

### Scheme of CBCS for MSC (CS)

Code		Semester I	Theory/ Practical		Internal		HpW	PpW	C
			Max	Min	Max	Min			
CS101T		Computer System Architecture	40	14	10	4	4		4
CS102T		Software Engineering	40	14	10	4	4		4
CS103T		Object Oriented Modeling and Design using UML	40	14	10	4	4		4
CS104T		Computer Oriented Statistical Analysis	40	14	10	4	4		4
CS105T		Java with GUI and Javascript	40	14	10	4	4		4
CS101P		Assembly Language Lab	34	12				4	2
CS104P		Statistical Analysis Lab using MATLAB/SPSS	33	12				4	2
CS105P		Java with GUI and Javascript Lab	33	12				4	2
SBC106		Skill Based Course							1
<b>Total Marks / CR</b>			<b>350</b>						<b>27</b>
Code		Semester II	Max	Min	Max	Min	HpW	PpW	C
CS201T		Automata Theory	40	14	10	4	4		4
CS202T		Computer Graphics	40	14	10	4	4		4
CS203T		Relational Database Management System	40	14	10	4	4		4
CS204T		Operation Research	40	14	10	4	4		4
CS205T		Advanced Java Programming and Web Technology	40	14	10	4	4		4
CS202P		Computer Graphics Lab	34	12				4	2
CS203P		SQL and PL/SQL Lab	33	12				4	2
CS205P		Advanced Java Programming and Web Technology Lab	33	12				4	2
SBC206		Skill Based Course							1
<b>Total Marks / CR</b>			<b>350</b>						<b>27</b>
Code		Semester III	Max	Min	Max	Min	HpW	PpW	C
CS301T		Advanced Computer Networks	40	14	10	4	4		4
CS302T		Data Mining	40	14	10	4	4		4
CS303T		Analysis and Design of Algorithms	40	14	10	4	4		4
CSE	304T	Artificial Intelligence	40	14	10	4	4		4
		Big Data Analytics							
OE	305T	Macro-Economic Analysis	40	14	10	4	4		4
		Management Concepts and Organizational Behavior							
		Environmental Economics							
		Digital Marketing							
CS302P		Data Mining Lab	34	12				4	2
CS303P		Analysis and Design of Algorithms Lab	33	12				4	2
CSE	304P	Prolog Programming Lab	33	12				4	2
		Big Data Analytics Lab							
SBC306		Skill Based Course							1
<b>Total Marks / CR</b>			<b>350</b>						<b>27</b>
Code		Semester IV	Max	Min	Max	Min	HpW	PpW	C
CS401T		Compiler Design	40	14	10	4	4		4
CS402T		Software Project Management	40	14	10	4	4		4
CSE	403T	Cloud Computing	40	14	10	4	4		4
		TCP/IP Concepts							
		Indian Economy							

OE	404T	Citizen and Civic Awareness	40	14	10	4	4		4
		Economics of Gender and Development							
		Cyber Security							
P405		Major Project/ Research Project	Project/100			Viva- 50 Min- 17	12		6
			Pre-25	File- 75	Min- 35				
SBC406		Skill Based Course							1
<b>Total Marks / CR</b>			<b>350</b>						<b>23</b>
<b>Grand Total/ CR</b>			<b>1400</b>				<b>88</b>	<b>16</b>	<b>104</b>

**Semester I**  
**Core Paper- CS101T**  
**Subject: Computer System Architecture**

Lectures/Unit	Credits		Theory		Internals		Practical	
			Max	Min	Max	Min	Max	Min
14	T	P	40	14	10	4	34	12
	4	2						

**Course objective:** To study the basic organization and architecture of digital computers, digital logics and microprogramming. Will provide understanding to design algorithm for computer hardware with respect to mathematical operation also can learn the concepts of parallel processing, pipelining and inter processor communication.

**Course outcome:** Students will be able to understand the architectural working of computer and can be used in the design and application of computer systems or as foundation for more advanced computer related studies.

### UNIT I

**Computer Arithmetic:** Arithmetic Algorithms - Addition & Subtraction (with signed Magnitude data, hardware implementation, Hardware Algorithm, Addition and Subtraction with Signed-2's Complement Data, Multiplication Algorithms -Hardware implementation for signed Magnitude data, Hardware Algorithm, Booth's Algorithm, Array Multiplier, Division algorithm- Hardware implementation for signed Magnitude data, Divide overflow, Hardware Algorithm. Floating point Arithmetic Operations- Register Configuration, Addition, Subtraction, Multiplication and Division.

### UNIT II

**Introduction to Parallel Processing:** Parallelism in Uni-Processor Systems, Parallel Processing Mechanisms, **Parallel Computer Structures:** Pipeline Computers, Array Computers, Multiprocessors Systems, Performance of Parallel Computers, Dataflow and New Concepts, Architectural Classification Schemes, Applications of Parallel Processing.

### UNIT III

**Pipeline & Vector Processing:** Principles of pipelining, Arithmetic pipeline, Instruction Pipeline Vector Processing, Matrix multiplication, Memory Interleaving, Supercomputers, Array Processor(Attached Array and SIMD).

### UNIT IV

Introduction to Assembly Language, Name field, operator field, comment field, program data (Number, Character), variable(Byte, word, array), named constant, Basic instructions (MOV,XCHG,ADD,SUB,INC,DEC). **Program Structure:** memory model, data segment, stack segment, code segment. **Input and output instruction:** INT instruction: INT 21h single key input, display a character, display a string.

### UNIT V

**Process status and flags register:** Status flag, carry flag, parity flag, auxiliary carry flag, zero flag, sign flag, overflow flag DEBUG program Flow control instruction (conditional jump, branching structure, looping structure, logic and shift instruction, stack application, Procedure(call and RET).

**Textbooks: -**

Computer System Architecture, by Morris Mano, PHI.

Computer Architecture & Parallel Processing by Hwang, Briggs, McGraw-Hill.

**Reference Books:-**

*Computer Organization and Design*, 3<sup>rd</sup> edition by David Patterson and John Hennessy's,  
Tanenbaum, A. S. *Structured Computer Organization*, 3<sup>rd</sup> Ed., Prentice Hall, 1990.

**Practical List**

1. Write a program for printing a character.
2. Display a message on screen.
3. Print characters starting from A to Z.
4. Write a program for Xchg operation.
5. Write a program to add two numbers.
6. Write a program to subtract two numbers.
7. Perform jump operation.
8. Write a program to multiply two numbers.
9. Print 10 times hello using loop.
10. Print all 255 ASCII Characters.
11. Program for reversing a string.
12. Program for creating an array.
13. Write a program for comparing two values.
14. Program to compare any number with 5.

**Semester I**  
**Core Paper- CS102T**  
**Subject: Software Engineering**

Lectures/Unit	Credits		Theory		Internals	
			Max	Min	Max	Min
14	T	P	40	14	10	4
	4	0				

**Course objective:** The course is desired to understand system, software design/architecture, development and software management. The course also gives the understanding of management of human resources in software development environment.

**Course outcome:** After completing this course students will be able to analyze quality of the software, new and better ways to solve computing problems, analyze existing software and to execute new ideas. They can be able to design and build software systems that are reliable, supportable with other attributes of quality. This course would be useful for the jobs like software tester, systems analyst, application analyst, IT consultant.

**UNIT I**

Software Processes: Processes, projects and products, component software processes, characteristics of a software process, software development process, project management process, software configuration management process, and process management process. Software requirement Analysis and Specification: Software requirement, need for SRS, requirement process, problem analysis, analysis issues, informal approach, structured analysis, object oriented modeling, other modeling approaches, prototyping, requirement specialization, characteristics of an SRS, component of an SRS, specialization languages, structure of requirement document validation, requirement reviews, other method metrics, size measures, quality metrics.

**UNIT II**

Planning Software Project: Cost estimation, uncertainties in cost estimation, building cost estimation models, on size estimation, COCOMO model, project scheduling, average estimation, project scheduling and milestones, staffing and personnel planning, Raleigh curve, personnel plan, team structure, software configuration management plans, quality assurance plans, verification and validation, project monitoring plans, risk management.

**UNIT III**

Function Oriented Design: Design principles, coupling, cohesion, design notation and specification, structured design methodology, verification, network metrics, stability metrics, information flow metrics software Testing.

**UNIT IV**

Testing Methods: Software testing fundamentals, test case design, white box testing, control structure testing, black - box testing, testing for specialized environments. Software Testing Strategies: A strategic Approach to software testing, strategic issues, unit testing, validation testing, system testing, the art of debugging.

## **UNIT V**

Re-Engineering: Software re-engineering, software maintenance, software reengineering process model, reverse engineering, reverse engineering user interfaces restructuring, code restructuring, data restructuring, forward engineering the economics of reengineering. Client/ Server software Engineering: The structure of Client/server systems, software engineering for c/s systems, analysis modeling issues, design for c/s systems, testing issues. Computer- Aided software Engineering: What is case, building blocks for case, taxonomy of case tools, integrated case environments, the integration architecture, case repository.

### **Textbooks:**

Software Engineering, A Practitioners Approach Tata Mc Graw hill by Pressman Rogers

Reference Books:

An Integrated Approach to Software Engineering by Pankaj Jalote.

Software Engineering Concepts by R.E. Fairly, Mc Graw Hill.

Software Project Management by Boyce

**Semester I**  
**Core Paper- CS103T**

**Subject: Object Oriented Modeling and Design using UML**

Lectures/Unit	Credits		Theory		Internals	
			Max	Min	Max	Min
14	T	P	40	14	10	4
	4	0				

**Course objective:** The course is designed to develop a solid foundation on object-oriented principles. To understand the fundamentals of object-oriented analysis and design and describe the three pillars of object-orientation and explain the benefits of each. Explore and analyze different analysis and design models, such as object-oriented models, structured analysis and design models.

**Course outcome:** At the end of the course the students will develop a working understanding of formal object-oriented analysis and design processes, understanding types of prototyping. They will be able to analyze information systems in real-world settings, and develop an understanding and skills of the application of OOAD practices from a software project management perspective

**UNIT I**

Object orientation, OO Development, Modeling Concepts- Modeling as a Design Technique- Modeling, Abstraction, the three models, Class Modeling- Object and class concepts, Link and association concepts, generalization and inheritance, Advanced class modeling-Concepts, association ends, N-ary associations, aggregation, abstract classes, multiple inheritance.

**UNIT II**

State Modeling- Events, states, transitions and conditions, state diagrams, Advanced state modeling- nested state diagrams, nested states, concurrency, Interaction Modeling- use case models, sequence models, activity models.

**UNIT III**

Analysis and Design- Process overview- Development stages, development life cycle, Domain analysis- overview of analysis, domain class model, domain state model, domain interaction model, iterating the analysis, Application analysis- Application Interaction Model, application state model, System Design- Estimating performance, making a reuse plan, breaking a system into subsystems, identifying concurrency, allocation of subsystems, management of data storage, handling global resources, common architectural styles.

**UNIT IV**

Class Design- Bridging the gap, realizing use cases, designing algorithms, recursing downward, design optimization, adjustment of inheritance, organizing a class design, process summary, Implementing Modeling- fine-tuning classes, fine-tuning generalization, realizing associations, testing.

**UNIT V**

Databases- Implementing structure-basic, implementing structure-advanced, implementing functionality, Programming Style: Object-Oriented Style, Reusability, Extensibility, Robustness, Programming – in – the Large, Software Engineering- Iterative Development, Managing Models.

**Text Books**

Object-Oriented Modeling and Design with UML by Michael Blaha, James Rumbaugh, Pearson Prentice Hall Pub.

**Reference Books:**

Object Oriented Analysis & Design with Application by Grady Booch, Pearson Prentice Hall Pub.

He UML User Guide by G. Booch, J Rumbaugh, Ivar Jacobson, Pearson Education



**Semester I**  
**Core Paper- CS104T**  
**Subject: Computer Oriented Statistical Analysis**

Lectures/Unit	Credits		Theory		Internals		Practical	
			Max	Min	Max	Min	Max	Min
14	T	P	40	14	10	4	33	12
	4	2						

**Course Objective:** The objective of this paper is to comprehend the methods of obtaining and analyzing data, in order to draw inference for making decisions. The course also briefs scientific methods for statistical analysis.

**Course Outcome:** Upon completion of the program, students will be able to demonstrate knowledge of:

1. Standard statistical distributions.
2. Fixed-sample and large-sample statistical properties of point and interval estimators.
3. How to design hypothesis and surveys for efficiency.

**UNIT I**

**Correlation and Regression Analysis:** Introduction, Methods of Correlation (Karl Pearson's, Direct Method, Deviations taken from Assumed mean), Regression Equations (X on Y, Y on X), Standard Error of Estimate, Univariate and Multivariate analysis.

**UNIT II**

**Statistical Inference:** Hypothesis Testing, Estimation, Test of Significance for large samples (Standard Error of Mean), Test of Significance for small samples (t and Z test), Chi-square test and Goodness of Fit, Variance Ratio test (F-test).

**UNIT III**

**Analysis of Variance and Time Series:** Introduction, Assumptions, Techniques (One Way and Two-Way ANOVA), Utility and Components of Time Series.

**UNIT IV**

**Statistical Quality Control:** Introduction, Control Charts and its Types, Setting up a Control Procedure, XChart, RChart, Control Chart for C, P, Advantages and Limitations of SQC, Acceptance Sampling.

**UNIT V**

**Business Forecasting:** Introduction, Role, Steps, Methods, Theories and Cautions. **Statistical Decision Theory:** Introduction, Ingredients, Optimal Decisions and Miscellaneous Illustrations using Decision Tree Analysis.

**Textbooks**

Statistical Methods by S.P. Gupta

**Reference Books:**

Statistical Methods by N.G. Das

Statistical Analysis Handbook by Dr. Michael J De Smith

## **List of Practicals**

1. WAP in Matlab to perform t-test
2. WAP in Matlab to perform Z-test
3. WAP in Matlab to perform F-test
4. WAP in Matlab to perform Chi-squaretest
5. WAP in Matlab to perform One way ANOVA
6. WAP in Matlab to perform Two way ANOVA

**Semester-I**  
**Core Paper- CS105T**  
**Subject- Java with GUI and Javascript**

Lectures/Unit	Credits		Theory		Internals		Practical	
			Max	Min	Max	Min	Max	Min
14	T	P	40	14	10	4	33	12
	4	2						

**Course objective:**

- To understand the concepts and features of object-oriented programming.
- To examine key aspects of java Standard API library such as util, io, applets, swings, GUI based controls.
- To learn java's exception handling mechanism, multithreading, packages and interfaces.
- To develop skills in internet programming using applets and swings.
- To develop skills of client-side scripting.

**Course Outcome:**

The students will be able to comprehend classical problems using Java Programming, implement frontend and backend of an application and also build real world applications.

**UNIT I**

Introduction of Java, Features of Java, Java Development Kit(JDK), Java Runtime Environment(JRE), Java Virtual Machine (JVM), JVM components, Unicode System, Data Type, Control Statement, Array, String, Java Class and Object, Methods Overloading , Inheritance, Method Overriding, Constructor, Object Cloning, super, this and static keyword, Extending and Implementing Interface, inner classes.

**UNIT II**

Access Modifiers, Packages, Multithreading, Interrupting Threads, thread life cycle ,Thread Properties, Inter thread communication, Thread synchronization, Exception Handling, **Applet Class:** Life Cycle of an Applet, The Applet Tag and their attributes, Passing Parameter to an Applet, Graphics in Applet. **AWT:** Event Handling: Event Handling Mechanism, the Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, AWT controls, Adapter Classes, Layout Managers and Menus.

**UNIT III**

Swings: JButton, JLabel, JTextField, JTextArea, JPasswordField, JCheckBox, JRadioButton, JComboBox, JTable, JList, JOptionPane , JScrollBar, JMenuItem & JMenu, JPopupMenu , JCheckBoxMenuItem , JTree , JTabbedPane , JPanel , JFrame, JScrollPane ,Use of ToolTip.

**UNIT IV**

**Java Database Connectivity(JDBC):** Introduction, JDBC Driver, DB Connectivity steps, Connectivity with Oracle, MySQL and MS Access, Connection Interface, Statement Interface, ResultSet Interface, Scrollable ResultSet, PreparedStatement, Transaction Management.

**UNIT V**

**Networking:** Socket Overview, Client/Server, TCP/IP Client Sockets and TCP/IP Server Sockets.

**Javascript:** Introduction, Variables, Data type, control statements, functions, arrays, Strings, Math and Dates, Window properties and Methods, Document Object Model.

**Methods of document object:** Write(), getElementById(), getElementsByName(), getElementsByTagName(). innerHTML and innerText property, Javascript validations.

**Text Books:**

The Complete Reference: Java 2 – 5Ed, Herbert Schildt, Tata McGraw-Hill Publishing Company Limited.

Core Java 2, Vol. I – Fundamentals 7Ed, Cay S. Horstmann and Gary Cornell, (LPE) Pearson Education, Sun Microsystems.

**Reference Books:**

Java Examples in a Nutshell - by David Flanagan

The Java AWT Reference by John Zukowski Publisher: O'Reilly & Associates, Inc.

The Java Class Libraries: An Annotated Reference by Patrick Chan, Rosanna Lee  
Publisher: Addison-Wesley

Designing Better Apps and Applets with Java by Peter Coad, Mark Mayfield

**Practical List**

1. Calculate area of circle, rectangle and triangle using method overloading.
2. WAP to demonstrate the concept of multilevel inheritance.
3. WAP to demonstrate object cloning.
4. WAP to demonstrate use of super keyword.
5. WAP to demonstrate use of this keyword.
6. WAP to demonstrate use of inner class.
7. WAP to demonstrate use of static keyword.
8. WAP to demonstrate multiple inheritance using interface.
9. WAP to run multiple threads at a time.
10. WAP to demonstrate use of user defined Package.
11. WAP to demonstrate thread synchronization.
12. WAP to demonstrate Layout managers.
13. WAP to demonstrate adapter classes.
14. WAP to create registration form with proper layout.
15. WAP to demonstrate login form.

**Semester-II**  
**Core Paper- CS201T**  
**Subject- Automata Theory**

Lectures/Unit	Credits		Theory		Internals	
			Max	Min	Max	Min
14	T	P	40	14	10	4
	4	0				

**Course objective:** This course is designed with the objective to give understanding of several formal mathematical models of computation to the students. Students will learn about automaton, their grammar and they are able to describe how they relate it to formal languages. Students will understand what is possible and what is not possible with computers. They will understand different types of problems such as P, NP, NP complete and NP hard problem.

**Course outcome:** At the end of the course, the student will be able to analyze different computational models. They will be able to apply rigorously formal mathematical methods to prove properties of languages, grammars and automata. They will be able to identify the limitations of some computational models and possible methods of proving them.

**UNIT I**

Fundamentals – alphabets, strings, languages, problems, graphs, trees, Finite State Systems, definitions, Finite Automaton model, acceptance of strings, and languages, Deterministic finite automaton and Nondeterministic finite automaton, transition diagrams, transition tables, proliferation trees and language recognizers, equivalence of DFA’s and NFA’s. Finite automata with  $\epsilon$ -moves, significance, acceptance of languages,  $\epsilon$ -closure.

**UNIT II**

Minimization of finite automata, Finite automata with output– Moore and Melay machines. Regular Languages: regular sets, regular expressions, identity rules, constructing finite automata for a given regular expressions, conversion of finite automata to regular expressions. Pumping lemma of regular sets and its applications, closure properties of regular sets. Grammar Formalism: Regular grammars–right linear and left linear grammars.

**UNIT III**

Context free grammar, derivation trees, sentential forms, right most and leftmost derivation of strings, ambiguity. Context Free Grammars: Simplification of Context Free Grammars, Chomsky normal form, Greibach normal form.

**UNIT IV**

Pumping lemma for context free languages and its applications, closure of properties of CFL (proofs omitted). Push Down Automata: PDA definition, model, acceptance of CFL, acceptance by final state and acceptance by empty state and its equivalence. Turing Machine: TM definition, model, design of TM, computable functions, unrestricted grammars, recursively enumerable languages.

**UNIT V**

Linear bounded automata and Context sensitive language. Computability Theory: Chomsky hierarchy of languages. Definitions of P and NP problems, NP complete and NP hard problems.

**Text Books:**

1. J. E. Hopcroft, J. D. Ullman, Introduction to Automata Theory, Languages, and Computation
2. Perter Linz, An Introduction to Formal Languages and Automata

**Reference Books:**

1. John C. Martin, Introduction to Languages and the Theory of Computation
2. Mishra, Chandrashekar, Theory of Computer Science

**Semester II**  
**Core Paper- CS202T**  
**Subject: Computer Graphics**

Lectures/Unit	Credits		Theory		Internals		Practical	
			Max	Min	Max	Min	Max	Min
14	T	P	40	14	10	4	34	12
	4	2						

**Course objective:** The objective is to introduce the use of the components of graphics and will be familiar with building approach of algorithms related to them. The course will comprehend the basic principles of 2-dimensional and 3-dimensional computer graphics, an understanding of how to scan, convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition and provide an understanding of mapping the world coordinates to device coordinates.

**Course outcome:** Student will be able to implement the basic concepts and various algorithms to scan, convert the basic geometrical primitives, transformations, area filling, clipping, viewing, projections and transformations.

**UNIT I**

A brief background about applications of Computer Graphics. Overview of graphic systems, video display devices, refresh cathode ray tubes, raster and random screen display, color CRT monitors, flat panel displays, LCD's. Design and architecture of raster scan and random scan display systems. A brief introduction to input devices and hardcopy devices. Output primitives, DDA and Bresenham's 2D line drawing algorithms, parallel line algorithms.

**UNIT II**

Midpoint circle generating algorithm, Ellipse generating algorithm, other curves, filled area primitives, scan line polygon fill algorithm, inside outside test, boundary fill algorithms, flood fill algorithm, character generation, attributes of output primitive, line and curve attributes, character attributes.

**UNIT III**

Anti-aliasing, two dimensional geometric transformations, composite transformations. General composite transformations and computational efficiency, other transformations, affined transformation, two dimensional viewing, window to view port coordinate transformations.

**UNIT IV**

Clipping operations, Cohen Sutherland line clipping, Liang Barsky line clipping, Nicholl-Lee- Nicholl line clipping, polygon clipping, Sutherland Hodgeman and Weiler Atherton polygon clipping, text and curve clipping. Three dimensional concepts, display methods, polygon surfaces, quadric surfaces and super quadrics.

**UNIT V**

Three dimensional geometric and modeling transformations, general three dimensional rotation. Three dimensional viewing, pipeline projections, parallel and perspective projections, view volume and general projective transformations. Visible surface detection methods, Back Face detection, Depth Buffer Method, A buffer method, Depth sorting method.

**Text Book:**

Donald Hearn and M. Pauline Baker, Second Edition, PHI 1997.

**Reference Books:**

J. D. Foley, A van Dam, S. K. Feiner, J. F. Hughes, Addison Wesley Publ. Company, 1997  
Jim Blinn, Jim Blinn's Corner : A trip down the graphics pipeline, Morgan Kaufman, 2000.  
Computer Graphics by schaum's outlines.

**Practical List**

1. Program to generate a pixel on screen.
2. Program to draw four connected pixels (Rectangle shape).
3. Program to generate line using DDA algorithm.
4. Program to plot line using slope and intercept.
5. Program to plot line using Bresenham's algorithm.
6. Program to generate circle using mid-point circle algorithm.
7. Program to translate line and rectangle.
8. Program to scale line and rectangle.
9. Program to generate ellipse.
10. Program to generate ellipse using mid-point algorithm.



**Semester II**  
**Core Paper- CS203T**  
**Subject: Relational Database Management System**

Lectures/Unit	Credits		Theory		Internals		Practical	
			Max	Min	Max	Min	Max	Min
14	T	P	40	14	10	4	33	12
	4	2						

**Course Objective:** To give knowledge of the Relational Model of Data Management. This course contains approaches to organize, store, retrieve and process data, architecture and design techniques for effective implementation, different anomalies, their solutions, a platform for understanding of SQL and PL/SQL, distributed database, transaction concurrency and recovery.

**Course Outcome:** Student will be able learn database creation and modification. Data definition, manipulation, control using SQL command. They will learn the concepts of joining the database which will help them access data from different relations. Students will be able to implement the programming using PL/SQL for automated and fast database activities.

**UNIT I**

Introduction: Advantages of DBMS approach, various views of data, data independence, schema & sub-schema, Primary concepts of data models, Database languages, transaction management, database administrator, & uses, data dictionary, overall system architecture. ER Model: Basic concepts, design issues, mapping constraints, keys, ER diagram, weak & strong entity sets, specialization & generalization, aggregation, inheritance, design of ER schema, reduction of ER schema to tables.

**UNIT II**

Domain Relation & Keys: Domains, relations, kinds of relation, relational databases, various types of keys, candidate, primary, alternate & foreign keys. Relation algebra & SQL: The structure, relation algebra with extended operations, modification of database, idea of relational calculus, basic structure of SQL, set operation, aggregate function, null values, nested sub queries, derived relations, views, modification of database, join relations, DDL & SQL.

**UNIT III**

Functional dependencies & Normalization: Base definition, trivial and nontrivial dependencies, closure set of dependencies, & of attributes, irreducible set of dependencies, introduction to normalization, non-loss decomposition, FD diagram, I,II & III NF, dependencies prevention, BCNF, multivalued dependencies, preventions, BCNF, Multivalued dependencies & 4NF, Join dependencies & 5NF. Database Integrity: General idea, Integrity rule, domain rules, attributes, relation, rules, database rule, assertions, triggers, integrity & SQL.

**UNIT IV**

Distributed databases: Basic idea, distributed, data storage, data replication, data fragmentation, horizontal, vertical, & mixed fragmentation. Emerging field in DBMS: Object- Oriented database- basic idea & the model object structures Object, class, inheritance, multiple object identify, data warehousing terminology, definitions, characteristics, data mining & its overview, database on WWW, multimedia database difference with conventional DBMS, issues, similarity based retrieval continuous media data, multimedia data formats, video servers.

## UNIT V

Transaction Management-concurrency & recovery, ACID properties, transaction state, implementation of atomicity and durability, concurrent execution. Basic idea of serializability, concurrency control, deadlock, failure classification, Storage structure- types, stable storage implementation, data access. Recovery & Atomicity: Log based recovery, deferred database modifications, immediate database modification, and check points.

### Text Books:

- Data base concepts by Henry F. Korth, MGH
- An Introduction to database system by Bipin C. Desai, Galgotia Pub.

### Reference Books:

- Database Management system by Arun K. Majumdar & P. Bhattacharya, TMH Pub.
- Principles of Database system by Jeffrey O. Ullman, Galgotia Pub, Co. Ltd.
- Principles of Database Management system by James Martin, PHI

### Suggested Practical List

#### I) Sample Table – Worker

WORKER_ID	FIRST_NAME	LAST_NAME	SALARY	JOINING_DATE	DEPARTMENT
001	Monika	Arora	100000	2014-02-20 09:00:00	HR
002	Niharika	Verma	80000	2014-06-11 09:00:00	Admin
003	Vishal	Singhal	300000	2014-02-20 09:00:00	HR
004	Amitabh	Singh	500000	2014-02-20 09:00:00	Admin
005	Vivek	Bhati	500000	2014-06-11 09:00:00	Admin
006	Vipul	Diwan	200000	2014-06-11 09:00:00	Account
007	Satish	Kumar	75000	2014-01-20 09:00:00	Account
008	Geetika	Chauhan	90000	2014-04-11 09:00:00	Admin

#### II) Sample Table – Bonus

WORKER_REF_ID	BONUS_DATE	BONUS_AMOUNT
1	2016-02-20 00:00:00	5000
2	2016-06-11 00:00:00	3000
3	2016-02-20 00:00:00	4000
1	2016-02-20 00:00:00	4500
2	2016-06-11 00:00:00	3500

### III) Sample Table – Title

WORKER_REF_ID	WORKER_TITLE	AFFECTED_FROM
1	Manager	2016-02-20 00:00:00
2	Executive	2016-06-11 00:00:00
8	Executive	2016-06-11 00:00:00
5	Manager	2016-06-11 00:00:00
4	Asst. Manager	2016-06-11 00:00:00
7	Executive	2016-06-11 00:00:00
6	Lead	2016-06-11 00:00:00
3	Lead	2016-06-11 00:00:00

- Q-1. Write an SQL query to fetch “FIRST\_NAME” from Worker table using the alias name as <WORKER\_NAME>.
- Q-2. Write an SQL query to fetch “FIRST\_NAME” from Worker table in upper case.
- Q-3. Write an SQL query to fetch unique values of DEPARTMENT from Worker table.
- Q-4. Write an SQL query to print the first three characters of FIRST\_NAME from Worker table.
- Q-5. Write an SQL query to find the position of the alphabet (‘a’) in the first name column ‘Amitabh’ from Worker table.
- Q-6. Write an SQL query to print the FIRST\_NAME from Worker table after removing white spaces from the right side.
- Q-7. Write an SQL query to print the DEPARTMENT from Worker table after removing white spaces from the left side.
- Q-8. Write an SQL query that fetches the unique values of DEPARTMENT from Worker table and prints its length.
- Q-9. Write an SQL query to print the FIRST\_NAME from Worker table after replacing ‘a’ with ‘A’.
- Q-10. Write an SQL query to print the FIRST\_NAME and LAST\_NAME from Worker table into a single column COMPLETE\_NAME. A space char should separate them.
- Q-11. Write an SQL query to print all Worker details from the Worker table order by FIRST\_NAME Ascending.
- Q-12. Write an SQL query to print all Worker details from the Worker table order by FIRST\_NAME Ascending and DEPARTMENT Descending.
- Q-13. Write an SQL query to print details for Workers with the first name as “Vipul” and “Satish” from Worker table.
- Q-14. Write an SQL query to print details of workers excluding first names, “Vipul” and “Satish” from Worker table.
- Q-15. Write an SQL query to print details of Workers with DEPARTMENT name as “Admin”.
- Q-16. Write an SQL query to print details of the Workers whose FIRST\_NAME contains ‘a’.
- Q-17. Write an SQL query to print details of the Workers whose FIRST\_NAME ends with ‘a’.
- Q-18. Write an SQL query to print details of the Workers whose FIRST\_NAME ends with ‘h’ and contains six alphabets.
- Q-19. Write an SQL query to print details of the Workers whose SALARY lies between 100000 and 500000.
- Q-20. Write an SQL query to print details of the Workers who have joined in Feb’2014.
- Q-21. Write an SQL query to fetch the count of employees working in the department ‘Admin’.
- Q-22. Write an SQL query to fetch worker names with salaries >= 50000 and <= 100000.
- Q-23. Write an SQL query to fetch the no. of workers for each department in the descending order.
- Q-24. Write an SQL query to print details of the Workers who are also Managers.

- Q-25. Write an SQL query to fetch duplicate records having matching data in some fields of a table.
- Q-26. Write an SQL query to show only odd rows from a table.
- Q-27. Write an SQL query to show only even rows from a table.
- Q-28. Write an SQL query to clone a new table from another table.
- Q-29. Write an SQL query to fetch intersecting records of two tables.
- Q-30. Write an SQL query to show records from one table that another table does not have.
- Q-31. Write an SQL query to show the current date and time.
- Q-32. Write an SQL query to show the top n (say 10) records of a table.
- Q-33. Write an SQL query to determine the nth (say n=5) highest salary from a table.
- Q-34. Write an SQL query to determine the 5th highest salary without using TOP or limit method.
- Q-35. Write an SQL query to fetch the list of employees with the same salary.
- Q-36. Write an SQL query to show the second highest salary from a table.
- Q-37. Write an SQL query to show one row twice in results from a table.
- Q-38. Write an SQL query to fetch intersecting records of two tables.
- Q-39. Write an SQL query to fetch the first 50% records from a table.
- Q-40. Write an SQL query to fetch the departments that have less than five people in it.
- Q-41. Write an SQL query to show all departments along with the number of people in there.
- Q-42. Write an SQL query to show the last record from a table.
- Q-43. Write an SQL query to fetch the first row of a table.
- Q-44. Write an SQL query to fetch the last five records from a table.
- Q-45. Write an SQL query to print the name of employees having the highest salary in each department.
- Q-46. Write an SQL query to fetch three max salaries from a table.
- Q-47. Write an SQL query to fetch three min salaries from a table.
- Q-48. Write an SQL query to fetch nth max salaries from a table.
- Q-49. Write an SQL query to fetch departments along with the total salaries paid for each of them.
- Q-50. Write an SQL query to fetch the names of workers who earn the highest salary.
- Q-51. Create a View.
- Q-52. Write a Query to Demonstrate equi Join Concept.
- Q-53. Create a Trigger for updating a row.

**Semester II**  
**Core Paper- CS204T**  
**Subject: Operation Research**

Lectures/Unit	Credits		Theory		Internals	
			Max	Min	Max	Min
14	T	P	40	14	10	4
	4	0				

**Course Objective:** Students will acquire the knowledge and understanding of the mathematical tools that are needed to solve optimization problems, understand the development of reports that describes the formulation of the problem techniques to solve, analyze the results, finally prepare optimal solution used for decision making processes in Management Engineering.

**Course Outcome:** After the completion of the course students are able to solve and formulate the optimization problems. Develop models for shortest path, critical path, minimum cost flow, and assignment and transshipment problems.

**UNIT I**

Linear programming – Mathematical formulation of problems, graphical solution, simplex method, two phase method, Big M method, concept of duality, dual simplex method, degeneracy and its resolution, sensitivity analysis.

**UNIT II**

Assignment problems – Mathematical formulation, Hungarian method for solution, unbalanced assignment problem, infeasible assignment, Crew based problems, transportation problems – Vogel’s approximation method, optimal solution by stepping stone method and modified distribution method, degeneracy in transportation problems, transshipment problems.

**UNIT III**

Game theory, two person zero sum game, minimax (maximin) criterion, solution of games with saddle point and without saddle point, equivalence of the rectangular game and linear programming and solution by simplex method, concept of dominance, graphical method for 2 x n and m x 2 games, algebraic method for a general game, iterative method, sequencing problems of n jobs through 2 machines, 3 machines, and n jobs through m machines.

**UNIT IV**

Replacement problems – replacement of items that deteriorate with time, money value and present work factor, replacement policy when money value changes, replacement of items that are failed completely, group replacement of items, integer programming, nonlinear programming problem, Kuhn Tucker conditions, graphical solution, quadratic programming, solution by Wolf’s method.

**UNIT V**

Dynamic programming – minimum path problems, problems on single additive constraint additive separable return, single multiplicative constraint additive separable return, single additive constraint multiplicative separable return, serial multistage model. Development of CPM/PERT technique, constraint of network diagram, determination of critical path, probability of completing the project by scheduled date.

**Text Books:**

Operations Research: S.D.sharma

**Reference Books:-**

Introduction to Operation research: A Computer Oriented Algorithmic Approach Gillett Billy E  
Tata Mc-Graw Hill Publishing Company Ltd., New Delhi.

Fundamentals of Operation Research. A Ckoff, R.L. and Sasieni, M.W,  
Wiley, 1968. Linear Programming, Hadley G. Oxford and IBH Publishing  
Co. Ltd., New-Delhi.

**Semester II**  
**Core Paper-CS205T**  
**Subject: Advanced Java Programming and Web Technology**

Lectures/Unit	Credits		Theory		Internals		Practical	
			Max	Min	Max	Min	Max	Min
14	T	P	40	14	10	4	33	12
	4	2						

**Course objective:** The objective of this course is to familiarize the student with client server architecture and development of web application using Java technologies. Students will gain the skills and project-based experience needed to enter into Web Application and Development careers.

**Course outcome:** Students will be able to write a well formed / valid XML document, can establish connectivity to database, perform Server-Side application using JSP and Servlet, execute interactive effects on websites using JavaScript & jQuery and utilizing AngularJS formats adequately.

#### UNIT I

**Servlet:** Introduction, Web Terminology: static and dynamic website, HTTP, HTTP Requests, Get and Post request, Servlet API, Servlet interface, GenericServlet class, HttpServlet class, Life Cycle of a Servlet, ServletRequest Interface, RequestDispatcher interface, ServletConfig Interface, ServletContext Interface, cookies, hidden form field, HttpSession.

#### UNIT II

**Data Access with Servlets:** JDBC Concepts, Connecting to a Database, Retrieving Data. **JSP Overview:** Why use JSP?, Advantages of JSP, JSP Environment Setup: Setting up Java Development Kit, Setting up Web Server: Tomcat, Setting up CLASSPATH. **JSP Architecture, JSP- Life Cycle:** JSP Compilation, JSP Initialization, JSP Execution, JSP Cleanup. **JSP Syntax:** The Scriptlet, JSP Declarations, JSP Expression, JSP Comments, JSP Directives, JSP Actions, JSP Implicit Objects, Control Flow Statements, Decision Making Statements, Loop Statements, JSP Operators, JSP Literals.

#### UNIT III

**JSP Directives:** The page Directive, Attributes, The include Directive, The taglib Directive. **JSP- Client Request:** The HttpServletRequest Object, HTTP Header Request Example. **JSP- Server Response:** The HttpServletResponse Object, HTTP Header Response Example. **JSP Form Processing:** GET method, POST method, Reading Form Data using JSP, GET Method Example Using URL.

#### UNIT IV

AngularJS: Introduction, MVC Architecture, Data Binding- One way and two way, Expressions, Directives, Controllers, Modules, Scopes, Dependency, Filters, Tables, Select, DOM, Forms, Validations, Ajax, Animation.

#### UNIT V

jQuery: Introduction, Selectors, Effects: display, fading, sliding,hide method, show method, toggle method, fadeIn method,fadeout method,fadeToggle method,fadeTo method, slideup and slidedown method.

**Text Books:**

Java Servlet Programming Bible, S. Rajagopalan, R. Rajamani, R. Krishnaswamy, and S. Vijendran, WILEY dreamtech India Pvt. Lmt.

The Complete Reference: Java 2 – 5Ed, Herbert Schildt, Tata McGraw – Hill Publishing Company Limited.

Core Java 2 Vol. II – Advance Features 7Ed, Cay S. Horstmann and Gary Cornell, (LPE) Pearson Education, Sun Microsystems.

JavaScript Bible 4th Edition by Danny Goodman, Wiley dreamtech Pub

**Reference Books:**

OOPS with C++- E Balaguruswamy.

Complete Reference C++ by Herbert Schield, BPB Pub.

Java Servlet Programming Bible

JavaScript Bible 4th Edition by Danny Goodman,

Database Programming with JDBC and Java - by George Reese

**Practical List**

1. Create a servlet that prints today's date.
2. Create a servlet for a login page. If the username and password are correct then it says message "Hello <username>" else a message "login failed".
3. create a servlet that uses Cookies to store the number of times a user has visited servlet.
4. Create a servlet that displays some header information from your request as well as any form data.
5. Create a servlet filter that changes all text to upper case.
6. Create a JSP that prints current date and time.
7. Create a JSP that adds and subtracts two numbers.
8. Create a JSP that prints odd numbers that come within a range.
9. Create a JSP for login module.



**Semester III**  
**Core Paper- CS301T**

**Subject: Advanced Computer Networks**

Lectures/Unit	Credits		Theory		Internals	
			Max	Min	Max	Min
14	T	P	40	14	10	4
	4	0				

**Course Objective:** To comprehend the switching mechanism of computer network, internet address system, different routing protocol, user account management, network resource management, security techniques, services, attacks, cryptography, encryption technique and virus threats.

**Course Outcome:** Students will be able to understand the concepts of packets in networks, work and role of various protocols used to achieve different purposes, IPv4 and IPv6 internet addressing, user management for networks system.

**UNIT-I**

**Circuit & Packet Switching**-Switched Communication Networks, Circuit Switching Networks, **Circuit Switching Concepts**-Space Division Switching, Time Division Switching, **Soft switching Architecture, Packet Switching Principles**-Switching Technique, Packet Size, Comparison of Circuit Switching and Packet Switching, Routing in Packet Switching Networks- Characteristics, performance criteria, decision, time and place, network information and update timing. Routing strategies- fixed, flooding, random and adaptive.

**UNIT-II**

IPv4 Addresses. Classes, Classes and Blocks, Class full Addressing Two Level Addressing, Masking, Three- Level Addressing – Sub netting, Classless Addressing-Two Level Addressing, **Unicast Routing Protocols**- Routing Information Protocol (**RIP**)-RIP Message Format, Timer in RIP, Open Shortest Path First (**OSPF**)Types of Links, Types of OSPF Packets, OSPF Common Header, Border Gateway Protocol (**BGP**)-External and Internal BGP, Types of BGP Message.

**UNIT-III**

Network Administration: Managing Network accounts- user account, group account, managing resources. Managing network performance- potential network performance problems, tools and techniques.

**UNIT-IV**

Network security- introduction, attacks, services and mechanisms, security attacks, security services. Public-key cryptography principles, the RSA public-key encryption algorithm, Kerberos IP security overview and architecture. Intruders and viruses- intruders, viruses and related threats. Firewalls- design principles.

**UNIT-V**

Mobile IP- addressing, agents, three phase, inefficiency in mobile IP. IPv6 addressing, Emerging Technologies-LiFi, Software Defined Network(SDN) and 5G network.

**Text Books**

Data and Computer Communication ,8th Edition, William Stallings Peter Norton's Complete Guide

to Networking, SAMS Techmedia.

Network Security Essentials Application and Standards William Stallings.

Douglas Comer, Internetworking with TCP/IP – Volume 1, Volume 2, Prentice-Hall of India, New Delhi

Forouzan, TCP/IP Protocol Suite, TMH

**Semester III**  
**Core Paper-CS302T**  
**Subject: Data Mining**

Lectures/Unit	Credits		Theory		Internals		Practical	
			Max	Min	Max	Min	Max	Min
14	T	P	40	14	10	4	34	12
	4	2						

**Course Objective:** The objective of the course is to comprehend data analysis and models for respective application and also to develop research interest towards the advancement in Data Mining.

**Course Outcome:** After the completion of the course students will be able to develop algorithms for data mining models and they will also be able to compare and evaluate different data mining techniques like classification, prediction, clustering and association rules to solve real world problems.

**UNIT I**

Introduction of data mining: KDD process and Data Mining, KDD steps, Types of data for Data Mining, Data Mining functionalities: Data Characterization, Data Discrimination, Mining frequent patterns, Association, Correlation, Classification, Prediction, Cluster analysis, Outlier Analysis and Evolution analysis. Classification of Data Mining systems, Data Mining task primitives, Major issues in Data Mining.

**UNIT II**

Data Preprocessing: Needs for Data Preprocessing, Data Cleaning, Data Integration and Transformation, Data Normalization, Data Reduction, Principal Component Analysis (PCA), Discretization and Concept Hierarchy Generation.

**UNIT III**

Association Rule Mining: Frequent itemsets, closed itemsets, and association rules. Support and Confidence. Apriori Algorithms for mining frequent itemsets. Generating association rules from frequent itemsets. Improving the efficiency of Apriori algorithm-Dynamic Hashing and Pruning(DHP), Partitioning methods, FP-Growth algorithm for mining frequent itemsets without Candidate Generation.

**UNIT IV**

Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification Based on Concepts from Association Rule Mining, Other Classification Methods, Prediction, Classifier Accuracy.

**UNIT V**

Cluster Analysis: Introduction, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Outlier Analysis.

**Text Books:**

Data Mining – Concepts and Techniques - Jiawei Han & Micheline Kamber Harcourt, India.  
 Building the DataWarehouse- W. H. Inmon, Wiley Dreamtech India Pvt. Ltd..

**Reference Books:**

Data Mining Techniques-Arun K Pujari

Data Warehousing Fundamentals-Paulraj Pannaiah  
The Data Warehouse Life Cycle Tool Kit-Ralph Kimball  
Data Mining Introductory and Advanced Topics-Margaret H Dunham

## **Practical List**

### **(Laboratory Practicals using WEKA tool.)**

1. Study of the **WEKA Explorer** version **3-5-6**. (Section Tabs, Status Box, Log Button, WEKA Status Icon, Graphical output.)
  - 1.1. Preprocessing of the data  
Loading data from file / URL / DB or Generate using DataGenerators File Formats (.arff, .CSV, .data or .names) and current relation Working with attributes and filters.
  - 1.2 Introduction to Classification
  - 1.3 Introduction to Clustering.
  - 1.4 Introduction to Association and Visualization (Plot Matrix.)
2. Working with GraphVisualizer.  
(DataSources, DataSinks, Filters, Classifiers, Clusterers, Associations, Evaluation and Visualization.)
3. Creation of attribute relation format (.arff) file.
4. Experimenter Analysis.
5. Knowledge flow analysis.
6. MultipleROC(Receiveroperatingcharacteristic)curve.

**Semester III**  
**Core Paper-CS303T**

**Subject: Analysis and Design of Algorithms**

Lectures/Unit	Credits		Theory		Internals		Practical	
			Max	Min	Max	Min	Max	Min
14	T	P	40	14	10	4	33	12
	4	2						

**Course objective:** The objective of the course is to teach techniques for effective problem solving in computing. The use of different paradigms of problem solving will be used to illustrate clever and efficient ways to solve a given problem. In each case emphasis will be placed on rigorously proving correctness of the algorithm. In addition, the analysis of the algorithm will be used to show the efficiency of the algorithm over the naive techniques.

**Course outcome:** The students will be able to apply the algorithms and design techniques to solve problems. They will be able to analyze the complexities of the problems in different domains and can prove the correctness and analyze the running time of the basic algorithms for classic problems in various domains.

**UNIT I**

Introduction: Algorithm, Fundamentals of Algorithmic Problem Solving, Important Problem Types. Fundamentals of the Analysis of Algorithm: The Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Brute Force Search: Selection Sort, Bubble Sort, Sequential Search, Brute-Force String Matching, Exhaustive Search, Depth-First Search, Breadth-First Search.

**UNIT II**

Decrease-&-Conquer: Insertion Sort, Topological Sorting, Binary Search, Interpolation Search  
Divide-and-Conquer: Merge Sort, Quick Sort, Multiplication of Large Integers, Strassen's Matrix Multiplication

**UNIT III**

Transform-and-Conquer: Presorting, Balanced Search Trees, Heaps and Heap Sort, Problem Reduction. Space and Time Trade-Offs: Hashing, B-Trees, Dynamic Programming: Knapsack Problem, Optimal Binary Search Trees, Warshall's and Floyd's Algorithms.

**UNIT IV**

Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and Codes. Iterative Improvement: Simplex Method, Maximum-Flow Problem. Limitations of Algorithm Power: Lower-Bound Arguments, Decision Trees, P, NP, and NP-Complete Problems.

**UNIT V**

Backtracking: n-Queens Problem, Hamiltonian Circuit Problem, Subset-Sum Problem, Branch-and-Bound: Assignment Problem, Knapsack Problem, Traveling Salesman Problem, Approximation Algorithms for the Knapsack Problem.

**Text Books:**

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms (3e)

**Reference Books:**

1. Richard Neapolitan, Foundations of Algorithms
2. Thomas H. Cormen, Introduction to Algorithms
3. E.Horowitz, S. Sahni, Fundamentals of Computer Algorithms
4. A.V. Aho, J.V. Hopcroft, J.D. Ullmann, The Design and Analysis of Computer Algorithms
5. Donald E Knuth, The Art of Programming\_Volumes-1, 2, 3, 4

### **Practical List**

1. To find HCF and LCM of two numbers
2. Code and analyses to find median element in an array of integers.
3. Code and analyze to find majority element in an array of integers.
4. Code and analyze to sort an array of integers using merge sort
5. Code and analyze to sort an array of integers using quick sort
6. To implement maximum and minimum problem using divide and conquer strategy
7. To implement binary search using divide and conquer strategy
8. To implement program of Heap Sort.
9. WAP of minimum spanning tree using Kruskal algorithm.
10. WAP of minimum spanning tree using Prim's algorithm.

**Semester III**  
**Computer Science Elective Paper- CSE304T**  
**Subject: Artificial Intelligence**

Lectures/Unit	Credits		Theory		Internals		Practical	
			Max	Min	Max	Min	Max	Min
14	T	P	40	14	10	4	33	12
	4	2						

**Course objective:** The objective of the course is to present an overview of artificial intelligence (AI) principles and approaches. Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic, and learning.

**Course outcome:**

- Understand the knowledge of the building blocks of AI as presented in terms of intelligent agent.
- Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
- Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference and planning.

**UNIT I**

What is Artificial Intelligence, what is an AI technique, criteria for success, Problems, Problem spaces and search, Production system, Problem characteristics, Hill-climbing, Best-First search, AO algorithm, constraint satisfaction.

**UNIT II**

Natural language Processing, Introduction, overview of Linguistics, Grammars and language, Basic Parsing techniques, Semantic analysis and representation, structure, Natural Language generation, Natural Language Systems.

**UNIT III**

Knowledge Representation Issues, Approaches to knowledge Representation, Representing simple facts in logic, computable functions and predicates, Procedural vs. Declarative knowledge, forward vs. Backward Reasoning matching, control knowledge.

**UNIT IV**

Expert systems, Rule-Based system architecture, Non-productive system Architecture, dealing with uncertainty, knowledge acquisition and validation, knowledge system building tools. Pattern Recognition, Recognition and classification process, learning classification patterns, Recognizing and understanding speech.

**UNIT V**

Prolog programming-Introduction to prolog, Facts and predicates, data types, simple input/output, arithmetic operators in prolog, rules: if-then, queries, relation, recursion, structures and list, functions in prolog, matching, applications of prolog.

**Text Books:**

Artificial Intelligence by Rich and Knight  
 Introduction to AI and expert system by Patterson

## References:

Principles of AI by Nilson

<https://www.youtube.com/watch?v=SykxWpFwMGs>

<https://www.youtube.com/playlist?list=PLWPirh4EWFpEYxjEJyDoqplBhJF91Mwkp>

## Practical List

1. Addition of two numbers.
2. Find factorial of a number.
3. Calculate average of three numbers.
4. Calculate Simple Interest.
5. Calculate Compound Interest.
6. Calculate area of a circle.
7. Convert Farenheit to Celsius.
8. Print Count-Down.
9. Print Count-Up.
10. To build family tree.
11. Print square of a given number.
12. Query about weather.(Q1. Find cities that are hot in summer. Q2. Find all cities that are warm. Q3. Find all the cities that are hot in summer and warm in winter.).
13. Ask user to enter your name and printout the name.
14. Input a character and print its ASCII value.
15. Create salary structure and query about customer balance.
16. Update the database using query window.
17. Male(albert)  
Male(bob)  
Male(bill)  
Male(Charlie)  
Male(dan)  
Male(Edward)  
Female(alice)  
Female(betsy)  
Female(Diana)
  - a) Write a query to print list of all males.
  - b) Write a query to print list of all females.
  - c) Write a query to print combination of all males and females.



**Semester III**  
**Computer Science Elective Paper- CSE304T**  
**Subject: Big Data Analytics**

Lectures/Unit	Credits		Theory		Internals		Practical	
			Max	Min	Max	Min	Max	Min
14	T	P	40	14	10	4	33	12
	4	2						

**Course Objective:** The aim of this course is to give understanding of Big Data, its security provision, concepts of Hadoop, different techniques and tool used in Hadoop, MapReduce, HBase, Deployment process, Data Manipulation, Joins etc.

**Course Outcome:** Student will be able to learn concepts of Big Data, application methods of Big data analytics in industry, social networking, different software used for data analysis, installation and configuration of tools.

### UNIT I

Overview of Big Data: What is Big Data? Evolution of Big Data, Structuring Big Data, Elements of Big Data, Big Data Analytics. Exploring the Use of Big Data in Business Context: Use of Big Data in Social Networking, Use of Big Data in Preventing Fraudulent Activities, Use of Big Data in Detecting Fraudulent Activities in Insurance Sector, Use of Big Data in Retail Industry. Introducing Technologies for Handling Big Data: Distributed and Parallel Computing for Big Data, Introducing Hadoop. Understanding Hadoop Ecosystem: Hadoop Ecosystem, HDFS, MapReduce, Hadoop YARN, HBase, Hive, Pig and Pig Latin, Sqoop, ZooKeeper, Flume, Oozie.

### UNIT II

Understanding MapReduce Fundamentals and HBase: The MapReduce Framework, Techniques to Optimize MapReduce Jobs, Role of HBase in Big Data Processing. Exploring the Big Data Stack, Virtualization and Big Data, Virtualization Approaches. Storing Data in Databases and Data Warehouses: RDBMS and Big Data, Non Relational Database, Integrating Big Data with Traditional Data Warehouses, Big Data Analysis and Data Warehouse, Changing Deployment Models in Big Data Era.

### UNIT III

Processing Your Data with MapReduce: Developing Simple MapReduce Application, Points to Consider while Designing MapReduce. Customizing MapReduce Execution: Controlling MapReduce Execution with InputFormat, Reading Data with Custom RecordReader, Organizing Output Data with OutputFormats, Customizing Data with RecordWriter, Optimizing MapReduce Execution with Combiner, Implementing a MapReduce Program for Sorting Text Data.

### UNIT IV

Understanding Hadoop YARN Architecture: Introduction YARN, Advantages of YARN, YARN Architecture, Working of YARN. Exploring Hive: Introducing Hive, Getting Started with Hive, Hive Services, Data Types in Hive, Built-In Functions in Hive, Hive DDL, Data Manipulation in Hive, Data Retrieval Queries, Using JOINS in Hive. Analyzing Data with Pig: Introducing Pig, Running Pig, Getting Started with Pig Latin, Working with Operators in Pig, Working with Functions in Pig, Debugging Pig, Error Handling in Pig.

## **UNIT V**

Using Oozie: Introducing Oozie, Installing and Configuring Oozie, Understanding the Oozie Workflow, Simple Application. NoSQL Data Management: Introduction to NoSQL, Types of NoSQL Data Models, Schema-Less Databases, Materialized Views, Distributed Models, Sharding, MapReduce Partitioning and Combining, Composing MapReduce Calculations. Understanding Analytics and Big Data: Comparing Reporting and Analysis, Types of Analytics, Developing an Analytic Team. Analytical Approaches and Tools to Analyze Data: Analytical Approaches, History of Analytical Tools, Introducing Analytical Tools, Comparing Various Analytical Tools.

### **Text Books:**

DT Editorial Services, Big Data – Black Book (dreamtech)

### **Reference Books:**

1. Radha S, M. Vijayalakshmi, Big Data Analytics
2. Arshdeep B and Vijay M, Big Data Science & Analytics – A Hands-On Approach.
3. Frank Ohlhorst, Big Data Fundamentals – Concepts, Drivers, Techniques
4. Kuan-Ching Li, H Jiang, L T Yang, A Cuzzocrea, Big Data Algorithms, Analysis and Applications
5. Tom White, Hadoop: The Definitive Guide
6. Shiva Achari, Hadoop Essentials
7. Alex Holmes, Hadoop in Practice

**Semester III**  
**Open Elective Paper-OE305T**  
**Subject: Digital Marketing**

Lectures/Unit	Credits		Theory		Internals	
			Max	Min	Max	Min
14	T	P	40	14	10	4
	4	0				

**Course Objective:** The objective of this course is to understand structured digital marketing plan and budget, to identify the correct measures to set objectives and evaluate digital marketing and to review and prioritize the strategic options for boosting customer acquisition, conversion, and retention using digital marketing.

**Course outcome:** After the completion of the course the students will be able to use digital marketing in a rapidly changing business landscape. They will be able to use the key elements of a digital marketing strategy, measure the effectiveness of a digital marketing campaign, work on SEO digital marketing tool and implement ecommerce and payment gateway.

**UNIT I**

**Digital Marketing Fundamentals:** Marketing v/s Sales, Marketing Mix and 4 Ps, What is Digital Marketing, Inbound vs Outbound Marketing, Content Marketing, Understanding Traffic, Understanding Leads, Strategic Flow for Marketing Activities. **Website Planning and Structure:** WWW, Domains, Buying a Domain, Website Language & Technology, Core Objective of Website and Flow, One Page Website,

**UNIT II**

Strategic Design of Home Page, Strategic Design of Products & Services Page, SEO Overview Google Analytics Tracking Code, Website Auditing. **Facebook Marketing Fundamentals:** Profiles and Pages, Business Categories, Getting Assets Ready, Creating Facebook Pages, Page Info and Settings, Facebook Page Custom URL, Invite Page Likes, Featured Video, Pin Post and Highlights, Scheduling Posts, Facebook Events, Reply and Message, Facebook Insights Reports, Competitor's Facebook Page, Ban User on Facebook Page.

**UNIT III**

**Google Adwords Basics:** Understanding Adwords, Google Ad Types, Pricing Models, PPC Cost Formula, Ad Page Rank, Billing and Payments, Adwords User Interface, Keyword Planning, Keywords Control, Creating Ad Campaigns, Creating Text Ads, Creating Ad Groups, Bidding Strategy for CPC. **YouTube Marketing Fundamentals:** Video Flow, Google Pages for YouTube Channel, Verify Channel, Webmaster Tool –Adding Asset, Associated Website Linking, Custom Channel URL Channel ART, Channel Links, Channel Keywords, Branding Watermark, Featured Contents on Channel, Channel Main Trailer, Uploading Videos, Uploading Defaults, Creator Library.

**UNIT IV**

**Ecommerce and Payment Gateway:** eCommerce Business, Planning eCommerce Website, Product Placements, Product Grouping, Promoting eCommerce Website, Remarketing Products, Understanding Coupon System, Appointing Affiliates for Products, Cross/Up/Down Selling, Payment Gateway in India, Application and Documentation, Collecting Online Payment, Web Store using Payment Gateway, Web Fronts using Payment Gateway, Invoice Payments through Emails, SMS Invoice Payments, Integrating Payment Gateway, Payment Links and its Promotion, Affiliates for Payment Links.

## **UNIT V**

**Search Engine Optimization:** Understanding SEO, SEO Keyword Planning, Meta Tags and Meta Description, Website Content Optimization, Back Link Strategies, Internal and External Links, Optimizing Site Structure, Keywords in Blog and Articles, On Page SEO, Off Page SEO, Local SEO, Mobile SEO, eCommerce SEO, Optimizing with Google Algorithms, Using WebMasterTool, Measuring SEO Effectiveness.

### **Reference Books**

- Blanchard O. (2014) Social Media ROI: Managing and Measuring Social Media Efforts in Your Organization
- Pulizzi, J. (2013) Epic Content Marketing
- Marketing on Facebook – Best practice guide (2015) Facebook Marketing Press
- Chaffey, D., & Ellis-Chadwick, F. (2012) Digital Marketing: Strategy, Implementation and Practice, 5/E, Pearson
- Tapp, A., & Whitten, I., & Housden, M. (2014) Principles of Direct, Database and Digital Marketing, 5/E, Pearson
- Tasner, M. (2015) Marketing in the Moment: The Digital Marketing Guide to Generating More Sales and Reaching Your Customers First, 2/E, Pearson

**Semester IV**  
**Core Paper- CS401T**  
**Subject: Compiler Design**

Lectures/Unit	Credits		Theory		Internals	
			Max	Min	Max	Min
14	T	P	40	14	10	4
	4	0				

**Course objective:** The Objectives of this course is to provide in depth knowledge of

- The principles, algorithms, and data structures involved in the design and construction of compilers.
- Different types of grammars associated with compiler and their use.

**Course outcome:** At the end of this course, the students will be able to understand the phases of compiler, design and implement a Lexical analyzer, design and implement a Parser, storage allocation, to optimize and design code generator.

### UNIT I

Introduction: language processors, phases of a compiler, a model for a compiler front end, syntax-directed translation, parsing, a translator for simple expressions, Lexical Analysis: role of lexical analyzer, input buffering, specification of tokens, Lex lexical analyzer generator, data structures in compilation.

### UNIT II

Top-Down Parsing: Introduction, Context free grammars, writing a grammar, recursive-descent parsing, LL(1) grammars, predictive parsing, preprocessing steps required for predictive parsing. Bottom-Up Parsing: shift reduce parsing, SLR parsing, CLR parsing and LALR parsing, error recovery in parsing, handling ambiguous grammar, parser generator – YACC.

### UNIT III

Semantic Analysis: syntax-directed definitions, evaluation order for SDD's, application of SDT. Intermediate-Code Generation: syntax trees, three-address code, types and declarations, translation of expressions, type checking.

### UNIT IV

Runtime Environment: storage organization, stack allocation of space, heap management, storage allocation for arrays, strings and records, introduction to garbage collection and trace based collection. Code Generation: issues in the design of code generator, target language, addresses in the target code, basic blocks and flow graphs.

### UNIT V

Optimization of basic blocks, peephole optimization, registers allocation and assignment. Code Optimization: principal sources of optimization, data flow analysis, constant propagation, partial redundancy elimination, loops in flow graphs.

### Text Books:

1. A. V. Aho, Monica S. Lam, Ravi Sethi, J. D. Ullman, Compilers Principles, Techniques, & Tools, (2e)

### Reference Books:

1. Dick Grune, Henry E. Bal, Cariel T. H. Jacobs, Modern Compiler Design
2. Kenneth C. Loudon, Compiler Construction Principles and Practice
3. Thomas w. Parsons, Introduction to Compiler Construction
4. Andrew N. Appel, Modern Compiler Implementation in C
5. John R. Levin, Tony Mason, Doug Brown, LEX & YACC
6. Cooper, Linda, Engineering a Compiler

**Semester IV**  
**Core Paper- CS402T**  
**Subject: Software Project Management**

Lectures/Unit	Credits		Theory		Internals	
			Max	Min	Max	Min
14	T	P	40	14	10	4
	4	0				

**Course objective:** This course introduces the concepts and methods required for the construction of large Software intensive systems. It develops a broad understanding of the discipline of Software Engineering and Management of Software System. This course provides an understanding of both theoretical and methodological issue involved in Modern Software Engineering Project Management and focuses strongly on Practical techniques.

**Course outcome:** After the completion of the course the students will understand the fundamental principles of Software Project management & will also understand the responsibilities of a Project Manager. They will be familiar with the different methods and techniques used for Project Management and will have good knowledge of the issues and challenges faced during Software Project Management. They will be able to manage Project Scheduling, tracking, Risk analysis, Quality management and Project Cost estimation using different techniques.

**UNIT I**

**Conventional Software Management:** The waterfall model, conventional software Management performance. **Evolution of Software Economics:** Software Economics, pragmatic software cost estimation. **Improving Software Economics:** Reducing Software product size, improving software processes, improving team effectiveness, improving automation, Achieving required quality, peer inspections.

**UNIT II**

**The old way and the new:** The principles of conventional software Engineering, principles of modern software management, transitioning to an iterative process. **Life cycle phases:** Engineering and production stages, inception, Elaboration, construction, transition phases. **Artifacts of the process:** The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts.

**UNIT III**

**Model based software architectures:** A Management perspective and technical perspective. **Work Flows of the process:** Software process work flows, Iteration workflows, **Checkpoints of the process.** Major mile stones, Minor Milestones, Periodic status assessments. **Iterative Process Planning:** Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process, pragmatic planning.

**UNIT IV**

**Project Organizations and Responsibilities:** Line-of-Business organizations, Project Organizations, evolution of Organizations. **Process Automation:** Automation Building blocks, The Project Environment. **Project Control and Process instrumentation:** The seven core Metrics, Management indicators, quality indicators, life cycle expectations, pragmatic Software Metrics, Metrics automation.

**UNIT V**

**Tailoring the Process:** Process discriminants. Future Software Project Management: Modern

Project Profiles, Next generation Software economics, modern process transitions. Case Study: The command Center Processing and Display system- Replacement (CCPDS-R).

**Text Books:**

Software Project Management, Walker Royce: Pearson Education, 2005.

**Reference Books:**

Software Project Management, Bob Hughes and Mike Cotterell: Tata McGraw-Hill Edition.

Software Project Management, Joel Henry, Pearson Education.

Software Project Management in practice, Pankaj Jalote, Pearson Education.2005.



**Semester IV**  
**Computer Science Elective Paper- CSE403T**  
**Subject: Cloud Computing**

Lectures/Unit	Credits		Theory		Internals	
			Max	Min	Max	Min
14	T	P	40	14	10	4
	4	0				

**Course objective:** The objective of this course is to familiarize the student with cloud environment, building software systems and components that scale to millions of users in modern internet, cloud concepts capabilities across the various cloud service models including IaaS, PaaS, SaaS and MCC.

**Course outcome:** The student will understand the key dimensions of the challenge of Cloud Computing. They will understand services provided by cloud computing, implementation of open cloud, implementation of Small and Medium Businesses, authentication, authorization & accounting (AAA) and Mobile Cloud Computing.

**UNIT I**

Era of Cloud Computing (CC): introduction, cloud and other similar configurations, CC vs. peer-to-peer architecture, CC vs. client-server architecture, CC vs. GC, components of CC, impact of CC on businesses. Introduction Virtualization: Introduction, virtualization benefits, implementation levels of virtualization, virtualization at the OS level, virtualization structure, open source virtualization technology, Xen virtualization architecture, binary translation with full virtualization, para-virtualization with compiler support, virtualization of CPU, memory, I/O devices, hardware support for virtualization, virtualization in multicore processors. Cloud Computing Services: IaaS, PaaS, leveraging PaaS for productivity, guidelines for selecting a PaaS provider, concerns with PaaS, languages and PaaS, SaaS, DBaaS.

**UNIT II**

Cloud Computing and Business Value: key drivers for CC, CC and outsourcing, types of scalability, use of load balancers to enhance scalability, variable operating costs using CC, time-to-market benefits of CC, distribution over the internet, levels of business values from CC. Cloud Types and Models: private cloud, public cloud, hybrid cloud. Open Source Cloud Implementation and Administration: Eucalyptus & OpenStack cloud architectures, CSB (158) Recent Trends in Cloud Computing and Standards: conflicts of interest for public cloud and IT product providers, BYOD and encryption exposures, cloud standards, cloud ratings, CC trends that are accelerating adoption.

**UNIT III**

Host Security in the Cloud: security for virtualization products, host security for SaaS, PaaS, IaaS. Data Security in the Cloud: challenges with cloud data and data security, data confidentiality and encryption, data availability, data integrity, CSGs. Cloud application requirements, SOA for cloud applications. Adoption and Use of Cloud by Small and Medium Businesses: place of adoption, benefits, adoption phases, vendor roles and responsibilities, selection phases, provider liability, provider capabilities, success factors for CC Adoption process of public clouds by enterprises. Cloud migration techniques, Phases during the migration of an application to the cloud. IT Service Management for Cloud Computing: ITIL based service management, service strategy, service design, service transition, service operations, continual service improvement.

#### **UNIT IV**

SLA with Cloud Service Providers: concept, aspects and requirements of SLA, credit calculation, samples 1 and 3. Risks, Consequences, and Costs for Cloud Computing: introduction, risk assessment and management, risk of vendor lock-in, loss of control, not meeting regulatory compliances, resource scarcity, multitenant environment, failure, inadequate SLA, malware and internet attacks, management of cloud resources, network outages, in fracture, legal, licensing, TCO, cloud costs, cost allocations, chargeback models and methodology, billable items. AAA Administration for Cloud: AAA model, single sign0on for clouds, industry implementation for AAA, authentication management in the cloud, SAML, authentication for resource utilization.

#### **UNIT V**

Security as a Service: benefits of security as a service, concerns with security as a service, security service providers, IdMaaS, attributes of IdMaaS providers. Cloud Certifications and Audits: certifications, cloud audit framework, cloud auditing requirements. Application Security in the Cloud: cloud application SDLC, cloud service reports by providers, application security in IaaS, PaaS and SaaS environments. Mobile Cloud Computing (MCC): Architecture of MCC, benefits of MCC, MCC challenges.

#### **Text Books:**

Kailash J, Jagannath K, Donald J H, Deven Shah, Cloud Computing – Black Book

#### **Reference Books:**

1. Rajkumar Buyya, Cloud Computing: Principles and Paradigms
2. Arshdeep Bahga, Vijay Madisetti, Cloud Computing – A Hands-On Approach
3. David E.Y. Sarna, Implementing and Developing Cloud Computing Applications
4. Kai Hwang, Distributed and Cloud Computing From Parallel Processing to Internet of Things

**Semester IV**  
**Computer Science Elective Paper- CSE403T**  
**Subject: TCP/IP Concepts**

Lectures/Unit	Credits		Theory		Internals	
			Max	Min	Max	Min
14	T	P	40	14	10	4
	4	0				

**Course objective:** The objectives of the course is to give the understanding of the standards of TCP / IP protocol and addressing types. The course also includes the study of various protocols like ARP, RARP, UDP, ICMP, IGMP, Multicasting protocols etc.

**Course outcome:** After the completion of this course the student will understand the functions, data encapsulation of TCP/IP and UDP, the process of packet fragmentation and reassembly. Also the course will comprehend the basic routing functionality using routing protocols.

### UNIT I

Introduction, layering, DNS—encapsulation, de-multiplexing, client/server model, port numbers, standardization process, the internet. Link layer: introduction, Ethernet and IEEE 802 encapsulation, trailer encapsulation, SLIP, PP—Loop back interface, MTU. Internet protocol: introduction, IP header, IP routing, subnet addressing, subnet mask- special case if IP address, a subnet example.

### UNIT II

Introduction to Address Resolution Protocol, an example, ARP cache packet format, ARP examples, proxy ARP, ARP command. RARP: introduction, RARP packet format, RARP examples, RARP server design. ICMP: introduction, ICMP message types, ICMP address mask request and reply-ICMP timestamp request and reply -4.4 BSD processing of ICMP messages.

### UNIT III

Introduction, ping program, IP record route option, IP time stamp option. Trace route Program: introduction, trace route program operation, LAN output, and WAN output- IP source routing option. IP routing: introduction, routing principles, ICMP host, and ICMP redirect errors Dynamic routing, RIP-ASPF, BGP, CIDR. UDP: introduction, UDP header, UDP checksum, IP fragmentation, UDP server design.

### UNIT IV

Introduction to DNS- basics, message format, simple example, pointer quires, resource records caching, UDP. TFTP: introduction, protocol, security. BOOTP: introduction, packet format, server design, through router. TCP: introduction, services, headers, connection establishment and termination, timeout of connection establishment- maximum segment size- half, close, state transition diagram, reset segment, simultaneous open and close-options, server design.

### UNIT V

Introduction to SNMP, protocol, structure of management information, object identifiers, Management information base, instance identification. Telnet: rlogin protocols, examples, telnet protocol and examples, FTP, protocol, examples, STMP protocols, examples, NFS, TCP/IP Applications.

### Text Books:

- Behnrouz A. Forouz, TCP/IP Protocol Suite, IV edition, McGraw-Hill Publishing

- W. Richard Stevens, TCP/IP illustrated Volume, I “The protocols”, Addison Wesley Longman.
- Jaiswal. S, TCP/IP principles, architecture, protocols and implementation, first Edition, Galgotia publication.

**Reference Books:**

Candace Leiden and Marshall Wilensky, TCP/IP for Dummies

**Semester IV**  
**Open Elective Paper-OE404T**  
**Subject: Cyber Security**

Lectures/Unit	Credits		Theory		Internals	
			Max	Min	Max	Min
14	T	P	40	14	10	4
	4	0				

**Course Objective:** Cyber security is one of the greatest challenges of contemporary society, and it will only become more complicated as we progress therefore the depth of knowledge and wealth of skills required to engage with and overcome these challenges. Cyber security comprises technologies, processes and controls that are designed to protect systems, networks and data from cyber-attacks. Effective cyber security reduces the risk of cyber-attacks, and protects organizations and individuals from the unauthorized exploitation of systems, networks and technologies.

**Course Outcome:** The study of Cyber Security helps to gather and analyze data, and learn techniques to accurately present and communicate findings. It aims to empower and enhance proficiency in cyber security among learners and provides guidance on cyber security trends, industry best practices, protective measures against cyber threats, and more. A solid cyber security foundation will identify technology gaps and propose the appropriate action to take to mitigate the risk of an attack. This provides organizations the confidence to build their cyber security strategies.

**UNIT I**

Basic of Communication Systems, Transmissions Media, ISO/OSI and TCP/IP Protocol Stacks, Local Area Networks, Internetworking, Packet Formats, Wireless Networks, Working of Internet.

**UNIT II**

Security principles, threats and attack techniques, Introduction to security, Information, security, Security triad, Security management, Authentication and access control, Security threats and attacks, Security management, Authentication and access control Identification, Authentication: Authentication by passwords, Protecting passwords, Access control structures, Types of access control.

**UNIT III**

Cryptography, Cryptographic mechanisms, Conventional Encryption Principles, Public Key Cryptography Principles, Applications of Public-Key Cryptosystems, Requirements of Public-key Cryptography, RSA Public-key algorithm, Digital signatures and Certificates.

**UNIT IV**

Bell–LaPadula (BLP) Model: State Set, Security Policies, Star Property, Tranquility, Aspects and Limitations of BLP, Security models: The Biba Model, Chinese wall model, Clark–Wilson Model, SSL/TLS protocol, Firewalls and Intrusion detection.

**UNIT V**

Unix security: Architecture, Principals, Subjects, Objects, Access Control, Management Issues. Windows Security: Architecture, Components of Access Control, Administration. Database Security: Relational Databases, Access Control, Statistical Database Security. Software Security: Malware Taxonomy, Hackers, The rlogin Bug and SQL Injection.

**Text Books:**

1. Computer Security, 2nd edition Author: Dieter Gollmann, Publisher: John Wiley & Sons, 2016, ISBN: 0-470-86293-9
2. Security in Computing, Fourth Edition Author: Charles P. Pfleeger, Shari Lawrence, Publisher: Pearson India
3. Cryptography and Network Security Principles and Practices 3rd edition, Author: William Stallings Pearson Education.