Courses offered in Part-II, Even Semester

Code	Course Title	Marks	Credit
LAW2211	Cyber and Intellectual Property Law	50	2
MATH2231	Numerical Methods	50	2
MATH2232	Numerical Methods Lab	25	1
MATH2241	Linear Algebra	75	3
CSE2211	Theory of Computation	75	3
CSE2221	Design and Analysis of Algorithms	75	3
CSE2222	Design and Analysis of Algorithms Lab	25	1
CSE2231	Computer Architecture and Organization	75	3
CSE2232	Computer Architecture and Organization Lab	25	1
CSE2242	Technical Writing and Presentation	25	1
CSE2252	Software Development Lab II	25	1
	Total	**525**	**21**

Courses offered in Part-III, Odd Semester

Code	Course Title	Marks	Credit
CSE3111	System Analysis and Design	75	3
CSE3121	Database Management Systems	75	3
CSE3122	Database Management Systems Lab	25	1
CSE3131	Digital Signal Processing	75	3
CSE3132	Digital Signal Processing Lab	25	1
CSE3141	Compiler Design	75	3
CSE3142	Compiler Design Lab	25	1
CSE3151	Computer Networks	75	3
CSE3152	Computer Networks Lab	25	1
CSE3162	Software Development Lab III	25	1
	Total	**500**	**20**

Courses offered in Part-III, Even Semester

Code	Course Title	Marks	Credit
CSE3211	Software Engineering	75	3
CSE3212	Software Engineering Lab	25	1
CSE3221	Computer Graphics	75	3
CSE3222	Computer Graphics Lab	25	1
CSE3231	Microprocessor and Assembly Language	75	3
CSE3232	Microprocessor and Assembly Language Lab	25	1
CSE3241	Operating System and System Programming	75	3
CSE3242	Operating System and System Programming Lab	25	1
ICE3261	Communication Engineering	75	3
ICE3262	Communication Engineering Lab	25	1
	Total	**500**	**20**

Part-II, Even Semester

LAW 2211: Cyber and Intellectual Property Law

Credits: 2 **Contact Hours:** 26
Year: Second **Semester:** Even

Prerequisite: None

Motivation To provide a deep understanding of cyber law concepts and while explaining intellectual property concepts, making students aware of their rights for the protection of their invention done.

Course Objective:

This course aims to understand the different theoretical and cross-disciplinary approaches related to cyber-security and the regulations of the Internet. Also to make the students knowledgeable about the current ICT policy and law of Bangladesh, as well as International cyber law. This course also intends to teach students Intellectual property concept and fundamental knowledge of patents, copyrights, trademarks, designs and Information Technology Act. Students also get awareness of importance of acquiring the patent and copyright for their innovative works and get the knowledge of plagiarism in their innovations which can be questioned legally.

CLO (Course Learning Outcome):			
CLOs	After successfully completing this course, students will be able	**PLO mapping**	
CLO1	To **describe** laws governing cyberspace and analyze the role of Internet Governance in framing policies for Internet security.	P1	
CLO2	To **discuss** different types of cybercrimes and analyze legal frameworks to deal with these cybercrimes.	P2	
CLO3	To **identify** intellectual property right issues in the cyberspace and design strategies to protect your intellectual property.	P4	P5
CLO4	To **recognize** the importance of digital evidence in prosecution and compare laws of different countries for handling evidence.	P5	P6
CLO5	To **assess** the legal issues with online trading, and analyze applicable e-contracting and taxation regulations.	P5	P6

Evaluation/ Assessment System: Students will be evaluated out of total **50 Marks**. There are different types of assessment tools. In **the final written** examination, total time **is2 hours** where students should answer Four questions from two sections out of Six taking not more than Two from each section. The detail with **COs-Assessment Mapping** is given below.

CLOs	Assessment Tools (Total 100%)					
	20%				70%	10%
	Class Test 1	Class Test 2	Assignment	Presentation	Final Written	Attendance
CLO1	√			√	√	√
CLO2	√			√	√	√
CLO3	√			√	√	√
CLO4		√	√		√`	√
CLO5		√	√		√	√

Course Contents:

Cyber Law

Cyber Law: Definition Nature, Scope, Utility of Cyber Law, Origin and Development of Cyber Law and Internet

ICT Policy in Bangladesh; Internet Service Providers (ISP)- Domain Name, Present Legal Basis of ISP in Bangladesh; e-Readiness in Bangladesh- e-Commerce in Bangladesh, e-Governance in Bangladesh, e-Learning/Education in Bangladesh, e-Journal in Bangladesh, e-Voting in Bangladesh; Electronic Evidence-Digital Signature, The Evidence Act of 1872 Vs. ICT Act-2006, Electronic Evidence in Bangladesh, Legal Effects of Electronic Evidence, UNCITRAL Model Law on Electronic Evidence;

Cyber Crime: Jurisdiction and Cyber Crime, Criminal Justice in Bangladesh and Implications on Cyber Crime; Cyber vandalism, Hacking, Malicious Spreading in Viruses, Password fraud, Cheating, Cyber

Pornography, Child Pornography, Protection of Copyrights and Intellectual Property right. Invasion of Privacy, Constitutional basis of Privacy, Unsolicited e-Mail, Defamation, Harassment and e-Mail Abuse, Present Legal Protection;

Human Rights Violation and Internet; The Information and Communication Technology Act, 2006- Objectives, Strengths & Weaknesses of the ICT Law, Regulation of Cryptography;

International Cyber Law- India, Sri Lanka, Japan, Malaysia, Australia and the USA, International Conventions on Cyber Law & Crime
Electronic Commerce- Electronic Money, Online Credit card Payments and Electronic Bills of Lading, UNCITRAL Model Law on Electronic Commerce.

Intellectual Property Law

Intellectual Property Law: Basic Concepts of IP Law, Nature of IPR, Computer-related intellectual property rights; Copyright- Original and development of copyright law, subject matter of copyright protection, Rights protected by copyright, Neighboring rights, Limitations of Copyright protecting, Piracy and infringement, Remedies, Computer Program, New technology and copyright, Software Patents Vs. Copyright, International Convention on Copyright

Patent- Patents and technological development, Requirements for patentability and ownership of patents, Scope of exclusive rights and duration of protection, Patents infringement, defenses and remedies, Legal arrangement for the transfer of technology, Types of intellectual Property licenses

Trademarks- Reasons for the protection of trademarks, Acquisition of trademark right, Registration procedure, Duration of protection and renewal, Termination, Trademarks in Cyberspace; Domain Name and Meta-tag Controversies.

Text Book:

1. VivckSood : **Cyber Law Simplified**,*Tata McGraw Hill Publications.*

Reference Books:

1. V. D. Dudej : **Information Technology & Cyber Laws**, *Commonwealth Publishers.*
2. Arpad Bogsch : **Universal Copyright Convention: An Analysis and Commentary**, *Bowker*
3. Alan Daubeny Russell Clarke : **Copyright in Industrial Designs**, *Sweet and M.*

MATH2231: Numerical Methods

Credits: 2 **Contact Hours:** 26
Year: Second **Semester:** Even

Prerequisite: CSE1121: Computer Programming with C
Motivation To know the story of how functions, derivatives, integrals, and differential equations are handled as strings of numbers in the computer.

Course Objective:
This course provides a foundation in some fundamental numerical methods for problem solving in a scientific computing environment. The primary objective of the course is to develop the basic understanding of numerical algorithms and skills to implement algorithms to solve mathematical problems such as findings roots of the linear and non-linear equations, approximation and interpolation data, solving the problem involving integration and differentiations etc. on the computer.

CLO (Course Learning Outcome):			
CLOs	After successfully completing this course, students will be able	**PLO mapping**	
CLO1	**To understand** numerical error in computational analysis, rates of convergence of algorithms, and identify known difficulties associated with classical computational algorithms.	P1	P2
CLO2	To **estimate** the approximation and interpolation of the data and functions and work with fundamental concepts in approximation.	P1	P2
CLO3	To **solve** systems of linear equations numerically and solve nonlinear systems.	P2	P3
CLO4	To **distinguish** between iterative and direct methods of solution for linear and nonlinear equations.	P6	
CLO5	To analyze and solve problems involving numerical integration and differentiation.	P3	
CLO6	To **construct** numerical solutions to problems and analyze the results.	P5	

Evaluation/ Assessment System: Students are evaluated out of total **50 Marks**. There are different types of assessment tools. In **the final written** examination, total time**is2 hours** where students should answer Four questions from two sections out of Six taking not more than Two from each section. The detail with **COs-Assessment Mapping** is given below.

CLOs	Assessment Tools (Total 100%)					
	20%				70%	10%
	Class Test 1	Class Test 2	Assignment	Presentation	Final Written	Attendance
CLO1	√			√	√	√
CLO2	√		√	√	√	√
CLO3		√	√	√	√	√
CLO4		√	√		√	√
CLO5		√	√	√	√	√
CLO6			√		√	

Course Contents:

Approximations and Errors: Accuracy and Precision, Error Definitions, Round-Off Errors, Truncation Errors.

Roots of Equations: Graphical Methods, The Bisection Method, The False-Position Method, Simple One-Point Iteration, The Newton-Raphson Method, The Secant Method.

Systems of linear algebraic equations: Gauss Elimination, Solving Small Numbers of Equations, Naive Gauss Elimination, Pitfalls of Elimination Methods, Matrix Inversion and Gauss –Seidel, The Matrix Inverse, Error Analysis and System Condition.

Curve Fitting: Linear Regression, Polynomial Regression, Multiple Linear Regression, Newton's Divided-Difference Interpolating Polynomials, Lagrange Interpolating Polynomials, Coefficients of an Interpolating Polynomials, Curve Fitting with sinusoidal Functions.

Numerical Differentiation and Integration : The Trapezoidal Rule, Simpson's Rules, Integration with Unequal Segments, Romberg Integration, Gauss Quadrature, High-Accuracy Differentiation Formulas, Richardson Extrapolation, Derivatives of Unequally Spaced Data.

Pseudorandom-number generators, the FFT.

Text Book:

1. Steven C. Chapra, Raymond P. Canale : **Numerical Methods for Engineers**, *McGraw-Hill*

Reference Books:

1. S. S. Kuo : **Computer Applications of Numerical Methods***, Addison-Wesley*
2. S. S. Sastry : **Introductory Methods of Numerical Analysis** *Prentice-Hall of India Pvt. Ltd.*
3. Press, Teukolsky, Vetterling and Flannery : **Numerical Recipes in C**: The Art of Scientific Computing,CambridgeUniversity Press.

CSE2232: Numerical Methods Lab

25 Marks [60% Practical, 30% Quizzes/Viva-voce, 10% Attendance]
1 Credit, 26 Contact hours

Laboratory works based on CSE2231

MATH2241: Linear Algebra

Credits: 3 **Contact Hours:** 39
Year: Second Semester: Even

Prerequisite: MATH1111: Algebra, Trigonometry and Vector, STAT1211: Statistics for Engineers

Motivation To develop a mathematical base for signal processing and machine learning

Course Objective:

The main objective of this course is to provide necessary knowledge on linear equations, matrix algebra, vector spaces, linear algebra concepts to model, solve, and analyze real-world situations.

CLO (Course Learning Outcome):			
CLOs	To **use** computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra, vector spaces, eigenvalues and eigenvectors, orthogonality and diagonalization.	**PLO mapping**	
CLO1	To i**dentify** linear transformations of finite dimensional vector spaces and compose their matrices in specific bases.	P1	
CLO2	To **use** visualization, spatial reasoning, as well as geometric properties and strategies to model, solve problems, and view solutions, especially in R^2 and R^3, as well as conceptually extend these results to higher dimensions.	P2	
CLO3	To **construc**t mathematical expressions that involve vectors, matrices, and linear systems of linear equations.	P3	
CLO4	To **evaluate** mathematical expressions to compute quantities that deal with linear systems and eigenvalue problems.	P4	
CLO5	To critically **analyze a**nd construct mathematical arguments that relate to the study of introductory linear algebra.	P2	
CLO6	Apply linear algebra concepts to model, solve, and analyze real-world situations.	P3	
CLO7	Use computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra, vector spaces, eigenvalues and eigenvectors, orthogonality and diagonalization.	P3	

Evaluation/ Assessment System: Students are evaluated out of total **75 Marks**. There are different types of assessment tools. In **the final written** examination, total time **is3 hours** where students should answer Six questions from two sections out of Eight taking not more than Three from each section. The detail with **COs-Assessment Mapping** is given below.

CLOs	Assessment Tools (Total 100%)					
	20%				70%	10%
	Class Test 1& 2	Class Test 3 & 4	Assignment	Presentation	Final Written	Attendance
CLO1			√	√	√	√
CLO2	√			√	√	√
CLO3			√	√	√	√
CLO4	√			√	√	√
CLO5		√		√	√	√
CLO6			√	√	√	√
CLO7		√		√	√	√

Course Contents:

Vector space, subspace, sum and direct sum, Hilbert space, normed space, Banach space.

Linear dependence and independence basis and dimension.

Linear transformation: range, kernel, nullity, rank, singular and non-singular transformations.

Matrices and linear operators: Matrix representation of a linear operator. Change of basis, similarity, Matrices and linear mapping.

Characteristic roots and vectors of linear transformations, theorems and problems; characteristic and minimum polynomials of square matrices.

Linear functionals and dual vector spaces, Annihilators.

Norms and inner products, Orthogonal complements, orthonormals sets, Gram-schmidtorthogonalization process.

Text Book:

1. Seymour Lipschutz, Marc Lipson : **Linear Algebra,Schaum's Outline Series**, *McGraw-Hill*
2. I. N. Herstein : **Topics in Algebra,***Wiley*

CSE 2211: Theory of computation

Credits: 3 **Contact Hours:** 39
Year: Second **Semester:** Even

Prerequisite: None
Motivation To know basic of computer network, its different protocol, network designing issues
Course Objective:
The main objective of this course is to provide several formal mathematical models of computation along with their relationships with formal languages. In particular, student will learn regular languages and context free languages which are crucial to understand how compilers and programming languages are built. Also, students will learn that not all problems are solvable by computers, and some problems do not admit efficient algorithms. Throughout this course, students will strengthen their rigorous mathematical reasoning skills.

CLO (Course Learning Outcome):			
CLOs	After successfully completing this course, students will be able	**PLO mapping**	
CLO1	To **demonstrate** advanced knowledge of formal computation and its relationship to languages.	P1	
CLO2	To **apply** rigorously formal mathematical methods to prove properties of languages, grammars and automata.	P3	
CLO3	To **analyze** and design finite automata, pushdown automata, Turing machines, formal languages, and grammars.	P4	P5
CLO4	To **compare** the characteristics of different types of computational models.	P12	

Evaluation/ Assessment System: Students are evaluated out of total **75 Marks**. There are different types of assessment tools. In **the final written** examination, total time**is3 hours** where students should answer Six questions from two sections out of Eight taking not more than Three from each section. The detail with **COs-Assessment Mapping** is given below.

CLOs	Assessment Tools (Total 100%)					
	20%				70%	10%
	Class Test 1	Class Test 2	Assignment	Presentation	Final Written	Attendance
CLO1	√			√	√	√
CLO2	√		√	√	√	√
CLO3		√	√	√	√	
CLO4		√	√		√	

Course Contents:

Introduction: Logic and Proofs, Mathematical Inductions, Sets, Equivalence relations, Language and recursive definitions.

Languages and Grammars: Finite Automata - accepting languages, strings, string search algorithm, distinguishing strings, integers, lexical analysis, decision problems and languages, minimizing finite automata.

Regular languages and expression: Non-deterministic finite automata, Kleene's theorem. Context-free languages, regular languages and grammars.Simplified forms and normal forms.Push-Down Automata-deterministic PDA and non-deterministic PDA, top-down and bottom-up PDA, Parsing - top down and bottom-up parsers.Decision problems and CFL.

Computational Models: Computational tasks - search and decision problems, General model of computation, Turing Machines - definition of Turing machine, Turing machine and regular languages,

computing partial functions with Turing machine, composite and multi-tape Turing machines, non-deterministic Turing machines, universal Turing machine. Boolean circuits.Parallel random access machines.

Decision problems: Undecidable problems, reduction and halting problem, undecidable problems and context-free languages. Decision trees.Satisfiability problem.

Computational complexity: Introduction to complexity theory, Time complexity of a Turing machine, Polynomial-time reductions and NP completeness, NP-hard and NP-complete languages, the Cook-Levin theorem. Space complexity - time vs. space, logarithmic space, non-deterministic space complexity.Communication complexity.

Text Book:

1. John C. Martin : **Introduction to Languages and The Theory of Computation**. McGraw Hill 2011.
2. SanjeevArora and Boaz Barak : **Computational Complexity**: A Modern Approach

Reference Books:

1. OdedGoldreich : **Complexity of Algorithms** - A Conceptual Perspective
2. Peter Gacs and Laszlo Lovasz : **Complexity Algorithms**

CSE2221: Design and Analysis of Algorithms

Credits: 3 **Contact Hours:** 39
Year: Second **Semester:** Even

Prerequisite: CSE2121: Data Structure, CSE1121: Structural Programming Language

Motivation : This course aims to introduce the classic algorithms in various domains, and techniques for designing efficient algorithms.

Course Objective:

The main objective of this course is to provide necessary knowledge on major modern algorithms, analyze efficient algorithms, algorithm design principles and complexity of algorithms.

CLO (Course Learning Outcome):			
CLOs	After successfully completing this course, students will be able	**PLO mapping**	
CLO1	To **describe** the major modern algorithms and selected techniques that are essential to today's computers.	P2	
CLO2	To **decide o**n the suitability of a specific algorithm design technique for a given problem.	P3	
CLO3	To **apply t**he algorithms and design techniques to solve problems, and mathematically evaluate the quality of the solutions;	P4	
CLO4	To **decide** on the suitability of a specific algorithm design technique for a given problem	P4	
CLO5	Tp**design a**nd analyze efficient algorithms using standard algorithm design technique for real world problems	P3	
CLO6	To **apply d**esign principles and concepts to algorithm design	P3	P4
CLO7	Analyze the complexity of algorithms	P2	

Evaluation/ Assessment System: Students are evaluated out of total **75 Marks**. There are different types of assessment tools. In **the final written** examination, total time **is3 hours** where students should answer Six questions from two sections out of Eight taking not more than Three from each section. The detail with **COs-Assessment Mapping** is given below.

CLOs	Assessment Tools (Total 100%)					
	20%				70%	10%
	Class Test 1& 2	Class Test 3 & 4	Assignment	Presentation	Final Written	Attendance
CLO1			√	√	√	√
CLO2	√			√	√	√
CLO3			√	√	√	√
CLO4	√			√	√	√
CLO5		√		√	√	√

CLO6			√	√	√	√
CLO7		√		√	√	√

Course Contents:

Basics of Algorithm: Algorithms as a technology, Analyzing algorithms, Designing algorithms, Time and space analysis of algorithms, Average, best and worst case analysis, different notations.

Sorting: Insertion sort,Heapsort, Quicksort, Counting sort, Radix sort, Bucket sort.

Dynamic programming: Assembly-line scheduling, Matrix-chain multiplication, Longest common subsequence, Optimal binary search trees.

Greedy method: An activity-selection problem, Elements of the greedy strategy, Huffman codes.

Graph algorithms: Depth-first search, Breadth-first search, Topological sort, Minimum spanning tree, Kruskal's and Prim's algorithm, Bellman-Ford algorithm, Dijkstra's algorithm, Floyd-Warshall algorithm, Johnson's algorithm for sparse graphs, Ford-Fulkerson method.

Computational Geometry: Line-segment properties, Determining whether any pair of segments intersects, Finding the convex hull, Finding the closest pair of points.

Backtracking: 8 queens problem, Sum of subsets, Graph coloring problem, Hamilton cycles.

Branch and bound: Lest cost search, 15-puzzle problem, Knapsack problem, Traveling salesman problem.

NP-Completeness: Polynomial time, Polynomial-time verification, NP-completeness and reducibility, NP-complete problems.

Text Book:

1. Thomas H. Kormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein : **Introduction to Algorithms**, The MIT Press
2. D. E. Knuth : **The Art of Computer Programming**, Vol. 1, 2, 3, Addison-Wesley.

Reference Books:

3. Ellis Horowitz, SartajSahni and SanguthevarRajasekaran : **Fundamentals of Computer Algorithms**, *Galgotia Publications*

CSE2222: Design and Analysis of Algorithms Lab

25 Marks [60% Practical, 30% Quizzes/Viva-voce, 10% Attendance]
1 Credit, 26 Contact hours

Laboratory works based on CSE2221

CSE 2231: Computer Architecture and Organization

Credits: 3 **Contact Hours:** 39
Year: Second **Semester:** Even

Prerequisite: APEE1131: Electrical Circuit and Electronics, CSE2111: Digital System Design
Motivation To develop basics and design knowledge on Computer Architecture and Systems
Course Objective: To provide students with a fundamental understanding of the functional components of a computer system, and how they are organised. The emphasis of the module is on the hardware aspects of a system, and how hardware is used during the execution of software. This is a core component of all computer science related degree courses. Practical skills will also be developed in the use and construction of computer components, and their interfacing to microprocessors.

CLO (Course Learning Outcome)			
CLOs	After successfully completing this course, students will be able	**PLO mapping**	
CLO1	To provide **knowledge** on basic of Computer Architecture and its organization	P1	P2
CLO2	To **understand** how Computer Systems works, its design objectives	P3	P4

CLO3	To **show** thedesigning procedure of a processor, memory and storage	P6	P12

Evaluation/ Assessment System:: Students are evaluated out of total **75 Marks.** There are different types of assessment tools. In **the final written** examination, total time **is 3 hours** where students should answer Six questions from two sections out of Eight taking not more than Three from each section. The detail with **COs-Assessment Mapping** is given below.

CLOs	**Assessment Tools (Total 100%)**					
	20%				**70%**	**10%**
	Class Test 1	Class Test 2	Assignment	Presentation	Final Written	Attendance
CLO1	√			√	√	√
CLO2	√		√	√	√	√
CLO3		√	√	√	√	

Course Contents:

Concepts and Terminology: Digital computer components Hardware & Software and their dual nature, recent development, Role of Operating Systems (OS).

Processor Design: Introduction: Processor organization, information representation, number formats; Fixed Point Arithmetic: Addition, subtraction, multiplication, division; ALU Design: Basic ALU organization, floating point arithmetic.
Control Design: Hardwired control: Design methods, multiplier control unit, CPU control unit; Basic concept of Micro programmed Control, Control memory optimization.

Memory Devices and its Organization: Different types of semiconductor memory, magnetic memory, optical memory, virtual memory, memory hierarchies; High-speed Memories: Interleaved memories, caches, associative memories. System Organization: Communications: Introduction, bus control; IO Systems: Programmed IO, DMA and interrupts, IO processors.

Application HDL for microcomputer design: Description of Adder, ALU by using HDL, implementation of a simple microcomputer system using HDL.

Text Book:

1. John P. Hayes : **Computer Architecture and Organization**, *McGraw-Hill.*
   M. Morris Mano : **Computer Architecture,***Prentice Hall.*

Reference Books:

1. Kai Hwang and Faye A. Briggs : **Computer Architecture and Parallel Processing**, *McGraw-Hill.*
2. William Stallings : **Computer Organization and Architecture: Designing for Performance**, *Prentice Hall.*

CSE2232: Computer Architecture and Organization Lab

25 Marks [60% Practical, 30% Quizzes/Viva-voce, 10% Attendance]
1 Credit, 26 Contact hours

Laboratory works based on CSE2231

CSE2242: Technical Writing and Presentation

25 Marks [60% Practical, 30% Quizzes/Viva-voce, 10% Attendance]
1 Credit, 26 Contact hours

CSE2252: Software Development Lab II

25 Marks [60% Practical, 30% Quizzes/Viva-voce, 10% Attendance]
1 credits, 26 Contact hours