design

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Introduction to design methodology, Introduction to microelectronics and CMOS technology, Brief overview of fabrication process, Basic electrical properties of CMOS and BiCMOS circuits.
Hardware Modeling: Logic networks, State diagrams, Data flow, Behavioral optimization, Introduction to GaAs technology: Ultra-fast VLSI circuits and systems.
CMOS and BiCMOS Design Process: Stick diagram and lambda-based design rules, Subsystem design processes.
Subsystem Design Layout: Gate logic, Combinational design, Clocked sequential circuits, Bus designs.
Design of Computational Elements: ALU sub-system, Adder, Multipliers, Memory, Registers and aspects of system timing, Architectural synthesis: Circuit specification, Architectural optimization, Data-path synthesis, Control unit synthesis, Synthesis and testing of VLSI circuits, Various CAD tools for design, Simulation and verification: Introduction to Hardware Description Languages (VHDL and Verilog), Design style: FPGA and CPLDs.

CSE 4104: VLSI Design Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 4103

CSE 4107: Digital Signal Processing

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Representation of discrete-time signals and systems, Sampling of continuous-time signals, Discrete Fourier Transform (DFT), Computation of DFT, Z-transform, Spectral analysis of signals using DFT, Introduction to filter design, Digital filter structure, Infinite impulse response filter design techniques, Finite impulse response filter design techniques, Applications of DSP in audio, Image and video processing.

CSE 4108: Digital Signal Processing Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 4107

CSE 4111: Machine Learning

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Basic Concepts of Machine Learning: Aspects of machine learning, Supervised, unsupervised, semi-supervised and reinforcement learning, Evaluation of hypothesis, Practical applications of machine learning, Bayesian estimation, Maximum likelihood estimation (MLE), Maximum a posteriori (MAP), Linear and logistic regression, Bias-variance tradeoff, Regularization.
Artificial Neural Networks: Neurons and biological motivation, Perceptron and solving Boolean functions, Feed forward and recurrent networks, Single layer and multilayer networks, Back-propagation training method, Radial basis function networks, Associative memory, Ensemble methods.
Support Vector Machines: Linear maximal margin classifier, Linear soft margin classifier; Nonlinear classifier, Kernels.
Decision Trees: Recursive induction, Splitting attribute selection, Entropy and information Gain, Overfitting and pruning, ID3 and C4.5 algorithms.
Genetic Algorithms: Motivation from natural evolution, Genetic operators, Fitness function, Genetic algorithms for optimization.
Swarm Intelligence: Features of natural swarms, Swarm based methods for optimization: Ant colony optimization, Particle swarm optimization.
Clustering and Unsupervised Learning: Learning from unclassified data, Clustering, Hierarchical agglomerative clustering, K-means partitional clustering.
Dimensionality Reduction: Curse of the dimensionality, Empty space phenomenon, Linear and nonlinear techniques for dimensionality reduction, Principal Component Analysis (PCA).

CSE 4112: Machine Learning Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 4111

CSE 4117: Modeling and Simulation

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Basic Simulation Modeling: Systems, Models and simulation, Classification of simulation models, Steps in a simulation study.
Concepts in Discrete-Event Simulation: Event-scheduling vs. process-interaction approaches, Time-advance mechanism, Organization of a discrete-event simulation models, Continuous simulation models, Combined discrete-continuous models, Monte Carlo simulation, Simulation of queuing systems.
Building Valid and Credible Simulation Models: Validation principles and techniques, Statistical procedures for comparing real-world observations and simulated outputs, Simulation and analytical methods for analysis of computer systems and practical problems in industry, Introduction to the development of simulation packages, Introduction to petri nets and their applications to computing systems.

CSE 4118: Modeling and Simulation Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 4117

CSE 4121: Natural Language Processing

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: NLP tasks in syntax, Semantics and pragmatics, Applications such as information extraction, Question answering and machine translation, The problem of ambiguity, The role of machine learning, Brief history of the field.
N-gram Language Models: The role of language models, Simple N-gram models, Estimating parameters and smoothing, Evaluating language models.
Part of Speech Tagging and Hidden Markov Models: The concept of parts-of-speech, Examples, Usage, The Penn Treebank and brown corpus, Probabilistic (weighted) finite state automata, Hidden Markov Models (HMMs), Definition and use, Lexical Semantics, Pragmatics.
Syntactic Parsing: Grammar formalisms and treebanks, Efficient parsing for Context-Free Grammars (CFGs), Statistical parsing and probabilistic CFGs (PCFGs), Lexicalized PCFGs, Neural shift-reduce dependency parsing.
Semantic Analysis: Lexical semantics and word-sense disambiguation, Compositional semantics, Semantic role labeling and semantic parsing.
Information Extraction (IE), Machine Translation (MT) and Text-To-Speech (TTS): Named entity recognition and relation extraction, IE using sequence labeling, Basic issues in MT, Statistical translation, Word alignment, Phrase-based translation and synchronous grammars, Text coherence and discourse structure, Reference resolution, Information status, Spoken dialogue systems, TTS systems, Question answering.
Summing Up: NLP applications.

CSE 4122: Natural Language Processing Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 4121

CSE 4129: Ubiquitous Computing

Credits: 3.0 *Contact Hours:* 3L+0T+0P Hrs/Week

Ubiquitous Computing Vision: Introduction, definition and scope of ubiquitous computing, essential elements of ubiquitous networks; Visions and challenges in ubiquitous computing.
Architecture: Autonomic Computing, Distributed Computing, Cloud Computing, Peer to Peer, Mobility, Mobile Computation and Agents, Smart Places, Wearable Computing, Service-Orientation, Sensors and Actuators.
Design and Evaluation of Different Ubicomputing Applications: Context-aware computing, Automated capture and access systems, Smart home, healthcare and assistive applications, Energy monitoring and sustainability, Mobile social network software, Games and entertainment, Augmented reality.
Context Awareness: Surveillance, Monitoring, Navigation, GPS, Location and Tracking, Ontologies, Reasoning.
Privacy: Problems of Authentication, Confidentiality, Total Information Awareness, Credentials, Access Control.

CSE 4130: Ubiquitous Computing Laboratory

Credits: 0.75 *Contact Hours:* 0L+0T+3/2P Hrs/Week

Laboratory works based on CSE 4129.

CSE 4131: Pattern Recognition

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Basic concepts of pattern recognition, Importance of pattern recognition.
Statistical and Neural Pattern Recognition: Bayesian classifier, Bayes decision theory, Discriminator functions and decision surfaces, Parametric and non-parametric classification methods.
Linear Classifiers: Discriminating functions and decision hyper-planes, Perceptron algorithm and its variants, Kessler's construction.
Nonlinear Classifiers: Multilayer perceptron, Back-propagation algorithm and its variants.
Template Matching: Optimal path searching techniques, Dynamic programming methods, Correlation based matching and 2D log search algorithm for image matching.
Context Dependent Classification: Viterbi algorithm, Observable and hidden Markov models (HMMs), HMMs and their application in speech recognition.
Syntactic Pattern Recognition: Introduction to syntactic pattern recognition, Grammar-based approach, Parsing, Graph-based approach.
Unsupervised Classification: Basic concepts of clustering, Proximity measures, Categories of clustering algorithms, Sequential clustering algorithms, Vector quantization, Feature extraction for representation and classification.

CSE 4132: Pattern Recognition Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 4131

Summary of 4th Year 2nd Term Courses

Course No.	Course Title	Theory Hrs./Week L	Laboratory Hrs./Week P	Credit
CSE 4000	Capstone Project/Thesis		6	3.0
CSE xxxx	Course from Optional-II (3.00)	3		3.0
CSE xxxx	Course from Optional-II (3.00)	3		3.0
CSE xxxx	Course from Optional-III (3.00 + 0.75)	3	3/2	3.75
IEM 4227	Industrial Management	3		3.0
HUM 4207	Entrepreneurship Development	2		2.0
Total		14	7.5	17.75

Weekly Contact Hours = 14L+7.5P=21.50 Hrs/week

NB: The Courses, CSE 4000 will be evaluated at the end of second term

Summary of Optional-II Courses

Optional-II should be selected from the following courses:

Course No.	Course Title	Theory Hrs./week L	Laboratory Hrs./Week P	Credit
CSE 4211	Algorithm Engineering	3		3.0
CSE 4213	Fault Tolerant System	3		3.0
CSE 4215	E-Commerce	3		3.0
CSE 4219	Distributed Database Systems	3		3.0
CSE 4227	Human Computer Interaction	3		3.0
CSE 4229	Digital Forensic	3		3.0
CSE 4231	Control Systems Engineering	3		3.0
CSE 4233	Robotics	3		3.0
CSE 4235	Multimedia Technology	3		3.0
CSE 4237	Computational Geometry	3		3.0
CSE 4239	Data Mining	3		3.0
CSE 4241	Biomedical Engineering	3		3.0
CSE 4243	Parallel and Distributed Processing	3		3.0
CSE 4245	Principles of Programming Languages	3		3.0
CSE 4247	Graph Theory	3		3.0
CSE 4249	Bioinformatics	3		3.0
CSE 4251	Software Architecture	3		3.0

Summary of Optional-III Courses

Optional-III should be selected from the following courses:

Course No.	Course Title	Theory Hrs./Week L	Lab. Hrs./Week P	Credit
CSE 4203	Peripherals and Interfacing	3		3.0
CSE 4204	Peripherals and Interfacing Laboratory		3/2	0.75
CSE 4217	Computer Vision	3		3.0
CSE 4218	Computer Vision Laboratory		3/2	0.75
CSE 4221	High Performance Computing	3		3.0
CSE 4222	High Performance Computing Laboratory		3/2	0.75
CSE 4223	Digital System Design	3		3.0
CSE 4224	Digital System Design Laboratory		3/2	0.75
CSE 4225	Real-time Embedded Systems	3		3.0
CSE 4226	Real-time Embedded Systems Laboratory		3/2	0.75

Syllabus of 4th Year 2nd Term Courses

CSE 4000: Capstone Project / Thesis

Credits: 3.0 ***Contact Hours:*** **0L+6P Hrs/Week**

N.B.: The project/thesis topic selected in the previous term is to be continued in this term.

IEM 4227: Industrial Management

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Basic theories of management, Management functions.
Organization: Theory and structure, Co-ordination, Span of control, Authority, Delegation, Centralization and decentralization.
Personnel Management: Need hierarchy, Motivation, Leadership, Performance appraisal, Wages and incentives, Organizational change and conflicts.
Cost and Financial Management: Elements of cost, Asset depreciation, Break event analysis, Investment analysis.
Operations Management: Demand forecasting, Inventory management systems, Master production schedule, MRP, Basic scheduling techniques, CPM and PERT, Plant location and layout, Maintenance management, Management Information System (MIS), Computer Aided Process Planning (CAPP).

HUM 4207: Entrepreneurship Development

Credits: 3.0 ***Contact Hours:*** **3L+0T+0P Hrs/Week**

Introduction to Entrepreneurship: Role of the entrepreneur in Bangladesh and around the globe, Forces that are driving the growth of entrepreneurship, Benefits and drawbacks of entrepreneurship, Mistakes of entrepreneurship and how to avoid them, Entrepreneurial failure, Tools to create sustainable and viable business, Qualities of entrepreneur, Critical success factors of entrepreneurship.
Overview of Business and its Functioning: Business and industry, Components of macro and micro business environment.
Business Idea and Feasibility: Creativity, Innovation and entrepreneurship, Mental locks that limit individual creativity, Steps in the creative process, Techniques for improving the creative process, Protection of intellectual property involving patents, Trademarks and copyrights.
Small and Medium Enterprise (SME): Concept, Contribution to national GDP, Critical success factors, Factors of failure, Development of SMEs, Drawbacks of SMEs in Bangladesh, Potentials of SMEs in Bangladesh, SME financing, SME positing strategies.
Forms of Business Ownership: Advantages and the disadvantages of the three major forms of ownership: The sole proprietorship, The partnership and the corporation, Types of franchising: Trade name, Product distribution, Major trends shaping franchising, Joint venture: Formation, advantages and disadvantages, Agreement, Operational aspects.
Building the Business Plan: Planning process, Developing business plan, Writing business plan, Cost and benefit analysis.
Foundations of New Venture Finance: Understanding capital requirements, Identifying the sources of finance, Angel investing and venture finance.
Creating the Organization: Structure and design Forms of organization structure, Factors contingent on organizational structure and design.
Technical Entrepreneur and the E-entrepreneur: Process of creating and growing high potential ventures, Basic approaches to launch an e-commerce effort.
Intrapreneurship: Concept and importance in corporate environment.
Crafting a winning business plan: Need and importance of business plan, Elements of a solid business plan.

Syllabus of Optional-II Courses

CSE 4211: Algorithm Engineering

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Randomized Algorithms: Las Vegas and Monte Carlo algorithms.
Randomized Data Structures: Skip lists.
Amortized Analysis: Different methods.
N Approximation Algorithms: Approximation schemes, Hardness of approximation.
P-Completeness Online Algorithms: Competitive analysis, Online paging problem, Randomized online algorithms, Adversary models, Marker algorithm view, Multithreaded algorithms, Van Emde Boas tree algorithms for massive data sets, External memory algorithms, Cache-Oblivious algorithms.
Quantum Algorithms: Quantum bits (Qbits), Quantum gates and circuits, Quantum algorithms, Quantum parallelism, Approximation algorithms, LP based approximation algorithms, Experimental algorithmic.

CSE 4213: Fault Tolerant System

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Definition of fault tolerance, Redundancy, Applications of fault-tolerance.
Fundamentals of Dependability: Attributes: Reliability, Availability, Safety, Impairments: Faults, Errors and failures, Means: Fault prevention, Removal and forecasting.
Dependability Evaluation Techniques: Common Measures: Failures rate, Mean time to failure, Mean time to repair, etc., Dependability model types, Dependability computation methods.
Hardware Redundancy: Redundancy allocation, Passive redundancy, Triple modular redundancy, Reliability evaluation, Voting techniques, N-modular redundancy, Active redundancy, Duplication, Standby sparing, Pair-and-a-spare, Hybrid redundancy, Self-purging redundancy, N-modular redundancy, Evaluation and comparison, Applications.
Information Redundancy: Coding Theory: Parity codes, Hamming codes, Cyclic codes, Checksum, M-of-N codes, Berger codes, Arithmetic codes, etc., Encoding and decoding techniques, Applications, Algorithm based fault tolerance.
Time Redundancy: Check-pointing and roll-back, Analysis and optimality, Alternating Logic.
Software Redundancy: Single-version techniques**,** Multi-version techniques, Software testing, Self-checking software.
Fault Detection in Cryptographic Systems: Overview of ciphers, Security attacks through fault injection: Fault attacks on symmetric key ciphers, Fault attacks on public (asymmetric) key ciphers, Countermeasures.
Fault-models: Layers of Reality, Stuck-at fault model and the Single fault assumption**,** Functional fault models.
Case Studies: Stratus systems**,** IBM Sysplex**.**
Soft Error: Overview of soft errors, Sources of soft errors, Soft error mitigation techniques.

CSE 4215: E-Commerce

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

E-commerce: What is e-commerce, Defining B2B, B2C and C2C commerce, Advantages & disadvantages of e-commerce, Tools for enabling e-commerce, Internet, Extranet, Intranet, WWW, Web Pages & their design, HTML, XML, WML, WAP.
B2B Commerce: Electronic data interchange standards EDIFACT, ANSI X12, Value added network services, Security issues in e-Commerce, Symmetric key encryption, Digital Encryption Standards (DES), Public key encryption, RSA system digital signature, Digital signature certification authority, MIME and MIME standards, PGP for e-mail.
B2C Commerce: Varieties of business, New business models, Electronic payment systems, Credit cards, Electronic funds transfer, Electronic cheque payments, Electronic cash, Issues in cash payment, Micro payments over the internet, Digital watermark, C2C commerce.
E-Governance: Introduction to e-governance, Understanding the relationship - governance and e-governance.
E-Government at Work: E-administration and e-services, E-democracy, Local e-government, Joined-up government, National land & property gazetteer (NLPG) - meta-frameworks and interoperability in action - GIS systems, Pathfinder-Beacon councils.
Example: One stop shop, International perspectives on e-government - focus on Malaysia, US perspectives on e-government, Information security and privacy protection, Future directions of e-governance.

CSE 4219: Distributed Database Systems

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction to distributed database management, Distributed architectures, Integrating data from distributed sources, Distributed database design, Distributed query processing and optimization, Distributed concurrency control, Distributed reliability protocols, Pervasive and mobile distributed database systems, Web data management, Interoperability and distributed recovery techniques.

CSE 4227: Human Computer Interaction

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction and Overview: Definition and importance of HCI, Usability requirements, Understanding users, Requirements analysis.
User Centered Design and Prototyping: System centered design, User centered design, Case studies, Participatory design, Design rationale, User interface prototyping, Paper-based prototypes, Software-based prototypes, Sensation.
Perception and Cognition: Psychophysics, Visual perception - low level, Visual perception - high level, Auditory perception, Haptic/kinesthetic perception, Attention, Motor behavior, Ergonomics.
Experimental Design and Analysis: A model of usability factors, Ethics, Experimental planning, Basic terminology, Experimental design, Statistical analysis (t-test, f-test, correlation/regression), ANOVA, Non-parametric analysis.
Interaction Systems: Visual: Eye movements, Gesture recognition, Tabletop interfaces, Tangible interfaces, 3D interfaces, Virtual and augmented reality, Brain computer interface.

CSE 4229: Digital Forensic

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Forensic science and digital forensics, Uses of digital forensics in criminal investigations, Civil litigation, Intelligence, Administrative matters, Locard's exchange principle, Organizations of note, Scientific working group on digital evidence, Role of the forensic examiner in the judicial system, Benefits of professional forensics methodology.
Collecting Evidence: Crime scenes and collecting evidence, Removable media, Cell phones order of volatility, Documenting the scene, Photography, Notes, Chain of custody, Marking evidence, The cloning process, Forensically clean media, Forensic image formats risks and challenges, Value in discovery, Live system versus dead system, Acquisition concerns, Advantage of live collection, Principles of live collection, Conducting and documenting a live collection, Final report.
Anti-Forensics: Hiding data, Early encryption, Algorithms, KeySpace, Some common types of encryption, Password attacks, Brute force attacks, Password reset, Dictionary attack, Steganography, Data destruction, Drive wiping.
Windows System Artifacts: Deleted data, Hibernation File (Hiberfile.sys), Sleep, Registry structure, Print spooling, Recycle bin, Metadata, Removing metadata. Thumbnail Cache Most Recently Used (MRU) restore points and shadow copy, Prefetch, Link files, Installed programs.
Legal: Copyrighted material, Criminal law—Searches without a warrant, Reasonable expectation of privacy, E-mail, The electronic Communications Privacy Act (ECPA).
Network Forensics: Social engineering, Network fundamentals, Network types, Network security tools, Network attacks incident response, Network evidence and investigations.
Labs and Tools: Forensic laboratories, Virtual labs, Lab security, Evidence storage policies and procedures, Quality assurance, Tool validation, Documentation, Digital forensic tools, Tool selection, Hardware, Software, Accreditation, Accreditation versus certification.

CSE 4231: Control Systems Engineering

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction to control systems, Dynamic systems modeling, Mathematical description of systems**:** Taxonomy of systems, Linear time invariant systems, Discrete-time systems, Basic elements in control systems – Open and closed loop systems, Block diagram and signal flow graph models, Transfer functions of linear systems, Mason's gain formula, Reduction of parameter variation and effects of disturbance by using negative feedback, Analysis and synthesis of continuous and sample data linear feedback control systems, Properties and advantages of feedback systems, Time domain and frequency domain performance measures, Stability and degree of stability of linear feedback systems, Frequency response methods and Nyquist stability, Root locus method, Compensation techniques.

CSE 4233: Robotics

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: History, Definitions, Robotic systems design, Applications.
Coordinate Systems: Cartesian coordinates, Degrees of freedom, Reference frames, Orientation, Bi-dimensional and tridimensional transformation matrices, Relative and general transformations, Homogeneous transformations, Inverse transformations, Graphs.
Robots Systems and Structures: Robot architectures, Technical concepts of robotics, Actuation.
Robot Kinematics (Position): Joints, Members, Reference frames, Amatrices, Direct and inverse kinematics, Trigonometric solution, Precision, Efficiency/complexity of kinematic solutions.
Robot Kinematics (Velocity and Acceleration): Derivatives, Velocity and acceleration of rigid bodies, Differential movement, Jacobian, Singularities.
Sensors and Perception: Internal and external sensors, Sensors hierarchy, Interfaces, Data fusion, Classification, Localization, Machine vision, Applications.
Control: Classical approaches for robot control, Feedback loops, Position and force control, Compliance, Fuzzy logic control.
Task and Path Planning: Action-level planning, Modeling, Motion planning in R-space and C-space, Path tracking.
Different Types of Robots: Legged robots and Zero Momentum Point (ZMP), Humanoid robots, Middle sized and small sized soccer robots.

CSE 4235: Multimedia Technology

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Fundamentals: Media and data streams, Sound/audio, Image, Graphics, Video and animation, Color science and color models.
Data Compression: Coding requirements, Source, Entropy and hybrid coding, Lossless and lossy compression, JPEG, H.261, MPEG, MP3 and etc.
Computer Technology Issues: Communication architecture, Multimedia workstations, Cache systems, Storage systems and optical storage.
Multimedia OS: Real-time operation, Resource management, Process management, File systems and multimedia networking.
Multimedia Synchronization: Presentation requirements, Reference model and synchronization techniques.
Multimedia Database: Data organization, Indexing and retrieval.
Web Technologies Issues: Elements of web styling, Usability, Accessibility and information architecture, Content Management Systems (CMS).
Multimedia Applications: Digital libraries, System software, Toolkits, Conferencing paradigms, Structured interaction support and examples from video/audio/graphics conferencing.

CSE 4237: Computational Geometry

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Historical perspective, Algorithmic background, Geometric preliminaries, Models of computation, Geometric searching, Point location problem and range searching problems, Divide and conquer, Amortization, Multi-dimensional search, Space sweep, Polygon triangulation, Intersection and union of rectangles. Proximity, Closest pair problem, Duality and randomization, Voronoi and Delaunay diagrams, Arrangements of lines and points, Geometry of rectangles, Hidden surface removal, Art gallery theorems, Shortest paths, and lower-bounds, Convex hulls: 2D & 3D proximity, Facility location and linear programming, Mobility of objects in space.

CSE 4239: Data Mining

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Kinds of data and patterns to be mined, Basic statistical description of data.

Data Preprocessing: Data objects and attributes, Data similarity and dissimilarity, Data cleaning, Data integration, Data reduction, Data transformation and discretization.
Data Warehousing: Data warehouse modeling, Design issue, Implementation and usage, Data mining, Associations, Correlations, Mining methods, Pattern evaluation.
Data Classification: Decision tree induction, Classification methods, Evaluation and selection of classification, Classification accuracy.
Cluster Analysis: Partitioning, Hierarchy, Density and grid based clustering methods, Evaluation of clustering methods, Cluster quality.
Outlier Detection: Outlier detection methods, Statistical approaches, Proximity based approaches, Clustering and classification based approaches.

CSE 4241: Biomedical Engineering

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Bioelectric Phenomena and Biosignals: Cell membrane, Resting potential, Action potential.
ECG, EEG, EMG, EOG and ERG: Origin, Characteristics and applications in medical diagnosis.
Physiological Measurement: Electrode: Working principle, Equivalent circuit and classifications.
Transducers: Characteristics, Classifications and applications.
Measurements: Body temperature, Blood pressure and heart rates.
Biosignal Processing: Instrumentation amplifiers, Signal conditioner, A/D and D/A converter, Computerized automatic analysis, Bio-telemetry.
Diagnostic Methods: Ultrasound, X-ray, CT, and MRI techniques: Principles, Merits, Demerits and applications, Applications of Laser and Optics in Diagnosis.
Biomedical Equipment: Surgical diathermy machines, Defibrillators, Pacemakers, Ventilators, Prosthesis and Prosthetic devices, ICU and CCU.
Electrical Safety: Physiological effects of electricity, Susceptibility parameters, Electrical shock hazards in safety aspects of biomedical instrumentation and good grounding concepts.

CSE 4243: Parallel and Distributed Processing

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Motivation for Parallelism: Parallel computing, Speed up, Moore's law, Grand challenge problems, Trends, The status and future of massively parallel processing.
Parallel and Distributed Computers: Flynn's taxonomy, Distributed memory multicomputer, Shared memory multiprocessors, Networks of workstations, Cluster and grid computing, PRAMs, Interconnection networks.
Performance Measures: Granularity, Speed up, Efficiency, Cost, Amdahl's law, Gustafson's law, Isoefficiency, Optical computing, Quantum computing.
Interconnection Networks: Interconnection networks for inter-processor communication, Permutation routing, Non uniform routing, Deadlock free routing and multicasting, Mapping and Embedding.
Distributed Processing: Distributed models and systems, Real time distributed systems.
Applications: Sorting, Searching, Matrix algorithms, Fourier transform, Finding the maximum, Image processing.

CSE 4245 Principles of Programming Languages

Credits: 3.0 *Contact Hours:* 3L+0T+0P Hrs/Week

Specification of Programming Languages: Syntax, semantics: operational semantics, denotational semantics, axiomatic semantics and attribute grammars.
Issues in Language Design: Names, scope, and binding, types, control flow, subroutines and control abstraction, modules, mutation, laziness, polymorphism, objects, classes and inheritance in object-oriented languages.
Programming Language Paradigms: Data abstraction and object oriented, programming, Non-imperative paradigms: Functional languages, Logic programming, Dynamic and scripting languages, Concurrent programming.
Runtime Management: Runtime structure and operating environment, Practical and implementation issues in run-time systems and environment.
Concurrency: Subprogram-level concurrency, semaphores, monitors, message passing, statement-level concurrency.
Exception Handling: Design issues, evaluation of exception handling in C++ and Java.

CSE 4247: Graph Theory

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Graphs: Simple graphs, Digraphs, Subgraphs and complements, Vertex-degrees, Walks, Paths, Cycles and distance, Connectedness and components of a graph, Random graphs**,** Bridges and Blocks, Isomorphism and *2*-isomorphism.
Matrices of a Graph: Incidence matrix, Cut matrix, Circuit matrix, Orthogonality relation.
Traversability: Eulerian graphs, Hamiltonian graphs, Chinese postman problem, Traveling salesman problem.
Graph Coloring: Vertex coloring and chromatic number, Chromatic polynomials, Edge coloring and chromatic index, Four-color problem, Vizing's theorem, Planar graphs.
Graph Applications: Matching, Covering and packing, Flow networks.
Trees: Trees, Spanning trees, *k*-trees, Spanning *k*-trees, Forests.

CSE 4249: Bioinformatics

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Genomic sequences, Online databases, Intro to sequence alignment, Finding information in online databases.
Sequence Alignment: Scoring Matrices, Pairwise alignment, Gaps, Pairwise sequence alignment, Sequence variation, Phenologs, Comparative Genomics.
Database Searching: BLAST: Limits of detection, Significance, Advanced BLAST: PSI-BLAST, Genomic DNA, Human variation and disease, Linking genes and disease.
Multiple Sequence Alignment: Relevance to inferences about evolution, Midterm review, Molecular phylogeny introduction, Molecular phylogeny and evolution.
Molecular Phylogeny: Molecular phylogeny introduction, Molecular phylogeny and evolution, mRNA and gene expression introduction, Unigene, Differential expression intro, Normalization, Visualization/clustering, GenePattern, Statistics for differential expression, Multiple testing.
Systems Biology: The functional analysis of genomes, Comparative genome analyses, Bioinformatics algorithms.

CSE 4251: Software Architecture

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction to the fundamentals of software architecture, Software architecture and quality requirements of a software system, Fundamental principles and guidelines for software architecture design, Architectural styles, Patterns and frameworks, Methods, Techniques and tools for describing software architecture and documenting design rationale, Software architecture design and evaluation processes.

Rationale and architectural knowledge management in software architecting, Approaches and tools for designing and evaluating software architectures for the state-of-the-art technologies such as cloud-computing and service-operation and mobile computing, Future challenges and emerging trends in software architecture discipline.

Syllabus of Optional-III Courses

CSE 4203: Peripherals and Interfacing

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Introduction: Basics of peripherals and interfacing, General purpose peripherals and special purpose peripherals, I/O techniques: Simple I/O, Strobe I/O, Handshake I/O, DMA controlled I/O, Hardware and software interfacing in microcomputer system design, Multi-processor configurations.
Memory Interfacing: Compatibility between memory and MPU system bus, Address space partitioning, Standard versus system memories, Restriction imposed by MPU architecture.
Common Peripherals and their Interfacing: Interfacing I/O devices - Floppy disk, Hard disk, Solid state disk, CDROM and other optical memory, Keyboard, Mouse, Display devices, etc., Interfacing with USB.
Programmable Peripheral Interface: Intel 8255 pin configuration, Internal structure of a port bit, Modes of operation, Bit SET/RESET feature, Programming, ADC and DAC chips and their interfacing.
Programmable Interval Timer: Intel 8254 pin configuration, Internal block diagram of counter and modes of operation, Counter read methods, Programming.
I/O Devices for Process Control and Instrumentation: Transducers, Operational Amplifier, Optocouplers, Relays, AD and DA converters.
Microprocessor in Scientific Instruments and Other Applications: Display, Protective relays, Measurements of Electrical quantities, Temperature monitoring system, Water level indicator, Motor speed controller, Traffic light controller, etc.

CSE 4204: Peripherals and Interfacing Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 4234

CSE 4217: Computer Vision

Credits: 3.0 ***Contact Hours*****: 3L+0P Hrs/Week**

Introduction: Rudimentary concepts of digital image, Human visual system.
Images Enhancement: Review of point processing, Spatial and frequency domain filtering.
Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region-oriented segmentation.
Morphological Processing: Basic morphological concepts, Morphological algorithms, Gray scale morphology and basic gray-scale morphological algorithms.
Color Image Processing: Color fundamentals, Color models, Color space conversion, Segmentation based on color.
Multiple Views and Motion: Geometric camera models, Stereo vision, Dense stereo correspondence, Motion field estimation techniques, Optical flow.
Recognition: Object recognition principles, Feature detector and descriptors: HoG, SIFT.

CSE 4218: Computer Vision Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 4217

CSE 4221: High Performance Computing

Credits: 3.0 ***Contact Hours: 3L+0P Hrs/Week***

Introduction: Basics of high-performance computing systems, Common high performance computing systems, Recent developments in high performance computing systems, Introductory components of parallel programming.
Parallel Processing Concepts: Levels of parallelism (Instruction, Transaction, Task, Thread, Memory, Function), Models (SIMD, MIMD, SIMT, SPMD, Dataflow models, Demand-driven computation etc.), Architectures (N-wide superscalar architectures, Multi-core, Multi-threaded).
Design Issues in Parallel Computing: Synchronization, Scheduling, Job allocation, Job partitioning, Dependency analysis, Mapping parallel Algorithms onto parallel architectures, Performance analysis of parallel algorithms.
Limitations Facing Parallel Computing: Bandwidth limitations, Latency limitations, Latency hiding/tolerating techniques and their limitations.
Graphics Processing Units: Introduction to GPU, GPU architecture, Thread hierarchy, GPU memory hierarchy.

CSE 4222: High Performance Computing Laboratory

Credits: 0.75 ***Contact Hours: 0L+3/2P Hrs/Week***

Laboratory works based on CSE 4221

CSE 4223: Digital System Design

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Register Transfer Logic: Inter register transfer, Arithmetic, Logic and shift micro-operations, Conditional control statements, Fixed-point binary data, Overflow, Arithmetic shifts, Decimal data, Floating-point data, Non-numeric data, Instruction codes, Design of simple computer.
Processor Logic Design: Processor organization, Arithmetic logic unit, Finite state machine-design and implementation, Design of arithmetic circuit, Design of logic circuit, Design of arithmetic logic unit, Status register, Design of shifter, Processor unit, Design of accumulator, Introduction to hardware description languages (VHDL and Verilog).
Control Logic Design: Control organization, Hardwired control, Micro-program control, Control of processor unit, PLA control, Micro-program sequencer.
Computer Design: System configuration, Computer instructions, Timing and control, Execution of instructions, Design of computer registers, Design of control, Register load and inter register transfer, Bus buffer and memory cycle of microcomputers.
Memories: ROMs, RAMs, Small TTL memory.
Simple as Possible (SAP-1) Computer Design: Architecture, Instruction set, Programming, Fetch cycle, Execution cycle.

CSE 4224: Digital System Design Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 4223

CSE 4225: Real-time Embedded Systems

Credits: 3.0 ***Contact Hours:*** **3L+0P Hrs/Week**

Overview of Embedded Systems: The product design cycle, Evaluation and justification of the available levels of system integration (Custom chip design through to turnkey-systems) and technological choice, Development of a system specification, Including case studies, Overview of the software and hardware design tools/techniques applicable to such systems such as UML, VHDL, Verilog, etc.
Software Issues: Real time operating systems, Software design methodologies pertinent to real-time embedded systems, Designing, Implementing and testing software for embedded systems including multiprocessor and System-on-Chip (SoC) devices, Verification strategies for embedded software development.
Hardware Issues: Choice of: Processor, Memory, I/O, Level(s) of integration, Development environments, Hardware acceleration devices such as DSPs and FPGAs, Interfacing to commonly used I/O devices, Types of interconnections, Sensors for measuring physical phenomena, Output devices such as power actuators and motors.
Software/Hardware Co-design Issues: Design, Implementation and verification considerations for the simultaneous design of both hardware and software.

CSE 4226: Real-time Embedded Systems Laboratory

Credits: 0.75 ***Contact Hours:*** **0L+3/2P Hrs/Week**

Laboratory works based on CSE 4225