



G.L. Bajaj Institute of Technology and Management
Information Technology – E Syllabus



DEPARTMENT OF INFORMATION TECHNOLOGY

E- SYLLABUS

FOR

B.TECH. INFORMATION TECHNOLOGY

GL BAJAJ
ODD SEMESTER

SESSION (2019--20)



G.L. Bajaj Institute of Technology and Management **Information Technology – E Syllabus**

ABOUT THE INSTITUTE

GL Bajaj Institute of Technology & Management is the 6th Institute established under the prestigious banner of Rajeev Memorial Academic Welfare Society (Registered Under Societies Registration Act 1860). The institute is approved by All India Council for Technical Education (AICTE), Ministry of HRD, Govt. of India and Affiliated to Dr. A.P.J. Abdul Kalam Technical University (Formerly UPTU Lucknow)

GL Bajaj Institute of Technology and Management is one of the qualities driven Educational Institute in the Greater Noida/Delhi-NCR Region. GL Bajaj stands out in its approach to assist and equip the students for their overall development, giving them a strong foundation for a successful future. The institute offers B.Tech, M.Tech, MBA, MCA.

This self-financed institute is governed by Rajeev Memorial Academic Welfare Society (Registered Under Societies Registration Act 1860). It is approved by All India Council for Technical Education (AICTE), Ministry of Human Resource Development, Government of India and affiliated to Dr. A.P.J. Abdul Kalam Technical University, Lucknow..

ABOUT THE DEPARTMENT

The Department of Information Technology at G.L. Bajaj Institute of Technology & Management was established in the year 2007 with a vision to develop competent IT professionals catering to the needs of Industry and society in a global perspective. The Department aims to foster students to attain professional excellence by providing exposure to new IT tools and technologies. Information Technology being the flagship branch of Engineering takes focus in scientific research, scientific programming, Application programming, and software engineering. The Department has well-equipped laboratories with state-of-the-art hardware and software resources, lecture halls, seminar halls, tutorial rooms and faculty sections. The Department has a blend of experienced and young faculty members who also work as mentors to the equally diligent and hardworking students.



G.L. Bajaj Institute of Technology and Management
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DEPARTMENT VISION & MISSION

VISION

To develop competent IT professionals catering to the needs of Industry and society in a global perspective.

MISSION

To attain academic & professional excellence with collective efforts of all stake holders through:

M1 : Dissemination of basic concepts and analytical skills.

M2 : Exposure to new tools in the area of Information technology.

M3 : Effective interaction with industry for better employability.

M4 : Inculcating values and professional ethics with social responsibility.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Below are the different educational objective of program:

• **PEO-1**

To provide students a strong foundation in mathematical and IT fundamentals with emphasis on different programming languages/ platforms.

• **PEO-2**

To prepare students with a strong foundation in IT tools and analytical skills.

• **PEO-3**

To analyse, design and develop efficient and cost effective IT solutions for society.

• **PEO-4**

To become a successful professional in software industry with leadership quality and value.

• **PEO-5**

To provide a supportive academic environment and guidance for life-long learning.



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PROGRAM OUTCOMES (POs)

The graduate of the program will be able to:

PO 1 - Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2 - Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3 - Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4 - Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5 - Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6 - The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7 - Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9 - Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10 - Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11 - Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader.

PO 12 - Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.



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PROGRAM SPECIFIC OUTCOMES (PSOS)

Program Graduates will be able to:

PSO 1: Design and develop an application/product that efficiently utilizes system software and hardware to cover current user requirement in social and economic form.

PSO 2: Apply and acquire knowledge of computer network in implementation of secure data communication and reliable network system.

PSO 3: Design and implement knowledge based discovery, machine based learning by using the concept of DBMS, soft computing, neural network, image processing and pattern recognition etc.

PSO 4: Design and develop mobile based applications which use the concepts of latest application system development technologies.





G.L. Bajaj Institute of Technology and Management
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Syllabus for Second Year (ODD Sem.)

Department of Information Technology



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STUDY EVALUATION SCHEME

**SECOND YEAR
SEMESTER –III**

2nd Year III-SEMESTER

| Sl. No. | Subject Codes | Subject | Periods | | | Evaluation Scheme | | | | End Semester | | Total | Credit | |
|---------|----------------------|--|---------|---|---|-------------------|----|-------|----|--------------|----|------------|-----------|---|
| | | | L | T | P | CT | TA | Total | PS | TE | PE | | | |
| 1 | KOE031-38/ KAS302 | Engineering Science Course/Maths-IV | 3 | 1 | 0 | 30 | 20 | 50 | | 100 | | 150 | 4 | |
| 2 | KAS301/ KVE301 | Technical Communication/Universal Human Values | 2 | 1 | 0 | 30 | 20 | 50 | | 100 | | 150 | 3 | |
| | | | 3 | 0 | 0 | | | | | | | | | |
| 3 | KCS301 | Data Structure | 3 | 1 | 0 | 30 | 20 | 50 | | 100 | | 150 | 4 | |
| 4 | KCS302 | Computer Organization and Architecture | 3 | 1 | 0 | 30 | 20 | 50 | | 100 | | 150 | 4 | |
| 5 | KCS303 | Discrete Structures & Theory of Logic | 3 | 0 | 0 | 30 | 20 | 50 | | 100 | | 150 | 3 | |
| 6 | KCS351 | Data Structures Using C Lab | 0 | 0 | 2 | | | | | 25 | | 25 | 50 | 1 |
| 7 | KCS352 | Computer Organization Lab | 0 | 0 | 2 | | | | | 25 | | 25 | 50 | 1 |
| 8 | KCS353 | Discrete Structure & Logic Lab | 0 | 0 | 2 | | | | | 25 | | 25 | 50 | 1 |
| 9 | KCS354 | Mini Project or Internship Assessment* | 0 | 0 | 2 | | | 50 | | | | 50 | 1 | |
| 10 | KNC301/ KNC302 | Computer System Security/Python Programming | 2 | 0 | 0 | 15 | 10 | 25 | | 50 | | | 0 | |
| 11 | | MOOCs (Essential for Hons. Degree) | | | | | | | | | | | | |
| | | Total | | | | | | | | | | 950 | 22 | |

*The Mini Project or internship (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester.

CT: Class Test

TA: Teacher Assessment

L/T/P: Lecture/ Tutorial/ Practical

Department of Information Technology



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B.TECH. (COMPUTER SCIENCE AND ENGINEERING)
THIRD SEMESTER (DETAILED SYLLABUS)

| DATA STRUCTURE (KCS301) | | |
|--|--|-------------------------------------|
| Course Outcome (CO) | | Bloom's Knowledge Level (KL) |
| At the end of course , the student will be able to understand | | |
| CO 1 | Describe how arrays, linked lists, stacks, queues, trees, and graphs are represented in memory, used by the algorithms and their common applications. | K₁, K₂ |
| CO 2 | Discuss the computational efficiency of the sorting and searching algorithms. | K₂ |
| CO 3 | Implementation of Trees and Graphs and perform various operations on these data structure. | K₃ |
| CO 4 | Understanding the concept of recursion, application of recursion and its implementation and removal of recursion. | K₄ |
| CO 5 | Identify the alternative implementations of data structures with respect to its performance to solve a real world problem. | K₅, K₆ |
| DETAILED SYLLABUS | | 3-1-0 |
| Unit | Topic | Proposed Lecture |
| I | <p>Introduction: Basic Terminology, Elementary Data Organization, Built in Data Types in C. Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations: Big Oh, Big Theta and Big Omega, Time-Space trade-off. Abstract Data Types (ADT)</p> <p>Arrays: Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Derivation of Index Formulae for 1-D,2-D,3-D and n-D Array Application of arrays, Sparse Matrices and their representations.</p> <p>Linked lists: Array Implementation and Pointer Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition Subtraction & Multiplications of Single variable & Two variables Polynomial.</p> | 08 |
| II | <p>Stacks: Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Iteration and Recursion- Principles of recursion, Tail recursion, Removal of recursion Problem solving using iteration and recursion with examples such as binary search, Fibonacci numbers, and Hanoi towers. Tradeoffs between iteration and recursion.</p> <p>Queues: Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, Dequeue and Priority Queue.</p> | 08 |
| III | <p>Searching: Concept of Searching, Sequential search, Index Sequential Search, Binary Search. Concept of Hashing & Collision resolution Techniques used in Hashing. Sorting: Insertion Sort, Selection, Bubble Sort, Quick Sort, Merge Sort, Heap Sort and Radix Sort.</p> | 08 |



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| | | |
|-----------|---|----|
| IV | Graphs: Terminology used with Graph, Data Structure for Graph Representations: Adjacency Matrices, Adjacency List, Adjacency. Graph Traversal: Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transitive Closure and Shortest Path algorithm: Warshal Algorithm and Dijkstra Algorithm. | 08 |
| V | Trees: Basic terminology used with Tree, Binary Trees, Binary Tree Representation: Array Representation and Pointer(Linked List) Representation, Binary Search Tree, Strictly Binary Tree ,Complete Binary Tree . A Extended Binary Trees, Tree Traversal algorithms: Inorder, Preorder and Postorder, Constructing Binary Tree from given Tree Traversal, Operation of Insertation , Deletion, Searching & Modification of data in Binary Search . Threaded Binary trees, Traversing Threaded Binary trees. Huffman coding using Binary Tree. Concept & Basic Operations for AVL Tree , B Tree & Binary Heaps | 08 |

Text books:

1. Aaron M. Tenenbaum, Yedidiah Langsam and Moshe J. Augenstein, “Data Structures Using C and C++”, PHI Learning Private Limited, Delhi India
2. Horowitz and Sahani, “Fundamentals of Data Structures”, Galgotia Publications Pvt Ltd Delhi India.
3. Lipschutz, “Data Structures” Schaum’s Outline Series, Tata McGraw-hill Education (India) Pvt. Ltd.
4. Thareja, “Data Structure Using C” Oxford Higher Education.
5. AK Sharma, “Data Structure Using C”, Pearson Education India.
6. Rajesh K. Shukla, “Data Structure Using C and C++” Wiley Dreamtech Publication.
7. Michael T. Goodrich, Roberto Tamassia, David M. Mount “Data Structures and Algorithms in C++”, Wiley India.
8. P. S. Deshpandey, “C and Data structure”, Wiley Dreamtech Publication.
9. R. Kruse etal, “Data Structures and Program Design in C”, Pearson Education.
10. Berztiss, AT: Data structures, Theory and Practice, Academic Press.
11. Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with applications”, McGraw Hill.
Adam Drozdek “Data Structures and Algorithm in Java”, Cengage Learning



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| Computer Organization and Architecture (KCS302) | | |
|---|---|-------------------------------------|
| Course Outcome (CO) | | Bloom's Knowledge Level (KL) |
| At the end of course , the student will be able to understand | | |
| CO 1 | Study of the basic structure and operation of a digital computer system. | K ₁ , K ₂ |
| CO 2 | Analysis of the design of arithmetic & logic unit and understanding of the fixed point and floating-point arithmetic operations. | K ₂ , K ₄ |
| CO 3 | Implementation of control unit techniques and the concept of Pipelining | K ₃ |
| CO 4 | Understanding the hierarchical memory system, cache memories and virtual memory | K ₂ |
| CO 5 | Understanding the different ways of communicating with I/O devices and standard I/O interfaces | K ₂ , K ₄ |
| DETAILED SYLLABUS | | 3-1-0 |
| Unit | Topic | Proposed Lecture |
| I | Introduction: Functional units of digital system and their interconnections, buses, bus architecture, types of buses and bus arbitration. Register, bus and memory transfer. Processor organization, general registers organization, stack organization and addressing modes. | 08 |
| II | Arithmetic and logic unit: Look ahead carries adders. Multiplication: Signed operand multiplication, Booths algorithm and array multiplier. Division and logic operations. Floating point arithmetic operation, Arithmetic & logic unit design. IEEE Standard for Floating Point Numbers | 08 |
| III | Control Unit: Instruction types, formats, instruction cycles and sub cycles (fetch and execute etc), micro operations, execution of a complete instruction. Program Control, Reduced Instruction Set Computer, Pipelining. Hardwire and micro programmed control: micro programme sequencing, concept of horizontal and vertical microprogramming. | 08 |
| IV | Memory: Basic concept and hierarchy, semiconductor RAM memories, 2D & 2 1/2D memory organization. ROM memories. Cache memories: concept and design issues & performance, address mapping and replacement Auxiliary memories: magnetic disk, magnetic tape and optical disks Virtual memory: concept implementation. | 08 |
| V | Input / Output: Peripheral devices, I/O interface, I/O ports, Interrupts: interrupt hardware, types of interrupts and exceptions. Modes of Data Transfer: Programmed I/O, interrupt initiated I/O and Direct Memory Access., I/O channels and processors. Serial Communication: Synchronous & asynchronous communication, standard communication interfaces. | 08 |
| Text books: | | |
| <ol style="list-style-type: none"> 1. Computer System Architecture - M. Mano 2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky Computer Organization, McGraw-Hill, Fifth Edition, Reprint 2012 3. John P. Hayes, Computer Architecture and Organization, Tata McGraw Hill, Third Edition, 1998. Reference books 4. William Stallings, Computer Organization and Architecture-Designing for Performance, Pearson Education, Seventh edition, 2006. 5. Behrooz Parahami, "Computer Architecture", Oxford University Press, Eighth Impression, 2011. 6. David A. Patterson and John L. Hennessy, "Computer Architecture-A Quantitative Approach", Elsevier, a division of reed India Private Limited, Fifth edition, 2012 7. Structured Computer Organization, Tannenbaum(PHI) | | |



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| Discrete Structures & Theory of Logic (KCS303) | | |
|--|---|-------------------------------------|
| Course Outcome (CO) | | Bloom's Knowledge Level (KL) |
| At the end of course , the student will be able to understand | | |
| CO 1 | Write an argument using logical notation and determine if the argument is or is not valid. | K ₃ , K ₄ |
| CO 2 | Understand the basic principles of sets and operations in sets. | K ₁ , K ₂ |
| CO 3 | Demonstrate an understanding of relations and functions and be able to determine their properties. | K ₃ |
| CO 4 | Demonstrate different traversal methods for trees and graphs. | K ₁ , K ₄ |
| CO 5 | Model problems in Computer Science using graphs and trees. | K ₂ , K ₆ |
| DETAILED SYLLABUS | | 3-1-0 |
| Unit | Topic | Proposed Lecture |
| I | <p>Set Theory: Introduction, Combination of sets, Multisets, Ordered pairs. Proofs of some general identities on sets. Relations: Definition, Operations on relations, Properties of relations, Composite Relations, Equality of relations, Recursive definition of relation, Order of relations.</p> <p>Functions: Definition, Classification of functions, Operations on functions, Recursively defined functions. Growth of Functions.</p> <p>Natural Numbers: Introduction, Mathematical Induction, Variants of Induction, Induction with Nonzero Base cases. Proof Methods, Proof by counter – example, Proof by contradiction.</p> | 08 |
| II | <p>Algebraic Structures: Definition, Groups, Subgroups and order, Cyclic Groups, Cosets, Lagrange's theorem, Normal Subgroups, Permutation and Symmetric groups, Group Homomorphisms, Definition and elementary properties of Rings and Fields.</p> | 08 |
| III | <p>Lattices: Definition, Properties of lattices – Bounded, Complemented, Modular and Complete lattice. Boolean Algebra: Introduction, Axioms and Theorems of Boolean algebra, Algebraic manipulation of Boolean expressions. Simplification of Boolean Functions, Karnaugh maps, Logic gates, Digital circuits and Boolean algebra.</p> | 08 |
| IV | <p>Propositional Logic: Proposition, well formed formula, Truth tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Theory of Inference. (8)</p> <p>Predicate Logic: First order predicate, well formed formula of predicate, quantifiers, Inference theory of predicate logic.</p> | 08 |
| V | <p>Trees: Definition, Binary tree, Binary tree traversal, Binary search tree.</p> <p>Graphs: Definition and terminology, Representation of graphs, Multigraphs, Bipartite graphs, Planar graphs, Isomorphism and Homeomorphism of graphs, Euler and Hamiltonian paths, Graph coloring, Recurrence Relation & Generating function: Recursive definition of functions, Recursive algorithms, Method of solving recurrences.</p> <p>Combinatorics: Introduction, Counting Techniques, Pigeonhole Principle</p> | 08 |



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Text books:

1. Koshy, Discrete Structures, Elsevier Pub. 2008 Kenneth H. Rosen, Discrete Mathematics and Its Applications, 6/e, McGraw-Hill, 2006.
2. B. Kolman, R.C. Busby, and S.C. Ross, Discrete Mathematical Structures, 5/e, Prentice Hall, 2004.
3. E.R. Scheinerman, Mathematics: A Discrete Introduction, Brooks/Cole, 2000.
4. R.P. Grimaldi, Discrete and Combinatorial Mathematics, 5/e, Addison Wesley, 2004
5. Liptschutz, Seymour, “ Discrete Mathematics”, McGraw Hill.
6. Trembley, J.P & R. Manohar, “Discrete Mathematical Structure with Application to Computer Science”, McGraw Hill.
4. Deo, 7. Narsingh, “Graph Theory With application to Engineering and Computer Science.”, PHI.
8. Krishnamurthy, V., “Combinatorics Theory & Application”, East-West Press Pvt. Ltd., New Delhi





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Data Structure using C Lab (KCS351)

Write C Programs to illustrate the concept of the following:

1. Sorting Algorithms-Non-Recursive.
2. Sorting Algorithms-Recursive.
3. Searching Algorithm.
4. Implementation of Stack using Array.
5. Implementation of Queue using Array.
6. Implementation of Circular Queue using Array.
7. Implementation of Stack using Linked List.
8. Implementation of Queue using Linked List.
9. Implementation of Circular Queue using Linked List.
10. Implementation of Tree Structures, Binary Tree, Tree Traversal, Binary Search Tree, Insertion and Deletion inBST.
11. Graph Implementation, BFS, DFS, Minimum cost spanning tree, shortest path algorithm.

Computer Organization Lab (KCS352)

1. Implementing HALF ADDER, FULL ADDER using basic logic gates
2. Implementing Binary -to -Gray, Gray -to -Binary code conversions.
3. Implementing 3-8 line DECODER.
4. Implementing 4x1 and 8x1 MULTIPLEXERS.
5. Verify the excitation tables of various FLIP-FLOPS.
6. Design of an 8-bit Input/ Output system with four 8-bit Internal Registers.
7. Design of an 8-bit ARITHMETIC LOGIC UNIT.
8. Design the data path of a computer from its register transfer language description.
9. Design the control unit of a computer using either hardwiring or microprogramming based on its registertransfer language description.
10. Implement a simple instruction set computer with a control unit and a data path.



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Discrete Structure & Logic Lab (KCS353)

Programming Language/Tool Used: C and Mapple

1. Write a program in C to create two sets and perform the Union operation on sets.
2. Write a program in C to create two sets and perform the Intersection operation on sets.
3. Write a program in C to create two sets and perform the Difference operation on sets.
4. Write a program in C to create two sets and perform the Symmetric Difference operation.
5. Write a program in C to perform the Power Set operation on a set.
6. Write a program in C to Display the Boolean Truth Table for AND, OR, NOT.
7. Write a C Program to find Cartesian Product of two sets
8. Write a program in C for minimum cost spanning tree.
9. Write a program in C for finding shortest path in a Graph

Note: Understanding of mathematical computation software Mapple to experiment the followings (exp. 10 to 25):

10. Working of Computation software
11. Discover a closed formula for a given recursive sequence vice-versa
12. Recursion and Induction
13. Practice of various set operations
14. Counting
15. Combinatorial equivalence
16. Permutations and combinations
17. Difference between structures, permutations and sets
18. Implementation of a recursive counting technique
19. The Birthday problem
20. Poker Hands problem
21. Baseball best-of-5 series: Experimental probabilities
22. Baseball: Binomial Probability
23. Expected Value Problems
24. Basketball: One and One
25. Binary Relations: Influence



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Syllabus for Third Year (ODD Sem.)

GL BAJAJ

Department of Information Technology



G.L. Bajaj Institute of Technology and Management
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STUDY EVALUATION SCHEME

THIRD YEAR
SEMESTER –V

B. Tech. (Information Technology)

FIFTH SEMESTER

| Sl No. | Subject Code | Subject Name | L-T-P | Th/Lab (ESE) Marks | Sessional | | Total | Credit |
|--------|-------------------|---|-----------|--------------------|-----------|------------|-------------|-----------|
| | | | | | Test | Assig/Att. | | |
| 1 | RAS501 | MANAGERIAL ECONOMICS | 3---0---0 | 70 | 20 | 10 | 100 | 3 |
| 2 | RAS502/ RUC501 | INDUSTRIAL SOCIOLOGY /CYBER SECURITY | 3---0---0 | 70 | 20 | 10 | 100 | 3 |
| 3 | RCS-501 | Database Management Systems | 3---0---0 | 70 | 20 | 10 | 100 | 3 |
| 4 | RCS-502 | Design and Analysis of Algorithm | 3---1---0 | 70 | 20 | 10 | 100 | 4 |
| 5 | RCS-503 | Principles of Programming Languages | 3---0---0 | 70 | 20 | 10 | 100 | 3 |
| 6 | IT-Elective-1 | DEPTT ELECTIVE COURSE-1 | 3---1---0 | 70 | 20 | 10 | 100 | 4 |
| 7 | RCS-551 | Database Management Systems Lab | 0---0---2 | 50 | - | 50 | 100 | 1 |
| 8 | RCS-552 | Design and Analysis of Algorithm Lab | 0---0---2 | 50 | - | 50 | 100 | 1 |
| 9 | RCS-553 | Principles of Programming Languages Lab | 0---0---2 | 50 | - | 50 | 100 | 1 |
| 10 | RIT-554 | Object Oriented Techniques Lab | 0---0---2 | 50 | - | 50 | 100 | 1 |
| | TOTAL | | | | | | 1000 | 24 |

DEPARTMENTAL ELECTIVES

IT-ELECTIVE -1: Information Technology Elective-1

RIT-E11: SOFTWARE PROJECT MANAGEMENT

RIT-E12: SOFTWARE TESTING & AUDIT

RIT-E13: OBJECT ORIENTED TECHNIQUES

RCS-E11: OPERATION RESEARCH



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| RCS-501:Database Management Systems | | 3-0-0 |
|--|--|-------------------------|
| Unit | Topic | Proposed Lecture |
| I | Introduction: Overview, Database system Vs file system, Database system concept and architecture, data model schema and instances, data independence and database language and interfaces, data definitions language, DML, Overall Database Structure. Data Modeling using the Entity Relationship Model: ER model concepts, notation for ER diagram, mapping constraints, keys, Concepts of Super Key, candidate key, primary key, Generalization, aggregation, reduction of an ER diagrams to tables, extended ER model, relationship of higher degree. | 08 |
| II | Relational Data Model and Language: Relational data model Concepts, integrity constraints, entity integrity, referential integrity, Keys constraints, Domain constraints, relational algebra, relational calculus, tuple and domain calculus. Introduction on SQL: Characteristics of SQL, advantage of SQL. SQL data type and literals. Types of SQL commands. SQL operators and their procedure. Tables, views and indexes. Queries and sub queries. Aggregate functions. Insert, update and delete operations, Joins, Unions, Intersection, Minus, Cursors, Triggers, Procedures in SQL/PL SQL | 08 |
| III | Data Base Design & Normalization: Functional dependencies, normal forms, first, second, third normal forms, BCNF, inclusion dependence, loss less join decompositions, normalization using FD, MVD and JDs alternative approaches to database design | 08 |
| IV | Transaction Processing Concept: Transaction system, Testing of serializability, serializability of schedules, conflict & view serializable schedule, recoverability, Recovery from transaction failures, log based recovery, checkpoints, deadlock handling. Distributed Database: distributed data storage, concurrency control, directory system. | 08 |
| V | Concurrency Control Techniques: Concurrency Control, Locking Techniques for concurrency control, Time stamping protocols for concurrency control, validation based protocol, multiple granularity, Multi version schemes, Recovery with concurrent transaction, case study of Oracle. | 08 |



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References:

1. Korth, Silbertz, Sudarshan, "Database Concepts", McGraw Hill
2. Date C J, "An Introduction to Database Systems", Addison Wesley
3. Elmasri, Navathe, "Fundamentals of Database Systems", Addison Wesley
4. O'Neil, Databases, Elsevier Pub.
5. RAMAKRISHNAN "Database Management Systems", McGraw Hill
6. Leon & Leon, "Database Management Systems", Vikas Publishing House
7. Bipin C. Desai, "An Introduction to Database Systems", Galgotia Publications
8. Majumdar & Bhattacharya, "Database Management System", TMH
9. R.P. Mahapatra, Database Management System, Khanna Publishing House

9. Course on 'PHP & MySQL', Spoken Tutorial MOOC





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| RCS-502: Design and Analysis of Algorithm | | 3-1-0 |
|--|--|-------------------------|
| Unit | Topic | Proposed Lecture |
| I | Introduction: Algorithms, Analyzing algorithms, Complexity of algorithms, Growth of functions, Performance measurements, Sorting and order Statistics - Shell sort, Quick sort, Merge sort, Heap sort, Comparison of sorting algorithms, Sorting in linear time. | 08 |
| II | Advanced Data Structures: Red-Black trees, B – trees, Binomial Heaps, Fibonacci Heaps, Tries, skip list | 08 |
| III | Divide and Conquer with Examples such as Sorting, Matrix Multiplication, Convex hull and Searching. Greedy methods with Examples such as Optimal Reliability Allocation, Knapsack, Minimum Spanning trees – Prim’s and Kruskal’s algorithms, Single source shortest paths - Dijkstra’s and Bellman Ford algorithms. | 08 |
| IV | Dynamic Programming with Examples such as Knapsack. All pair shortest paths – Warshal’s and Floyd’s algorithms, Resource allocation problem. Backtracking, Branch and Bound with examples such as Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of subsets. | 08 |
| V | Selected Topics: Algebraic Computation, Fast Fourier Transform, String Matching, Theory of NP-completeness, Approximation algorithms and Randomized algorithms | 08 |

References:

1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, “Introduction to Algorithms”, Printice Hall of India.
2. E. Horowitz & S Sahni, "Fundamentals of Computer Algorithms",
3. Aho, Hopcraft, Ullman, “The Design and Analysis of Computer Algorithms” Pearson Education, 2008.
4. LEE "Design & Analysis of Algorithms (POD)", McGraw Hill
5. Richard E. Neapolitan "Foundations of Algorithms" Jones & Bartlett Learning
6. Gajendra Sharma, Design & Analysis of Algorithms, Khanna Publishing House
7. Jon Kleinberg and Éva Tardos, Algorithm Design, Pearson, 2005.
8. Michael T Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Wiley, 2006.
9. Harry R. Lewis and Larry Denenberg, Data Structures and Their Algorithms, Harper Collins, 1997
10. Robert Sedgewick and Kevin Wayne, Algorithms, fourth edition, Addison Wesley, 2011.
11. Harsh Bhasin, "Algorithm Design and Analysis", First Edition, Oxford University Press.
12. Gilles Brassard and Paul Bratley, Algorithmics: Theory and Practice, Prentice Hall, 1995



G.L. Bajaj Institute of Technology and Management
Information Technology – E Syllabus

| RCS-503: Principles of Programming Languages | | 3-0-0 |
|---|---|-------------------------|
| Unit | Topic | Proposed Lecture |
| I | Introduction : The Role of Programming Languages: Why Study Programming Languages, Towards Higher-Level languages, Programming paradigms, Programming environments Language Description: Syntactic structure, language Translation Issues: Programming language Syntax, Stages in translation, Formal translation Models | 08 |
| II | Data, Data Types, and Basic Statements : Names , variables , binding, type checking, scope, scope rules ,lifetime and garbage collection, primitive data types, strings, array types, associative arrays ,record types, union types, pointers and references , Arithmetic expressions , overloaded operators, type conversions , relational and boolean expressions, assignment statements, mixed mode assignments, control structures, selection ,iterations, branching, guarded statements | 08 |
| III | Subprograms and Implementations : Subprograms ,design issues ,local referencing, parameter passing, overloaded methods, generic methods, design issues for functions , semantics of call and return ,implementing simple subprograms , stack and dynamic local variables, nested subprograms, , dynamic scoping. | 08 |
| IV | Object-Orientation, Concurrency, and Event Handling : Grouping of data and Operations — Constructs for Programming Structures, abstraction Information Hiding, Program Design with Modules, Defined types, Object oriented programming — concept of Object, inheritance, Derived classes and Information hiding – Templates, Semaphores, Monitors, Message passing, Threads, statement level concurrency Exception handling (Using C++ and Java as example language). | 08 |
| V | Functional and Logic Programming Languages : Introduction to lambda calculus, fundamentals of functional programming languages, Programming with Programming with ML, Introduction to logic and logic programming – Programming with Prolog. | 08 |
| References: <ol style="list-style-type: none">1. “Programming Languages: Design and Implementations” , Terrance W.Pratt, Marvin V. Zelkowitz, T.V.Gopal,Fourth ed.,Prentice Hall2. “Programming Language Design Concept”, David A. Watt, Willey India3. “Programming languages: Concepts and Constucts”, Ravi Sethi, Second Ed.,Pearson.4. “Types and programming Languages”, Benjamin C. Pierce. The MIT Press Cambridge, Massachusetts London, England5. Concepts of Programming Languages, Robert W. Sebesta, 10 th Ed.,Pearson | | |



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Information Technology – E Syllabus

IT-ELECTIVE -1: Information Technology Elective-1

| RIT-E11: SOFTWARE PROJECT MANAGEMENT | | 3-0-0 |
|---|---|-------------------------|
| Unit | Topic | Proposed Lecture |
| I | Introduction and Software Project Planning: Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework, Software Project Planning, Planning Objectives, Project Plan, Types of project plan, Structure of a Software Project Management Plan, Software project estimation, Estimation methods, Estimation models, Decision process. | 08 |
| II | Project Organization and Scheduling Project Elements: Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts. (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming.. | 08 |
| III | Project Monitoring and Control: Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators: Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming. | 08 |
| IV | Software Quality Assurance and Testing Objectives: Testing Principles, Test Plans, Test Cases, Types of Testing, Levels of Testing, Test Strategies, Program Correctness, Program Verification & validation, Testing Automation & Testing Tools, Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, The SEI Capability Maturity Model CMM), SQA Activities, Formal SQA Approaches: Proof of correctness, Statistical quality assurance, Cleanroom process. | 08 |
| V | Project Management and Project Management Tools Software Configuration Management: Software Configuration Items and tasks, Baselines, Plan for Change, Change Control, Change Requests Management, Version Control, Risk Management: Risks and risk types, Risk Breakdown Structure (RBS), Risk Management Process: Risk identification, Risk analysis, Risk planning, Risk monitoring, Cost Benefit Analysis, Software Project Management Tools: CASE Tools, Planning and Scheduling Tools, MS-Project. | 08 |

References:

1. M. Cotterell, Software Project Management, Tata McGraw-Hill Publication.
2. Royce, Software Project Management, Pearson Education
3. Kieron Conway, Software Project Management, Dreamtech Press
4. S. A. Kelkar, Software Project Management, PHI Publication.
5. Harold R. Kerzner, Project Mangment “A Systems Approach to Planning, Scheduling, and Controlling” Wiley.
6. Mohapatra, Software Project Management, Cengage Learning.
7. P.K. Agarwal, SAM R., Software Project Management, Khanna Publishing House



G.L. Bajaj Institute of Technology and Management
Information Technology – E Syllabus

| RIT-E12: SOFTWARE TESTING & AUDIT | | 3-0-0 |
|---|--|------------------|
| Unit | Topic | Proposed Lecture |
| I | Review of Software Engineering: Overview of Software Evolution, SDLC, Testing Process, Terminologies in Testing: Error, Fault, Failure, Verification, Validation, Difference Between Verification and Validation, Test Cases, Testing Suite, Test ,Oracles, Impracticality of Testing All Data; Impracticality of Testing AllPaths. Verification: Verification Methods, SRS Verification, Source Code Reviews, User Documentation Verification, Software, Project Audit, Tailoring Software Quality Assurance Program by Reviews, Walkthrough, Inspection and Configuration Audits. | 08 |
| II | Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique. Structural Testing: Control Flow Testing, Path Testing, Independent Paths, Generation of Graph from Program, Identification of Independent Paths, Cyclomatic Complexity, Data Flow Testing, Mutation Testing | 08 |
| III | Regression Testing: What is Regression Testing? Regression Test cases selection, Reducing the number of test cases, Code coverage prioritization technique. Reducing the number of test cases: Prioritization guidelines, Priority category, Scheme, Risk Analysis. | 08 |
| IV | Software Testing Activities: Levels of Testing, Debugging, Testing techniques and their applicability, Exploratory Testing Automated Test Data Generation: Test Data, Approaches to test data generation, test data generation using genetic algorithm, Test Data Generation Tools, Software Testing Tools, and Software test Plan. | 08 |
| V | Object Oriented Testing: Definition, Issues, Class Testing, Object Oriented Integration and System Testing. Testing Web Applications: Web Testing, User Interface Testing, Usability Testing, Security Testing, Performance Testing, Database testing, Post Deployment Testing. | 08 |
| References: 1 Yogesh Singh, “Software Testing”, Cambridge University Press, New York, 2012 2. K..K. Aggarwal & Yogesh Singh, “Software Engineering”, New Age International Publishers, New Delhi, 2003. 3. Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, Fifth Edition, McGraw-Hill International Edition, New Delhi,2001. 4. Marc Roper, “Software Testing”, McGraw-Hill Book Co., London, 1994. 5. M.C. Trivedi, Software Testing & Audit, Khanna Publishing House 6. Boris Beizer, “Software System Testing and Quality Assurance”, Van Nostrand Reinhold, New York, 1984. | | |



G.L. Bajaj Institute of Technology and Management
Information Technology – E Syllabus

| RIT-E13: OBJECT ORIENTED TECHNIQUES | | 3-0-0 |
|--|---|------------------|
| Unit | Topic | Proposed Lecture |
| I | Introduction: The meaning of Object Orientation, object identity, Encapsulation, information hiding, polymorphism, generosity, importance of modelling, principles of modelling, object oriented modelling, Introduction to UML, conceptual model of the UML, Architecture. | 08 |
| II | Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams. Class & Object Diagrams: Terms, concepts, modelling techniques for Class & Object Diagrams. Collaboration Diagrams: Terms, Concepts, depicting a message, polymorphism in collaboration Diagrams, iterated messages, use of self in messages. Sequence Diagrams: Terms, concepts, depicting asynchronous messages with/without priority, call-back mechanism, broadcast messages. Basic Behavioural Modeling: Use cases, Use case Diagrams, Activity Diagrams, State Machine , Process and thread, Event and signals, Time diagram, interaction diagram, Package diagram. Architectural Modeling: Component, Deployment, Component diagrams and Deployment diagrams. | 08 |
| III | Object Oriented Analysis: Object oriented design, Object design, Combining three models, Designing algorithms, design optimization, Implementation of control, Adjustment of inheritance, Object representation, Physical packaging, Documenting design considerations. Structured analysis and structured design (SA/SD) , Jackson Structured Development (JSD). Mapping object oriented concepts using non-object oriented language, Translating classes into data structures, Passing arguments to methods, Implementing inheritance, associations encapsulation. Object oriented programming style: reusability, extensibility, robustness, programming in the large. Procedural v/s OOP, Object oriented language features. Abstraction and Encapsulation. | 08 |
| IV | C++ Basics : Overview, Program structure, namespace, identifiers, variables, constants, enum, operators, typecasting, control structures C++ Functions : Simple functions, Call and Return by reference, Inline functions, Macro Vs. Inline functions, Overloading of functions, default arguments, friend functions, virtual functions Course on C and CPP (Spoken Tutorial MOOC) | 08 |
| V | Objects and Classes : Basics of object and class in C++, Private and public members, static data and function members, constructors and their types, destructors, operator overloading, type conversion. Inheritance : Concept of Inheritance, types of inheritance: single, multiple, multilevel, hierarchical, hybrid, protected members, overriding, virtual base class Polymorphism : Pointers in C++, Pointes and Objects, this pointer, virtual and pure virtual functions, Implementing polymorphism | 08 |



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Information Technology – E Syllabus

References:

1. James Rumbaugh et. al, “Object Oriented Modeling and Design”, PHI
2. Grady Booch, James Rumbaugh, Ivar Jacobson, “The Unified Modeling Language User Guide”, Pearson Education
3. Object Oriented Programming With C++, E Balagurusamy, TMH
4. R. S. Salaria, Mastering Object Oriented Programming with C++, Khanna Publishing House
5. C++ Programming, Black Book, Steven Holzner, dreamtech
6. Object Oriented Programming in Turbo C++, Robert Lafore, Galgotia
7. Object Oriented Programming with ANSI and Turbo C++, Ashok Kamthane, Pearson
8. The Complete Reference C++, Herbert Schlitz, TMH
9. C++ and Object Oriented Programming Paradigm, PHI
10. C++ : How to Program, 9th Edition, Deitel and Deitel, PHI
11. Object Oriented Programming with C++, Saurav Sahay, Oxford





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Information Technology – E Syllabus

| RCS-E11: OPERATION RESEARCH | | 3-0-0 |
|---|---|-------------------------|
| Unit | Topic | Proposed Lecture |
| I | Definition and scope of operations research (OR), OR model, solving the OR model, art of modelling, phases of OR study. Linear Programming: Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis. | 08 |
| II | Transportation Problems: Types of transportation problems, mathematical models , transportation algorithms, Assignment: Allocation and assignment problems and models, processing of job through machines. | 08 |
| III | Network Techniques: Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. Project Management: Phases of project management, guidelines for network construction, CPM and PERT. | 08 |
| IV | Theory of Games : Rectanagular games, Minimax theorem, graphical solution of 2 x n or m x 2 games, game with mixed strategies, reduction to linear programming model. Quality Systems: Elements of Queuing model, generalized poisson queuing model, single server models. | 08 |
| V | Control: Models of inventory, operation of inventory system, quantity discount. Replacement: Replacement models: Equipment's that deteriorate with time, equipment's that fail with time. | 08 |
| References: <ol style="list-style-type: none">1. Wayne L. Winston, "Operations Research" Thomson Learning,2003.2. Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education,2003.3. R. Panneer Seevam, "Operations Research" PHI Learning, 2008.4. V.K.Khanna, "Total Quality Management" New Age International, 2008.5. T.Veerarajan "Operation Research" Universities Press | | |



G.L. Bajaj Institute of Technology and Management

Information Technology – E Syllabus

RCS-551 Database Management Systems

Lab Objectives:

1. Installing oracle/ MYSQL
2. Creating Entity-Relationship Diagram using case tools.
3. Writing SQL statements Using ORACLE /MYSQL:
 - Writing basic SQL SELECT statements.
 - Restricting and sorting data.
 - Displaying data from multiple tables.
 - Aggregating data using group function.
 - Manipulating data.
 - eCreating and managing tables.
4. Normalization
5. Creating cursor
6. Creating procedure and functions
7. Creating packages and triggers
8. Design and implementation of payroll processing system
9. Design and implementation of Library Information System
10. Design and implementation of Student Information System
11. Automatic Backup of Files and Recovery of Files



G.L. Bajaj Institute of Technology and Management Information Technology – E Syllabus

RCS-552 Design and Analysis of Algorithm Lab Objective:-

1. Program for Recursive Binary & Linear Search.
2. Program for Heap Sort.
3. Program for Merge Sort.
4. Program for Selection Sort.
5. Program for Insertion Sort.
6. Program for Quick Sort.
7. Knapsack Problem using Greedy Solution
8. Perform Travelling Salesman Problem
9. Find Minimum Spanning Tree using Kruskal's Algorithm
10. Implement N Queen Problem using Backtracking

RCS-553 Principles of Programming Languages Lab Objective: -

1. Program for linear search in ML
2. Program for binary search in ML
3. Program for insertion sort in ML
4. Program for bubble sort in ML
5. Program for merge sort in ML
6. Program for Quick sort in ML
7. Program for making a dictionary in ML
8. Program for merging two unsorted-students-name-list in sorted order



G.L. Bajaj Institute of Technology and Management **Information Technology – E Syllabus**

RIT-554 Object Oriented Techniques Lab

It is expected that student should analyze, design and develop application based on object oriented techniques. The somecase studies are as follows (Subject Teacher may add more):

1. The Library System : This application will support the operations of a technical library for a university department. This includes the searching for and lending of technical library materials, including books, videos, and technical journals. All library items have registration code (research area code + running number). Each borrower can borrow up to 10 items. Each type of library item can be borrowed for a different period of time (books 6 weeks, journals 3 days, videos 1 week). If returned after their due date, the employee will be charged a fine, based on the type of item (books 5:-/day, journals and videos 20:- /day). Materials will be lent to employees only if they have (1) no overdue lendables, (2) fewer than 10 articlesout, and (3) total fines less than 100. For this case, develop the following:

1.) Use case Diagram

2.) Conceptual/Domain Diagram – You will define your own fields as they are not specifically mentioned on the story.

2. The Downtown Rental System: DownTown Videos is a chain of 11 video stores scattered throughout a major metropolitan area in the MidWest. The chain started with a single store several years ago and has grown to its present size. Paul Lowes, the owner of the chain, knows that competing with the national chains will require a state-of-the-art movie rental system. You have been asked to develop the system requirements for the new system.

Each store has a stock of movies and video games for rent. For the first iteration, just focus on the movies. It is important to keep track of each movie title: to know and to identify its category (classical, drama, comedy, etc), its rental type (new release, standard), movie rating, and other general information such as movie producer, release date, and cost. In addition to tracking each title, the business must track individual copies to note their purchase their purchase date, condition, type (VHS or DVD), and their rental status. Use functions must be provided to maintain this inventory information.

Customers, the lifeblood of the business, are also tracked. DownTown considers each household to be a customer, so specialmailings and promotions are offered to each household. For any given customer, several people may be authorized to rent videos and games. The primary contact for each customer can also establish several parameters for other members of the

household. For example, the parent wants to limit a child's rental authorization to only PG and PG-13 movies, the system will track that.

Each time a movie is rented, the system must keep track of which copies of which movies are rented, the rental date & time, and the household & person renting the movie. Each rental is considered to be open until all of the movies and gameshave been returned. Customers pay for rentals when checking out videos at the store.

For this case, develop the following diagrams:

1.) A use-case diagram. Analyze user



functions.

2.) A conceptual model

Syllabus for Fourth Year (ODD Sem.)

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G.L. Bajaj Institute of Technology and Management
Information Technology – E Syllabus

STUDY EVALUATION SCHEME

FOURTH YEAR
SEMESTER –VII

| Sl. No. | Subject Code | Subject Name | L-T-P | Th/Lab Marks | Sessional | | Total | Credit |
|---------|-----------------|-------------------------------------|---------|--------------|-----------|-----|-------|--------|
| | | | | ESE | CT | TA | | |
| 1 | Open Elective-1 | Open Elective Course -1 | 3--0--0 | 70 | 20 | 10 | 100 | 3 |
| 2 | IT Elective-3 | Deptt Elective Course-3 | 3--0--0 | 70 | 20 | 10 | 100 | 3 |
| 3 | IT Elective-4 | Deptt Elective Course-4 | 3--1--0 | 70 | 20 | 10 | 100 | 4 |
| 4 | RIT701 | Cryptography & Network Security | 3--1--0 | 70 | 20 | 10 | 100 | 4 |
| 5 | RCS702 | Artificial Intelligence | 3--0--0 | 70 | 20 | 10 | 100 | 3 |
| 6 | RIT751 | Cryptography & Network Security Lab | 0--0--2 | 50 | | 50 | 100 | 1 |
| 7 | RCS752 | Artificial Intelligence Lab | 0--0--2 | 50 | | 50 | 100 | 1 |
| 8 | RIT753 | Industrial Training | 0--0--3 | | | 100 | 100 | 2 |
| 9 | RIT754 | Project | 0--0--6 | | | 200 | 200 | 3 |
| | TOTAL | | | 450 | 100 | 450 | 1000 | 24 |

DEPARTMENTAL ELECTIVES

IT-ELECTIVE -3

1. RIT070 Computer Graphics
2. RCS071 Application of Soft Computing
3. RCS072 High Performance Computing
4. RCS073 Human Computer Interface



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IT-ELECTIVE-4

5. RCS075 Cloud Computing
6. RCS076 Blockchain Architecture Design
7. RCS077 Agile Software Development
8. RCS078 Augmented & Virtual Reality





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B.TECH. (INFORMATION TECHNOLOGY)
VII SEMESTER (DETAILED SYLLABUS)

| CRYPTOGRAPHY & NETWORK SECURITY | | |
|--|---|-------------------------|
| DETAILED SYLLABUS | | 3-1-0 |
| Unit | Topic | Proposed Lecture |
| I | Introduction to security attacks, services and mechanism, Classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, steganography, Stream and block ciphers. Modern Block Ciphers: Block ciphers principles, Shannon’s theory of confusion and diffusion, fiestal structure, Data encryption standard(DES), Strength of DES, Idea of differential cryptanalysis, block cipher modes of operations, Triple DES | 08 |
| II | Introduction to group, field, finite field of the form $GF(p)$, modular arithmetic, prime and relative prime numbers, Extended Euclidean Algorithm, Advanced Encryption Standard (AES) encryption and decryption Fermat’s and Euler’s theorem, Primarily testing, Chinese Remainder theorem, Discrete Logarithmic Problem, Principals of public key crypto systems, RSA algorithm, security of RSA | 08 |
| III | Message Authentication Codes: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions, Secure hash algorithm (SHA) Digital Signatures: Digital Signatures, Elgamal Digital Signature Techniques, Digital signature standards (DSS), proof of digital signature algorithm, | 08 |
| IV | Key Management and distribution: Symmetric key distribution, Diffie-Hellman Key Exchange, Public key distribution, X.509 Certificates, Public key Infrastructure. Authentication Applications: Kerberos, Electronic mail security: pretty good privacy (PGP), S/MIME. | 08 |
| V | IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Introduction to Secure Socket Layer, Secure electronic transaction (SET) System Security: Introductory idea of Intrusion, Intrusion detection, Viruses and related threats, firewalls | 08 |
| Text books: | | |
| 1. William Stallings, “Cryptography and Network Security: Principals and Practice”, Pearson Education. 2. Behrouz A. Frouzan: Cryptography and Network Security, Tata McGraw Hill 3. C K Shyamala, N Harini, Dr. T.R.Padmnabhan Cryptography and Security ,Wiley 4. Bruce Schiener, “Applied Cryptography”. John Wiley & Sons 5. Bernard Menezes,” Network Security and Cryptography”, Cengage Learning. 6. AtulKahate, “Cryptography and Network Security”, Tata McGraw Hill | | |



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| ARTIFICIAL INTELLIGENCE | | |
|--|--|-------------------------|
| DETAILED SYLLABUS | | 3-0-0 |
| Unit | Topic | Proposed Lecture |
| I | Introduction: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Processing. | 08 |
| II | Introduction to Search : Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning | 08 |
| III | Knowledge Representation & Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks. | 08 |
| IV | Machine Learning : Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning, | 08 |
| V | Pattern Recognition : Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbor (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering. | 08 |
| Text books: <ol style="list-style-type: none">1. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, Pearson Education2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, McGraw-Hill3. E Charniak and D McDermott, “Introduction to Artificial Intelligence”, Pearson Education4. Dan W. Patterson, “Artificial Intelligence and Expert Systems”, Prentice Hall of India, | | |



G.L. Bajaj Institute of Technology and Management **Information Technology – E Syllabus**

CRYPTOGRAPHY & NETWORK SECURITY LAB

The following programs may be developed -

1. Write a C program that contains a string (char pointer) with a value 'Hello World'. The program should XOR each character in this string with 0 and displays the result.
2. Write a C program that contains a string (char pointer) with a value 'Hello World'. The program should AND or and XOR each character in this string with 127 and display the result
3. Write a Java program to perform encryption and decryption using the following algorithms:
 - a) Ceaser Cipher
 - b) Substitution Cipher
 - c) Hill Cipher
4. Write a Java program to implement the DES algorithm logic
5. Write a C/JAVA program to implement the BlowFish algorithm logic
6. Write a C/JAVA program to implement the Rijndael algorithm logic.
7. Using Java Cryptography, encrypt the text "Hello world" using BlowFish. Create your own key using Java keytool.
8. Write a Java program to implement RSA Algorithm
9. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).
10. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.
11. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.

Artificial Intelligence Lab

The following programs may be developed -

1. Study of Prolog.
- 2 Write simple fact for the statements using PROLOG.
- 3 Write predicates One converts centigrade temperatures to Fahrenheit, the other checks if a temperature is below freezing.
- 4 Write a program to solve the Monkey Banana problem.
- 5 WAP in turbo prolog for medical diagnosis and show the advantage and disadvantage of green and red cuts.
- 6 WAP to implement factorial, fibonacci of a given number.
- 7 Write a program to solve 4-Queen problem.
- 8 Write a program to solve traveling salesman problem.
- 9 Write a program to solve water jug problem using LISP



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Information Technology – E Syllabus

COMPUTER GRAPHICS

DETAILED SYLLABUS

3-0-0

Unit

Topic

**Proposed
Lecture**

I

Introduction and Line Generation: Types of computer graphics, Graphic Displays- Random scan displays, Raster scan displays, Frame buffer and video controller, Points and lines, Line drawing algorithms, Circle generating algorithms, Mid-point circle generating algorithm, and parallel version of these algorithms.

08

II

Transformations: Basic transformation, Matrix representations and homogenous coordinates, Composite transformations, Reflections and shearing.
Windowing and Clipping: Viewing pipeline, Viewing transformations, 2-D Clipping algorithms- Line clipping algorithms such as Cohen Sutherland line clipping algorithm, Liang Barsky algorithm, Line clipping against non rectangular clip windows; Polygon clipping – Sutherland Hodgeman polygon clipping, Weiler and Atherton polygon clipping, Curve clipping, Text clipping

08

III

Three Dimensional: 3-D Geometric Primitives, 3-D Object representation, 3-D Transformation, 3-D viewing, projections, 3-D Clipping.

08

IV

Curves and Surfaces: Quadric surfaces, Spheres, Ellipsoid, Blobby objects, Introductory concepts of Spline, Bspline and Bezier curves and surfaces.

08

V

Hidden Lines and Surfaces: Back Face Detection algorithm, Depth buffer method, A- buffer method, Scan line method, basic illumination models– Ambient light, Diffuse reflection, Specular reflection and Phong model, Combined approach, Warn model, Intensity Attenuation, Color consideration, Transparency and Shadows.

08

Text books:

1. Donald Hearn and M Pauline Baker, “Computer Graphics C Version”, Pearson Education
2. Foley, Vandam, Feiner, Hughes – “Computer Graphics principle”, Pearson Education.
3. Rogers, “Procedural Elements of Computer Graphics”, McGraw Hill
4. W. M. Newman, R. F. Sproull – “Principles of Interactive computer Graphics” – Tata MCGraw Hill.
5. Amrendra N Sinha and Arun D Udai,” Computer Graphics”, Tata MCGraw Hill.
6. R.K. Maurya, “Computer Graphics ” Wiley Dreamtech Publication.
7. Mukherjee, Fundamentals of Computer graphics & Multimedia, PHI Learning Private Limited.
8. Donald Hearn and M Pauline Baker, “Computer Graphics with OpenGL”, Pearson education



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| APPLICATION OF SOFT COMPUTING | | |
|--|---|-------------------------|
| DETAILED SYLLABUS | | 3-0-0 |
| Unit | Topic | Proposed Lecture |
| I | Neural Networks-I (Introduction & Architecture) : Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory. | 08 |
| II | Neural Networks-II (Back propogation networks) : Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propogation algorithm, factors affecting backpropagation training, applications. | 08 |
| III | Fuzzy Logic-I (Introduction) : Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion. | 08 |
| IV | Fuzzy Logic –II (Fuzzy Membership, Rules) : Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications | 08 |
| V | Genetic Algorithm(GA) : Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications. | 08 |
| Text books: 1. S. Rajsekaran & G.A. Vijayalakshmi Pai, “Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications” Prentice Hall of India. 2. N.P.Padhy,”Artificial Intelligence and Intelligent Systems” Oxford University Press. Reference Books: 3. Siman Haykin,”Neural Netowrks”Prentice Hall of India 4. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India. 5. Kumar Satish, “Neural Networks” Tata Mc Graw Hill | | |



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| HIGH PERFORMANCE COMPUTING | | |
|--|--|-------------------------|
| DETAILED SYLLABUS | | 3-0-0 |
| Unit | Topic | Proposed Lecture |
| I | Overview of Grid Computing Technology, History of Grid Computing, High Performance Computing, Cluster Computing. Peer-to-Peer Computing, Internet Computing, Grid Computing Model and Protocols, Types of Grids: Desktop Grids, Cluster Grids, Data Grids, High-Performance Grids, Applications and Architectures of High Performance Grids, High Performance Application Development Environment. | 08 |
| II | Open Grid Services Architecture, Introduction, Requirements, Capabilities, Security Considerations, GLOBUS Toolkit. | 08 |
| III | Overview of Cluster Computing, Cluster Computer and its Architecture, Clusters Classifications, Components for Clusters, Cluster Middleware and SSI, Resource Management and Scheduling, Programming, Environments and Tools, Cluster Applications, Cluster Systems, | 08 |
| IV | Beowulf Cluster: The Beowulf Model, Application Domains, Beowulf System Architecture, Software Practices, Parallel Programming with MPL, Parallel Virtual Machine (PVM). | 08 |
| V | Overview of Cloud Computing, Types of Cloud, Cyber infrastructure, Service Oriented Architecture Cloud Computing Components: Infrastructure, Storage, Platform, Application, Services, Clients, Cloud Computing Architecture. | 08 |
| Text books: <ol style="list-style-type: none">1. Laurence T. Yang, Minyi Guo – High Performance Computing Paradigm and Infrastructure John Wiley2. Ahmar Abbas, “Grid Computing: Practical Guide to Technology & Applications”, Firewall Media, 2004.3. Joshy Joseph and Craig Fellenstein , “Grid Computing” Pearson Education, 2004.4. Ian Foster, et al., “The Open Grid Services Architecture”, Version 1.5 (GFD.80). Open Grid Forum, 2006.6. RajkumarBuyya. High Performance Cluster Computing: Architectures and Systems. PrenticeHall India, 1999. | | |



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Information Technology – E Syllabus

| HUMAN COMPUTER INTERFACE | | |
|---------------------------------|---|-------------------------|
| DETAILED SYLLABUS | | 3-0-0 |
| Unit | Topic | Proposed Lecture |
| I | Introduction : Importance of user Interface – definition, importance of 8 good design. Benefits of good design. A brief history of Screen design. The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface | 08 |
| II | Design process: Human interaction with computers, importance of 8 human characteristics human consideration, Human interaction speeds, understanding business junctions. III Screen Designing : Design goals – Scre | 08 |
| III | Screen Designing : Design goals – Screen planning and purpose, 8 organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design. | 08 |
| IV | Windows : New and Navigation schemes selection of window, 8 selection of devices based and screen based controls. Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors | 08 |
| V | Software tools : Specification methods, interface – Building Tools. 8 Interaction Devices – Keyboard and function keys – pointing devices – speech recognition digitization and generation – image and video displays – drivers. | 08 |

Text books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale Human Computer Interaction, 3rd Edition Prentice Hall, 2004.
2. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, Research Methods in HumanComputer Interaction, Wiley, 2010.
3. Ben Shneiderman and Catherine Plaisant Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition, pp. 672, ISBN 0- 321-53735-1, March 2009), Reading, MA: Addison-Wesley Publishing Co.



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CLOUD COMPUTING

DETAILED SYLLABUS

3-1-0

| Unit | Topic | Proposed Lecture |
|-------------|---|-------------------------|
| I | INTRODUCTION Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning. | 08 |
| II | CLOUD ENABLING TECHNOLOGIES Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Virtualization Support and Disaster Recovery. | 08 |
| III | CLOUD ARCHITECTURE, SERVICES AND STORAGE Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3. | 08 |
| IV | RESOURCE MANAGEMENT AND SECURITY IN CLOUD Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards. | 08 |
| V | CLOUD TECHNOLOGIES AND ADVANCEMENTS Hadoop – MapReduce – Virtual Box – Google App Engine – Programming Environment for Google App Engine – Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation. | 08 |

Text books:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
5. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O’Reilly, 2009.



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| BLOCKCHAIN ARCHITECTURE DESIGN | | |
|--|---|-------------------------|
| DETAILED SYLLABUS | | 3-1-0 |
| Unit | Topic | Proposed Lecture |
| I | Introduction to Blockchain: Digital Money to Distributed Ledgers , Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hashchain to Blockchain, Basic consensus mechanisms | 08 |
| II | Consensus: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains | 08 |
| III | Hyperledger Fabric (A): Decomposing the consensus process , Hyperledger fabric components, Chaincode Design and Implementation Hyperledger Fabric (B): Beyond Chaincode: fabric SDK and Front End (b) Hyperledger composer tool | 08 |
| IV | Use case 1 : Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance Use case 2: Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc | 08 |
| V | Use case 3: Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social welfare systems Blockchain Cryptography, Privacy and Security on Blockchain | 08 |
| Text books: <ol style="list-style-type: none">1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos2. Blockchain by Melanie Swa, O'Reilly3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html | | |



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| AGILE SOFTWARE DEVELOPMENT | | |
|-----------------------------------|--|-------------------------|
| DETAILED SYLLABUS | | 3-1-0 |
| Unit | Topic | Proposed Lecture |
| I | AGILE METHODOLOGY Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model – Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams – Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values | 08 |
| II | AGILE PROCESSES Lean Production – SCRUM, Crystal, Feature Driven Development- Adaptive Software Development – Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices. | 08 |
| III | AGILITY AND KNOWLEDGE MANAGEMENT Agile Information Systems – Agile Decision Making – Earl_S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment , Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM). | 08 |
| IV | AGILITY AND REQUIREMENTS ENGINEERING Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation. | 08 |
| V | AGILITY AND QUALITY ASSURANCE Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance – Test Driven Development – Agile Approach in Global Software Development. | 08 |

Text books:

1. David J. Anderson and Eli Schragenheim, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Prentice Hall, 2003.
2. Hazza and Dubinsky, "Agile Software Engineering, Series: Undergraduate Topics in Computer Science", Springer, 2009.
3. Craig Larman, "Agile and Iterative Development: A Managers Guide", Addison-Wesley, 2004.
4. Kevin C. Desouza, "Agile Information Systems: Conceptualization, Construction, and Management", Butterworth-Heinemann, 2007.



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| AUGMENTED & VIRTUAL REALITY | | |
|--|--|-------------------------|
| DETAILED SYLLABUS | | 3-1-0 |
| Unit | Topic | Proposed Lecture |
| I | <p>VIRTUAL REALITY AND VIRTUAL ENVIRONMENTS: The historical development of VR: Scientific landmarks Computer Graphics, Real-time computer graphics, Flight simulation, Virtual environments, Requirements for VR, benefits of Virtual reality.</p> <p>HARDWARE TECHNOLOGIES FOR 3D USER INTERFACES: Visual Displays Auditory Displays, Haptic Displays, Choosing Output Devices for 3D User Interfaces.</p> | 08 |
| II | <p>3D USER INTERFACE INPUT HARDWARE: Input device characteristics, Desktop input devices, Tracking Devices, 3D Mice, Special Purpose Input Devices, Direct Human Input, Home - Brewed Input Devices, Choosing Input Devices for 3D Interfaces.</p> | 08 |
| III | <p>SOFTWARE TECHNOLOGIES: Database - World Space, World Coordinate, World Environment, Objects - Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and other attributes, VR Environment - VR Database, Tessellated Data, LODs, Cullers and Occluders, Lights and Cameras, Scripts, Interaction - Simple, Feedback, Graphical User Interface, Control Panel, 2D Controls, Hardware Controls, Room / Stage / Area Descriptions, World Authoring and Playback, VR toolkits, Available software in the market</p> | 08 |
| IV | <p>3D INTERACTION TECHNIQUES: 3D Manipulation tasks, Manipulation Techniques and Input Devices, Interaction Techniques for 3D Manipulation, Deign Guidelines - 3D Travel Tasks, Travel Techniques, Design Guidelines - Theoretical Foundations of Wayfinding, User Centered Wayfinding Support, Environment Centered Wayfinding Support, Evaluating Wayfinding Aids, Design Guidelines - System Control, Classification, Graphical Menus, Voice Commands, Gestural Commands, Tools, Mutimodal System Control Techniques, Design Guidelines, Case Study: Mixing System Control Methods, Symbolic Input Tasks, symbolic Input Techniques, Design Guidelines, Beyond Text and Number entry .</p> <p>DESIGNING AND DEVELOPING 3D USER INTERFACES: Strategies for Designing and Developing Guidelines and Evaluation.</p> <p>VIRTUAL REALITY APPLICATIONS: Engineering, Architecture, Education, Medicine, Entertainment, Science, Training.</p> | 08 |
| V | <p>Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.</p> | 08 |



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Text books:

1. Alan B Craig, William R Sherman and Jeffrey D Will, “Developing Virtual Reality Applications: Foundations of Effective Design”, Morgan Kaufmann, 2009.
2. Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”, 2005.
3. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, “3D User Interfaces, Theory and Practice”,
Addison Wesley, USA, 2005.
4. Oliver Bimber and Ramesh Raskar, “Spatial Augmented Reality: Merging Real and Virtual Worlds”, 2005.
5. Burdea, Grigore C and Philippe Coiffet, “Virtual Reality Technology”, Wiley Interscience, India, 2003.
6. John Vince, “Virtual Reality Systems”, Addison Wesley, 1995.
7. Howard Rheingold, “Virtual Reality: The Revolutionary Technology and how it Promises to Transform Society”, Simon and Schuster, 1991.
8. William R Sherman and Alan B Craig, “Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics)”. Morgan Kaufmann Publishers, San Francisco, CA, 2002
9. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.