Dept. of Computer Science and Engineering

Jahangirnagar University

Syllabus for B.Sc. (Hons.) in Computer Science and Engineering

(Effective from 2018-19)

Detail Syllabus of Second Year First Semester

Course code	**:**	CSE 200	**Credit**	**:**	1.0
Title	**:**	Viva-Voce	**Prerequisite**	**:**	None
Type	**:**	*Viva-Voce*	**Contact hours**	**:**	-

Rationale
Viva-Voce is used to measure and evaluate the students through oral examination on their previous taught/learned courses so that students have ability to face viva-board confidently in their professional life.

Course Objectives
Measure and evaluate the students through oral examination on their previous taught/learned courses

Students Learning Outcomes
After successful completion of this course, students should be able to: Expose their views orally in different situations on diverse fields of Computer Science and Engineering

#	**Title and Descriptions**
	The viva-voce will be held on all the courses of second year first semester.

References
The reading materials provided by the Course Teachers for all the courses of second year first semester

Course code	:	MATH 201	**Credit**	:	3.0
Title	:	Mathematics III (Vector, Complex Variable, Fourier Analysis and Laplace Transformation)	**Prerequisite**	:	None
Type	:	*Theory*	**Contact hours**	:	39

Rationale

Vector spaces are widely used in Data Science. Complex numbers are used to encode geometric information through algebra. The Laplace transform has a number of properties that make it useful for analyzing linear dynamical systems. Most of the works of image matching, face recognition, 3-D map creation, video-processing, sound processing are done using Fourier Transform, Laplace Transform. Fourier series help to better analyze a signal in another domain rather in the original domain.

Course Objectives

- Introduce and develop the methods of vector analysis.
- Introduce vector spaces and linear transformations, and their applications to a variety of problems.
- Introduce complex number system in details.
- Provide basic concept of Fourier series, Fourier integral, Fourier transforms, Laplace Transforms and Inverse Laplace Transforms of different functions.

Students Learning Outcomes

After successful completion of this course, students should be able to:

- Explain the basic concepts of vector spaces and subspaces.
- Demonstrate an understanding of the fundamental concepts of complex analysis.
- Apply theorems and rules in problem analysis.
- Calculate Fourier and Laplace Transforms and Inverse Laplace Transforms.
- Solve boundary problems for using Fourier Transform.
- Classify Laplace Transforms, Definition, existence and basic properties, differential function, periodic function etc.
- Describe different types Inverse Laplace Transform with the help of partial fraction, evaluation of integrals.

Course Description

#	**Title and Descriptions**
1	**Vector Spaces** Definition and properties, subspaces, basis and dimension, change of basis; Linear Transformation (LT): definition and properties, linear operator matrix, geometry of LT, standard plane LT.
2	**Vector Calculus** Differentiation and integration of vectors together with elementary applications; Definition of line, surface and volume integrals; Gradient, divergence and curl of point functions, various formulae, Gauss’s theorem,

	Stoke's theorem, Green's theorem.
3	**Complex Variable** Complex number system; General functions of a complex variable; Limits and continuity of a function of complex variable and related theorems; Complex differentiation and the Cauchy's Riemann Equations; Mapping by elementary functions.
4	**Integral Theorem** Line integral of a complex function; Cauchy's Integral Theorem; Cauchy's Integral Formula; Liouville's Theorem; Taylor's Theorem and Laurent's Theorem. Singular points; Residue; Cauchy's Residue Theorem. Evaluation of residues; Contour integration; Conformal mapping.
5	**Fourier Analysis** Real and complex form of Fourier series; Finite transform; Fourier Integral; Fourier transforms and their uses in solving boundary value problems of wave equations.
6	**Laplace Transforms** Definition; Laplace transforms of some elementary functions; Sufficient conditions for existence of Laplace transforms; Inverse Laplace transforms; Laplace transforms of derivatives.
7	The unit step function; Periodic function; Some special theorems on Laplace transforms; Partial fraction; Solutions of differential equations by Laplace transforms; Evaluation of improper integrals.

Recommended Books					
1.	Vector and Tensor Analysis	George E. Hay	1st	Dover Publications	2012
2.	Schaum's Outline Complex Variables	Murray Spiegel, Seymour Lipschutz, John Schiller, Dennis Spellman	2nd	McGraw-Hill	2009
3.	Fourier Analysis and Its Applications	Gerald B. Folland	2nd	American Mathematical Society	2009
4.	An Introduction to Laplace Transforms and Fourier Series	Phil Dyke	2nd	Springer	2014

Course code	:	CSE 203	**Credit**	:	3.0
Title	:	Computer Ethics and Cyber Law	**Prerequisite**	:	N/A
Type	:	Theory	**Contact hours**	:	39

Rationale
In the recent years, many concerns and issues were raised on the integrity and security of information, legal status of online transactions, privacy and confidentiality of information, intellectual property rights and security of government data placed on the Internet. Therefore, ethical values in computing are essential for understanding and maintaining the relationship between computing professionals and researchers and the users of their applications

and programs. The concepts are needed to understand risks and how to deal with them. Since computer ethics and cyber law are constantly changing as technology changes, there is a need for understanding the concept of risks and how to deal with them.

Course Objectives

- Intended to give students a chance to reflect on the humanitarian, social, and professional impact of computer technology by focusing on ethical issues faced by and brought about by computing professionals, including those related to networking and the internet, intellectual property, privacy, security, reliability, and liability.
- Introduce the students to professional ethics, codes of conduct, and moral responsibility
- To facilitate understand & critical understanding about Cyber crimes, Ethical Hacking, cyber security, forensics and cyber laws
- To provide an understanding of principal concepts, major issues, technologies and basic approaches in cyber security.
- Focus on issues raised by the possible emergence in the future of highly intelligent machines.

Students Learning Outcomes

After successful completion of this course, students should be able to:

- Understand, identify, and apply different ethical philosophies, frameworks, and methodologies.
- Identify and interpret the codes of professional conduct relating to the disciplines of computer science and software engineering.
- Analyze the local and global impact of computing on individuals, organizations, and society.
- Understand and apply the concepts and principles of moral thinking to problems relating to computing and digital technologies.
- Improve their skills writing argumentative essays and pieces, and in critical thinking, analysis, and presentation.
- Become familiar with a number of noteworthy essays written by influential researchers in the field of cyberethics.

#	Title and Descriptions
1	**Introduction** What is Cyber Law, Cyber Space, Various Cyber Crimes, Legal fabric of Bangladesh regarding cyber-crimes, What is Computer Ethics, Ten Commandments of computer ethics, Code of ethics for information, technology professionals.
2	**Ethics for IT Professionals and IT Users** Definition of IT Professionals, Relationships Between IT Professionals and Employers, Clients, Suppliers, Other Professionals, IT Users and Society, Certification, Government Licensing, Common Ethical Issues for IT Users, Supporting the Ethical Practices of IT Users.
3	**Computer and Internet Crime**

	Why Computer Incidents Are So Prevalent, Types of Exploits, Types of Perpetrators, Types of Perpetrators, Establishing a Security Policy, Prevention, Detection, Response, and Computer Forensics.
4	**Privacy** The Right of Privacy, Data Encryption, Public Key Encryption, Private Key Encryption, Identity Theft, Phishing, Spyware, Spamming, Advanced Surveillance system.
5	**Intellectual Property and Software Development** Definition of Intellectual Property, Copyrights, Patents, Trade Secret Laws, Plagiarism, Reverse Engineering, Open Source Code, Competitive Intelligence, Strategies to Engineer Quality Software, Software Development Process, Development of Safety-Critical Systems, Quality Management Standards.
6	**National Cyber security Strategy** Legal Measures, Technical and Procedural, Organizational Structures.
7	**Association for Computing Machinery (ACM) Code of Ethics and Professional Conduct** General Moral Imperatives, Organizational Leadership Imperatives, Compliance with the Code

Recommended Books					
1.	Ethics and Technology	Tavani, H.T.	4th	Wiley	2011
2.	Ethics for the Information Age	M. J. Quinn	7th		
3.	Computer Ethics and Professional Responsibility	Terrell Ward Bynum, Simon Rogerson	Latest edition	Wiley	2003

Course code	**:**	CSE-205	**Credit**	**:**	3.0
Title	**:**	Numerical Methods	**Prerequisite**	**:**	N/A
Type	**:**	Theory	**Contact hours**	**:**	39

Rationale
Numerical error and stability analysis is the key to develop accurate and robust algorithms. Numerical methods, based upon sound computational mathematics, are the basic algorithms underpinning computer predictions in modern systems science. The subject is initiated with fundamental principles of digital computing and the implications for algorithm accuracy and stability. The solution of systems of linear equations, the error and stability issues associated with solving linear systems will be covered extensively. The numerical treatment of eigenvalue problems is briefly discussed. Several lectures are devoted to solving non-linear equations, including root finding. The concept of interpolation and its role as foundation for numerical differentiation and integration is introduced. Numerical differentiation and integration is covered in depth, with particular emphasis on the error and convergence analysis. The final part of the course introduces the fundamentals of finite-difference solutions to ordinary differential equations, again with emphasis on error and convergence analysis.

Course Objectives

- To introduce students with different numerical methods for solving real life mathematical, physical and engineering problems.
- To give basic understanding of how to solve system of linear equations.
- To provide basic knowledge of curve fitting.
- To give a basic knowledge of numerical integration, and numerical differentiation.
- To provide introductory concepts of differential equations.
- To prepare students for facing future challenges.

Students Learning Outcomes

After successful completion of this course, students should be able to:

- Apply numerical approaches to solve system of linear equations.
- Apply numerical techniques to solve integration and differentiation.
- Explain the concept of curve fitting and partial differential equations.

#	Title and Descriptions
1	**Numerical Computing Process and Numerical Errors** Definition, Necessity, Process of Numerical Computing, Characteristics of Numerical Computing. Significant Digits, Errors in Arithmetic, Different types of Errors in Numerical Computation.
2	**Roots of Nonlinear Equations** Definition, Necessity, Methods of Solution, Iterative Methods: Bisection, False position, Newton-Raphson, Secant, and Fixed Point method.
3	**Direct and Iterative Solution of Linear Equations** Need and Scope, Existence of Solution, Basic Gaussian Elimination Method, Gauss-Jordan Method, and Matrix Inversion Method. Jacobi Iteration Method and Gauss-Seidel Iteration Method.
4	**Curve Fitting** Interpolation Definition, Need and Scope, Linear Interpolation, Lagrange Interpolation Polynomial and Newton Interpolation Polynomial, Divided Difference Table. Regression Definition, Need and Scope, Fitting Linear Equations- Least Square Regression, Fitting Transcendental Equations.
5	**Numerical Differentiation** Need and Scope, Differentiating continuous functions, Higher-Order Derivatives, Differentiating tabulated functions.
6	**Numerical Integration** Need and Scope, Trapezoidal rule, Simpson’s 1/3 rule and Simpson’s 3/8 rule.
7	**Numerical Solution of Ordinary and Partial Differential Equation** Need and Scope, Taylor series Method, Picard Method, Euler’s method, Heun’s Method, Runge-Kutta Method, Determination of characteristics equation of a matrix using Fadeev-Leverrier method, Eigen value and Eigen vector and matrix inversion.

Recommended Books					
1.	Numerical Methods	E Balagurusamy	8th	Tata McGraw-Hill	
2.	Introductory Methods of Numerical Analysis	S. S. Sastry	5th	PHI Learning Private Ltd.	
3.	Applied Numerical Method for Engineers	Robert J. Schilling and Sandra L Harries	5th	Thomson	
4.	Numerical Methods For Engineers and Scientists: An Introduction with Applications Using MATLAB	Amos Gilat, Vish Subramaniam	2nd	Wiley	
5.	Numerical Methods for Engineers	Steven C. Chapra and Raymond P. Canale	6th	McGraw-Hill	

Course code	**:**	CSE-206	**Credit**	**:**	1
Title	**:**	Numerical Methods Laboratory	**Prerequisite**	**:**	
Type	**:**	Laboratory Work	**Contact hours**	**:**	26

Lab Objectives

- To provide a basic knowledge of programming in C and MATLAB.
- To give a practical experience of how to implement different numerical methods.
- To prepare students for future laboratory-oriented courses.

Lab Outcome

After successful completion of this course, students should be able to:

- Write algorithms and flowcharts of different numerical methods.
- Write programs in C and MATLAB to implement numerical methods for solving real life problems.

Exp. #	Title
1	Implementation of Bisection Method.
2	Implementation of False Position Method.
3	Implementation of Newton-Raphson Method.
4	Implementation of Jacobi Iteration Method.
5	Implementation of Gauss-Seidel Iteration Method.
6	Implementation of Lagrange Interpolation Polynomial Method.
7	Implementation of Newton Interpolation Polynomial Method.
8	Implementation of Least Square Regression Method.
9	Implementation of Trapezoidal rule.

Hardware and Software Requirements	
H/W Requirements	*S/W Requirements*
PCs	1. C/C++ /MATLAB and MS Excel.

Course code	:	CSE-207	**Credit**	:	3.0
Title	:	Electronic Devices and Circuits-II	**Prerequisite**	:	CSE-157
Type	:	Theory	**Contact hours**	:	39

Rationale

This course is designed to understand the two terminal devices, theory and operation of the operational amplifier, applications and Power amplifiers, Multivibrators, Oscilators and feedback amplifiers

Course Objectives

- To understand the two terminal devices, theory and operation of the operational amplifier, applications and Power amplifiers, Multivibrators, Oscilators and feedback amplifiers

Students Learning Outcomes

After successful completion of this course, students should be able to:

- Operating operational amplifier, applications and Power amplifiers, Multivibrators, Oscilators and feedback amplifiers.

#	**Descriptions**
1	**Two terminal Devices** Schottky Barrier (Hot-Carrier) Diodes, Varactor (Varicap) Diodes, Solar Cells, Photodiodes, Photoconductive Cells, IR Emitters, Liquid-Crystal Displays, Thermistors, Tunnel Diodes
2	**Operational Amplifier** Differential Amplifier Circuit, BiFET, BiMOS, and CMOS Differential Amplifier Circuits, Op-Amp Basics, Practical Op-Amp Circuits, Op-Amp Specifications—DC Offset Parameters, Op-Amp Specifications—Frequency Parameters, Unit Specifications, Differential and Common-Mode Operation
3	**Op-Amp Applications** Constant-Gain Multiplier, Voltage Summing, Voltage Buffer, Controlled Sources, Instrumentation Circuits, Active Filters, Differential amplifier; Stable ac coupled amplifier; Analogue integrator & differentiator; Logarithmic and anti-logarithmic amplifiers; Multipliers; Dividers; Squarer & square rooters; Electronic analogue computation.
4	**Power Amplifiers** Class A, Class B & Class C amplifiers, R-C coupled, Direct coupled and Transformer coupled amplifier, push-pull, complementary symmetry amplifier, simple tuned, inductively tuned and double tuned amplifier, power amplifier, wide band amplifier.
5	**Multivibrators** Concepts, Monostable, Astable and Bistable multivibrators using transistor & OP-AMPs; Schimitt trigger circuits; The 555 timer.

6	**Oscillators** Concept; Circuit requirement for oscillation; Nyquist criterion; Sinusoidal oscillators; Barkhausen criterion; Phase shift oscillator; Resonant circuit oscillator; A general form of oscillator circuit; Hartley & Colpitts oscillator; Wein bridge oscillator; Crystal oscillator.
7	**Feedback Amplifiers** Feedback Concepts, Feedback Connection Types, Practical Feedback Circuits, Feedback Amplifier—Phase and Frequency Considerations

Recommended Books

1.	Electronic Devices and Circuit Theory	R.L. Boylestad, L. Nashelshy		PHI	1999
2.	Solid State Electronic Devices	B.G. Streetman, S. Banerjee		Prentice Hall	2000
4.	Physical Properties of Semiconductors	C.M. Wolfe, N. Holonyak Jr., G.E. Stillman,		Prentice-Hall	1989
5.	Semiconductor Physics and Devices	Donald A Neaman,	3rd	Tata Mc GrawHill	2007

Course code	**:**	CSE 208	**Credit**	**:**	1
Title	**:**	Electronic Devices and Circuits-II Laboratory	**Prerequisite**	**:**	CSE-157
Type	**:**	Laboratory Work	**Contact hours**	**:**	26

Rationale

This course is designed to understand the two terminal devices, theory and operation of the operational amplifier, applications and Power amplifiers, Multivibrators, Oscilators and feedback amplifiers

Lab Objectives

- To understand the characteristics of basic electronic devices and their usage in the common circuit applications.

Lab Outcome

After successful completion of this laboratory course, students should be able to:

- Recognize the ICs containing the common electronic devices and understand their pin configuration.
- Apply the devices in various daily applications.

Lab Course Description

#	**Title**
1	Study of the characteristics of two terminal devices (Varactor, Solar cell and Photodiodes).
2	Study of the characteristics of two terminal devices(IR Emitters, Liquid-Crystal Displays, Thermistors).
3	Study the behavior of operational amplifier.
4	Study of the applications of operational amplifier.

5	Study of the characteristics of different type power amplifier
6	Study of the characteristics of monostable multivibrator
7	Study of the characteristics of bistable multivibrator
8	Study of the characteristics of oscillators
9	Study of the characteristics of Feedback amplifier.

Hardware and Software Requirements	
H/W Requirements	***S/W Requirements***
ICs, Bread boards, DC supply generator, Oscilloscope, Signal generators.	No special S/W is required.

Course code	**:**	CSE-209	**Credit**	**:**	3.0
Title	**:**	Algorithms I	**Prerequisite**	**:**	C/C++/Java
Type	**:**	Theory	**Contact hours**	**:**	41

Rationale

Algorithms are the soul of computing. The construction and analysis of algorithms is a basic and very important part of modern computer science. In mathematics and computer science, an algorithm is a step-by-step procedure which is used for calculation, data processing, and automated reasoning. All computer programs can be described as algorithms that operate on a structured set of data, or as a concatenation of such algorithms. To construct a large program with a reasonable time and space consumption it is essential to have efficient solutions to the problem parts. Algorithms help to acquire necessary skills to recognise problem scenarios and identify the right algorithms that can be used, to modify an existing algorithm or develop a new one for new problems.

Course Objectives

- Provides an introduction to mathematical modeling of computational problems.
- Covers the common algorithms, algorithmic paradigms, and data structures used to solve these problems.
- Emphasizes the relationship between algorithms and programming, and introduces basic performance measures and analysis techniques for these problems.

Students Learning Outcomes

After successful completion of this course, students should be able to:

- Solve problems using appropriate algorithm.
- Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it.
- Derive and solve recurrences describing the performance of divide-and-conquer algorithms.
- Describe the greedy paradigm and explain when an algorithmic design situation calls for it.
- Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it.

- Explain the major graph algorithms and their analyses. Employ graphs to model engineering problems, when appropriate.

#	Title and Descriptions
1	**Introduction to Algorithm** What Kind of Problems are solved by Algorithms?, What is Data Structure?, Algorithms as a Technology, Analyzing Algorithms, Searching, Linear Search, Binary Search, Sorting, Insertion Sort, Selection Sort, Bubble Sort, Algorithmic paradigms
2	**Divide and Conquer** Property, Recurrence, Power of an element, Merge Sort, Counting Inversion in Merge Sort, Quick Sort, Randomized Quick Sort
3	**Sorting** Heap Sort, Linear Sorting Algorithms, Counting Sort, Radix Sort
4	**Greedy Algorithms** Property, Problems, Task Scheduling, Fractional Knapsack, Greedy Coin Change, Huffman Coding
5	**Data Structures** Disjoint Set Union, Binary Search Tree
6	**Dynamic Programming** Property, Problems : Fibonacci Number, Rod Cutting, Knapsack, Coin Change, Hill Climbing, LCS, Bit-Masking
7	**Graph Algorithms** Graph Representation, BFS, DFS, Topological Sort, Shortest Path, Single Source Shortest Path: Dijkstra Algorithm, Bellman Ford Algorithm, All Pair Shortest Path: Floyd Warshall, Johnsons Algorithm, Minimum Spanning Tree: Prims Algorithm, Kruskal Algorithm.
8	**Number Theory** Elementary number-theoretic notions, GCD, Modular Arithmatic, Solving Modular linear equations, Prime factorizations, Chinese Remainder Theorem.

Recommended Books

1.	Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein	3rd	The MIT Press	
2.	Algorithms Unlocked	Thomas H. Cormen	1st	The MIT Press	
3.	Introduction to the Design and Analysis of Algorithms	Anany Levitin	3rd	Pearson	

Course code	**:**	CSE-210	**Credit**	**:**	1
Title	**:**	Algorithm-I Laboratory	**Prerequisite**	**:**	C / C++ / Java
Type	**:**	Laboratory Work	**Contact hours**	**:**	[52]

Lab Objectives

- Provides an introduction to mathematical modeling of computational problems.
- Covers the common algorithms, algorithmic paradigms, and data structures used to solve these problems.
- Emphasizes the relationship between algorithms and programming, and introduces basic performance measures and analysis techniques for these problems.

Lab Outcome

After successful completion of this course, students should be able to:

- Solving problems using appropriate algorithm.
- Implement the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.
- Implement the greedy paradigm and explain when an algorithmic design situation calls for it.
- Implement the dynamic-programming paradigm and explain when an algorithmic design situation calls for it.
- Implement major graph algorithms and their analyses. Employ graphs to model engineering problems, when appropriate.

Exp. #	**Title**
1	Searching a key in an array a. Linear Search and Insertion Sort b. Selection Sort, Bubble Sort, Binary Search
2	Sorting an array using: Insertion Sort, Selection Sort, Bubble Sort
3	Using divide and conquer approach for sorting: Merge Sort and Quick Sort
4	Using data structure for sorting: Heap Sort, Linear time sorting: Counting Sort, Radix Sort
5	Task Scheduling using Greedy Approach
6	Fractional Knapsack and Greedy Coin Change
7	Huffman Coding and Disjoint Set Union(Union Find)
8	Dynamic Programming
9	Graph Representation and Breadth First Search(BFS)
10	Depth First Search(DFS) and Topological Sort Single Source Shortest Path, Dijkstra Algorithm, Bellman Ford Algorithm

Hardware and Software Requirements

H/W Requirements	*S/W Requirements*
Intel® Pentium® 4 Processor	Code Blocks / InteliJ / Net beans / Eclipse

Course code	:	CSE- 212	**Credit**	:	1
Title	:	Object Oriented Programming (JAVA) Laboratory	**Prerequisite**	:	OOP Concept
Type	:	Laboratory Work	**Contact hours**	:	26

Rationale

Java is a programming language, designed to be concurrent, class-based and object-oriented, and specifically designed to have as few implementation dependencies as possible. Its portability, safety, and simplicity features made one of the most popular programming languages. The web acts as convenient transport mechanism for Java programs and the web's ubiquity has popularized Java as an Internet development tool. The underlying principle that has enabled Java's success is the ability of the developers and coders consistently upgrading the model to be competitive to modern technological standards.

Lab Objectives

- To introduce students about basic object oriented programming principles: abstract data types, encapsulation, inheritance and polymorphism in Java.
- To make students familiar with fundamental features of Java: object, classes and interfaces, exceptions and libraries of object collections.
- Equip students with the required object -oriented programming skills required to build highly reusable, robust and maintainable software systems.

Lab Outcome

After successful completion of this course, students should be able to:

- Solve real world problems using object oriented programming principles
- Create, compile and debug computer programs in JAVA.
- Design and implement classes to produce reliable, robust, and reusable code.
- Implement object-oriented designs using encapsulation, inheritance, polymorphism, and exception handling
- Develop software (application program) in JAVA.

Exp. #	Title
1	**Introduction** Basic structure and Syntax of Java Program, E. Lists and Maps F. Sorting, searching and string
2	**Object-Based Programming** A. Classes and objects, instance variables, and instance methods B. Member access modifiers: public, private, protected, package, Constructors, overloaded constructors D. Set (mutator), Get (access), and predicate methods E. Final instance variables
3	**Object-Based Programming** J. Creating packages (Packages, The import Statement, Static Imports, CLASSPATH and Import, Defining Packages, Package Scope) and Allocation of Project

4	**Object-Oriented Programming** A. Inheritance B. Super class, subclass
5	**Object-Oriented Programming** C. Polymorphism D. Dynamic method binding
6	**Object-Oriented Programming** E. Abstract class, Concrete class F. Inner class definition G. Type-wrapper class for primitive data types H. Interfaces
7	**Exception Handling** A. Exceptions Overview B. Catching Exceptions C. The finally Block D. Exception Methods E. Declaring Exceptions F. Defining and Throwing Exceptions G. Errors and Runtime Exceptions
8	**Input/Output Streams** A. Overview of Streams B. Bytes vs. Characters C. Converting Byte Streams to Character Streams D. File Object E. Binary Input and Output F. PrintWriter Class G. Reading and Writing Objects H. Closing Streams
9	**Java – Thread** A. Multitasking B. Main Thread C. How to create Thread D. Implementing Runnable E. Extending Thread F. Multiple Threads G. Synchronization H. Inter Thread Communication
10	**Graphical User Interface - Java Swing** A. Event-Driven Programming and Event Handling Model B. Window Components C. Mouse and keyboard event handling D. Adapter classes E. Layout managers and Java Database, javado

Hardware and Software Requirements	
H/W Requirements	*S/W Requirements*
Here are the minimum requirement: Core i5, 1.8 GHz, 4 gig RAM, 500 meg disk space	Here are the minimum requirement: • Java SDK or JRE 1.6 or higher • Supported Database and library that supports the database connection with Java Popular IDEs include: i. Netbeans/ Eclipse

Recommended Books					
1.	Java: The Complete Reference	Herbert Schildt	9th	McGraw-Hill Education	2014
2.	An Introduction to Object-oriented Programming with Java	C. Thomas Wu	5th	McGraw-Hill	2006
3.	Java How to Program	Paul Deitel, Harvey Deitel	9th	Prentice Hall	2011
4.	Head First Java	Kathy Sierra, Bert Bates	2nd	O'Reilly Media	