JSS MAHAVIDYAPEETHA
JSS SCIENCE & TECHNOLOGY UNIVERSITY

Sri Jayachamarajendra College of Engineering
Mysuru-570006.

Department of Information Science & Engineering

Bachelor of Engineering
In
Information Science & Engineering

SCHEME & SYLLABUS

III to VIII semesters

2017-2018

Scheme of Teaching and Examination

BE in Information Science & Engineering

Third Semester BE 2017-2018

SL. No.	Subject Code	Course Title	Teaching Department	Credits				Contact Hours	Marks			Exam Duration (Hours)
				L	T	P	Total		CIE	SEE	Total	
1.	MA310	Engineering Mathematics III	Mathematics	4	1	0	5.0	6	50	50	100	3
2.	IS310	Data Structures & Applications	IS&E	4	0	1	5.0	6	50	50	100	3
3.	IS320	Computer Organization & Architecture	IS&E	4	1	0	5.0	6	50	50	100	3
4.	IS330	Object Oriented Programming Concepts	IS&E	4	0	1	5.0	6	50	50	100	3
5.	IS340	Discrete Mathematical Structures	IS&E	4	1	0	5.0	6	50	50	100	3
6	HU320	Environmental Studies	Humanities	0	0	0	0.0	2	50	0	0	-
Total				20	3	2	25	32	300	250	500	-

Scheme of Teaching and Examination
BE in Information Science & Engineering
Fourth Semester BE 2017-2018

SL. No.	Subject Code	Course Title	Teaching Department	Credits				Contact Hours	Marks			Exam Duration (Hours)
				L	T	P	Total		CIE	SEE	Total	
1.	MA410	Engineering Mathematics IV	Mathematics	4	1	0	5.0	6	50	50	100	3
2.	IS410	Design & Analysis of Algorithms	IS&E	4	0	1	5.0	6	50	50	100	3
3.	IS420	Operating Systems	IS&E	4	1	0	5.0	6	50	50	100	3
4.	IS430	UNIX Programming	IS&E	4	0	1	5.0	6	50	50	100	3
5.	IS440	Theory of Computation	IS&E	4	1	0	5.0	6	50	50	100	3
6	HU410	Constitution of India & Professional Ethics	Humanities	0	0	0	0.0	2	50	0	0	-
Total				20	3	2	25	32	300	250	500	-

Scheme of Teaching and Examination
BE in Information Science & Engineering
Fifth Semester BE 2017-2018

SL. No.	Subject Code	Course Title	Teaching Department	Credits				Contact Hours	Marks			Exam Duration (Hours)
				L	T	P	Total		CIE	SEE	Total	
1.	IS510	Linear Algebra	IS&E	4	1	0	5.0	6	50	50	100	3
2.	IS520	Database Management System	IS&E	4	0	1	5.0	6	50	50	100	3
3.	IS530	Statistical Methods in Information Processing	IS&E	4	1	0	5.0	6	50	50	100	3
4.	IS540	Data Communication	IS&E	4	1	0	5.0	6	50	50	100	3
5.	IS55X	**Elective I**										
	IS551	Programming with Java	IS&E	4	0	1	5.0	6	50	50	100	3
	IS552	Web Programming	IS&E	4	0	1	5.0	6	50	50	100	3
	IS553	System Simulation Modeling	IS&E	4	0	1	5.0	6	50	50	100	3
Total				20	3	2	25	30	250	250	500	-

Scheme of Teaching and Examination

BE in Information Science & Engineering

Sixth Semester BE 2017-2018

SL. No.	Subject Code	Course Title	Teaching Department	Credits				Contact Hours	Marks			Exam Duration (Hours)
				L	T	P	Total		CIE	SEE	Total	
1.	IS610	Software Engineering	IS&E	4	1	0	5.0	6	50	50	100	3
2.	IS620	Computer Networks	IS&E	4	0	1	5.0	6	50	50	100	3
3.	IS630	Data Mining	IS&E	4	0	1	5.0	6	50	50	100	3
4.	IS640	Management Information Systems	IS&E	4	1	0	5.0	6	50	50	100	3
5.	IS65X	**Elective-II**										
	IS651	Advanced Database Systems	IS&E	4	1	0	5.0	6	50	50	100	3
	IS652	Human Computer Interaction	IS&E	4	1	0	5.0	6	50	50	100	3
	IS653	Soft Computing	IS&E	4	1	0	5.0	6	50	50	100	3
	IS654	Computer Vision	IS&E	4	1	0	5.0	6	50	50	100	3
Total				20	3	2	25	30	250	250	500	-

Scheme of Teaching and Examination

BE in Information Science & Engineering

Seventh Semester BE 2017-2018

SL. No.	Subject Code	Course Title	Teaching Department	Credits				Contact Hours	Marks			Exam Duration (Hours)
				L	T	P	Total		CIE	SEE	Total	
1.	IS710	Distributed Computing	IS&E	4	1	0	5.0	6	50	50	100	3
2.	IS720	Information & Network Security	IS&E	4	1	0	5.0	6	50	50	100	3
3.	IS730	Information Retrieval	IS&E	4	1	0	5.0	6	50	50	100	3
4.	IS74X	**Elective-III**										
	IS741	Cloud Computing	IS&E	4	1	0	5.0	6	50	50	100	3
	IS742	Cyber Security	IS&E	4	1	0	5.0	6	50	50	100	3
	IS743	Internet of Things	IS&E	4	1	0	5.0	6	50	50	100	3
	IS744	Robotics	IS&E	4	1	0	5.0	6	50	50	100	3
5.	IS75X	**Elective-IV**										
	IS751	Mobile Computing	IS&E	4	0	1	5.0	6	50	50	100	3
	IS752	C# Programming & .NET	IS&E	4	0	1	5.0	6	50	50	100	3
	IS753	Natural Language Processing	IS&E	4	0	1	5.0	6	50	50	100	3
	IS754	Internet Programming	IS&E	4	0	1	5.0	6	50	50	100	3
Total				20	4	1	25	30	250	250	500	-

Scheme of Teaching and Examination
BE in Information Science & Engineering
Eighth Semester BE 2017-2018

SL. No.	Subject Code	Course Title	Teaching Department	Credits				Contact Hours	Marks			Exam Duration (Hours)
				L	T	P	Total		CIE	SEE	Total	
1.	IS81X	**Elective-V**										
	IS811	Storage Area Networks	IS&E	4	1	0	5.0	6	50	50	100	3
	IS812	Information Storage Management	IS&E	4	1	0	5.0	6	50	50	100	3
	IS813	Big Data Analytics	IS&E	4	1	0	5.0	6	50	50	100	3
2.	IS82X	**Elective-VI**										
	IS821	Financial Management	MBA	4	1	0	5.0	6	50	50	100	3
	IS822	Entrepreneurship Development	MBA	4	1	0	5.0	6	50	50	100	3
	IS823	Human Resource Management	MBA	4	1	0	5.0	6	50	50	100	3
	IS824	Software Project Management	MBA	4	1	0	5.0	6	50	50	100	3
3.	IS83P	Project Work	IS&E	0	0	15	15.0	30	100	100	200	3
Total				8	2	15	25	42	200	200	400	-

IS310 DATA STRUCTURES & APPLICATIONS

Total Teaching hours: 50 **No. of credits: 05**

Syllabus

Introduction **10 Hours**

Review of Arrays, Structures, Self-Referential Structures, Pointers and Dynamic Memory Allocation, Functions, Array Operations: Traversing, inserting, deleting, searching, and sorting, Multidimensional Arrays, Strings: Basic Terminology, Storing, Operations and Pattern Matching algorithms, Programming Examples.

Stacks and Queues **10 Hours**

Stacks: Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays, Stack Applications: Polish notation , Infix to postfix conversion, evaluation of postfix expression, Recursion- Factorial, GCD, Fibonacci Sequence, Tower of Hanoi, Ackerman's function.
Queues: Definition, Array Representation, Queue Operations, Circular Queues, Circular queues using Dynamic arrays, Dequeues, Priority Queues, A Mazing Problem. Multiple Stacks and Queues, Programming Examples.

Linked Lists **10 Hours**

Definition, Representation of linked lists in Memory, Memory allocation, Garbage Collection, Linked list operations: Traversing, Searching, Insertion, and Deletion. Doubly Linked lists, Circular linked lists, and header linked lists, Linked Stacks and Queues. Applications of Linked lists – Polynomials, Sparse matrix representation, Programming Examples

Trees **10 Hours**

Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Additional Binary tree operations, Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, Searching, Application of Trees-Evaluation of Expression, Programming Examples.

Advanced Trees and Hashing **10 Hours**

AVL trees: Concepts, Balancing the AVL tree after insertion and deletion: Multiway Trees – B-Trees – Search, Insertion, Deletion; B*-Trees, B+-Trees, Programming Examples.

Hashing: Introduction, A Simple Hashing Algorithm, Hashing Functions and Record Distribution, Collision resolution by progressive overflow, Buckets, Other collision resolution techniques. Extendible Hashing: Introduction, Extendible Hashing Performance, Alternative approaches.

Text Books:

1. Fundamentals of Data Structures in C - Ellis Horowitz and Sartaj Sahni, 2nd edition, Universities Press,2014
2. Data Structures - Seymour Lipschutz, Schaum's Outlines, Revised 1st edition, McGraw Hill, 2014

Reference Books:

1. Data Structures: A Pseudo-code approach with C –Gilberg & Forouzan, 2nd edition, Cengage Learning,2014.
2. Data Structures using C, Reema Thareja, 3rd edition Oxford press, 2012.
3. An Introduction to Data Structures with Applications- Jean-Paul Tremblay & Paul G. Sorenson, 2nd Edition, McGraw Hill, 2013.
4. Data Structures using C - A M Tenenbaum, PHI, 1989.
5. Data Structures and Program Design in C – Robert Kruse, 2nd edition, PHI, 1996.

IS320 COMPUTER ORGANIZATION & ARCHITECTURE

Total Teaching hours: 50 **No. of credits: 05**

Syllabus

Introduction **10 Hours**

Basic structure of computers: Computer types, Functional units, Basic operational concepts, Bus structures, Performance, Historical perspective, Machine instructions & programs: Numbers, arithmetic operations & characters, Memory locations & addresses, Memory operations, Instructions & instruction sequencing; Addressing modes, Assembly language, Basic input/output operations, Stacks & queues, Subroutines, Additional instructions, Encoding of machine instructions.

Input/output Organization **10 Hours**

Accessing I/O devices, Interrupts, Direct memory access, Buses; Interface circuits, Standard I/O devices.

Memory system **10 Hours**

Basic concepts, Semiconductor RAM memories, Read-Only memories, Speed, size & cost, Cache memories, Performance considerations; Virtual memories, Secondary storage.

Arithmetic **10 Hours**

Addition & subtraction of signed numbers, Design of fast adders; Multiplication of positive numbers, Signed-operand multiplication, Fast multiplication, Integer division, Floating point numbers and operations.

Pipelining **10 Hours**

Basic concepts, Data Hazards, Instruction Hazards, Influence on Instruction sets, Data path & Control considerations, Superscalar Operation, UltraSPARC II example, Performance Considerations

Text Book:

1. Computer Organization, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, 5th edition, McGraw Hill International, 2002

IS330 OBJECT ORIENTED PROGRAMMING CONCEPTS

Total Teaching hours: 50 **No. of credits: 05**

Syllabus

Introduction **10 Hours**

Introduction to Python, Python **Basics** (Data Types, Operations on Data Types, Data Type Conversions, Basic I/O, Basic Formatting) Python, **Control Structures** (Decisions, Loops)

Collections **10 Hours**

Collections: Lists, Tuples, Sets, Dictionaries

Strings / Functions **10 Hours**

Strings (Searching, Splitting, Joining)
Functions (Definition, Call, Positional Arguments, Default Arguments, Keyword Arguments, Variable Arguments, Returning From Functions, Lambda Expressions, Unpacking Argument Lists)
Practical Python (Stacks, Queues, Sequence Processing using map, filter and reduce, List Comprehensions, Matrices)

Object Oriented Programming **10 Hours**

Object Oriented Programming (OOP Concepts, Class Definitions, Class Instantiation, Class and Instance Variables, Class Functions and Instance Methods, Constructors and Destructors, Inheritance)

Exception / File Handling **10 Hours**

Exception Handling (Handling Exceptions, Raising Exceptions, Exception Propagation, User-Defined Exceptions)
File Handling (Reading From Text Files, Writing to Text Files, Reading from Binary Files, Writing to Binary Files, Seeking Within Files)

Text Book:

1. "Learning Python", B. Nagesh Rao, A Cyberplus Publication, Indian Edition, 2016

Reference Book:

1. "Learning Python", by Mark Lutz, Fifth Edition, O'Reilly Media Publications, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472.

IS340 DISCRETE MATHEMATICAL STRUCTURES

Total Teaching hours: 50 **No. of credits: 05**

Syllabus

Mathematical Logic **10 Hours**

Proposition – Connectives – Truth Tables - Conditional and bi conditional propositions – Tautology and contradiction - Duality Law – Algebra and laws of Algebra of propositions – Tautological Implication Theory of Inference – Rules of Inference – Inconsistency – Indirect method of Proof.

Set Theory **10 Hours**

Laws of Set Theory – Partition of a set – Duality Principle – Relations – Properties – Equivalence relation and partial order relation – poset – Graphs of relations – Hasse diagram – Matrices of relations – Closure operations on relations – Warshall's algorithm – Functions.

Combinatorics **10 Hours**

Pigeonhole Principle – Generalized Pigeonhole principle – Mathematical induction – Recurrence relation – Formation of recurrence relation – Homogeneous Recurrence relation – Non homogeneous recurrence relation – Generating functions.

Group Theory and Coding Theory **10 Hours**

Group – Subgroups – Cyclic groups – Properties – Group homomorphism – Cosets – Lagrange's theorem – Encoders and decoders – Group code – Hamming codes – Error correction – Decoding group codes. .

Graph Theory **10 Hours**

Basic definitions – Special simple graphs – Matrix representation of graphs – Warshall's algorithm – Paths – Eulerian and Hamiltonian graphs – Shortest path algorithms – trees – spanning trees – Minimum Spanning tree – Kruskal's algorithm. .

Text Book:

Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education. 2004.

Reference Books:

1. Discrete Mathematics and Its Applications, 6th edition Kenneth Rosen
2. Basavaraj S Anami and Venakanna S Madalli: DiscreteMathematics – A Concept based approach, Universities Press, 2016
3. Kenneth H. Rosen: Discrete Mathematics and its Applications, 6th Edition, McGraw Hill, 2007.

4. Jayant Ganguly: A Treatise on Discrete Mathematical Structures, Sanguine-Pearson, 2010.
5. D.S. Malik and M.K. Sen: Discrete Mathematical Structures: Theory and Applications, Thomson, 2004.
6. Thomas Koshy: Discrete Mathematics with Applications, Elsevier, 2005, Reprint 2008.

IS410 DESIGN & ANALYSIS OF ALGORITHMS

Total Teaching hours: 50 **No. of credits: 05**

Syllabus

Introduction **10 Hours**

What is an Algorithm? Algorithm Specification, Analysis Framework, Performance Analysis: Space complexity, Time complexity, Asymptotic Notations: Big-Oh notation (O), Omega notation (Ω), Theta notation (Θ), and Little-oh notation (o), Mathematical analysis of Non-Recursive and recursive Algorithms with Examples Important Problem Types: Sorting, Searching, String processing, Graph Problems, Combinatorial Problems, Fundamental Data Structures: Stacks, Queues, Graphs, Trees, Sets and Dictionaries.

Divide and Conquer **10 Hours**

General method, Binary search, Recurrence equation for divide and conquer, Finding the maximum and minimum, Merge sort, Quick sort, Strassen's matrix multiplication, Advantages and Disadvantages of divide and conquer, Decrease and Conquer Approach, Topological Sort

Greedy Method **10 Hours**

General method, Coin Change Problem, Knapsack Problem, Job sequencing with deadlines, Minimum cost spanning trees: Prim's Algorithm, Kruskal's Algorithm, Single source shortest paths: Dijkstra's Algorithm, Optimal Tree problem: Huffman Trees and Codes, Transform and Conquer Approach: Heaps and Heap Sort

Dynamic Programming **10 Hours**

General method with Examples, Multistage Graphs, Transitive Closure: Warshall's Algorithm, All Pairs Shortest Paths: Floyd's Algorithm, Optimal Binary Search Trees, Knapsack problem Bellman-Ford Algorithm, Travelling Sales Person problem, Reliability design

Backtracking **10 Hours**

General method, N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles, Branch and Bound: Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem, LC Branch and Bound solution, FIFO Branch and Bound solution, NP-Complete and NP-Hard problems, Basic concepts, non-deterministic algorithms, P, NP, NP-Complete, and NP-Hard classes

Text Books

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin:, 2rd Edition, 2009, Pearson.
2. Computer Algorithms/C++, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, 2014, Universities Press.

Reference Books

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI
2. Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

IS420 OPERATING SYSTEMS

Total Teaching hours: 50 **No. of credits: 05**

Syllabus

Introduction **09Hours**

Concepts, OS objectives, OS functions, OS views, OS design issues, OS supports & services, evolution of system structure.

Process management **14 Hours**

Concept, process models, threads: thread states, types of threads, thread priority, multithreading, scheduling: short-term scheduler types of schedulers, non-preemptive & preemptive strategies, interprocess synchronization: concepts, critical section problem, peterson's solution, synchronization hardware, semaphores, bounded buffer problem, readers-writers problem, dining philosophers problem, deadlocks: deadlocks & starvation, conditions for deadlocks, deadlock detection, deadlock prevention, deadlock recovery, deadlock avoidance, starvation.

Memory management **09 Hours**

Key Characteristics, memory management functions, logical address & physical address, address translation, management schemes: contiguous memory allocation & non contiguous memory allocation, virtual memory: paging, segmentation, cache memory design issues.

Device & file management **09 Hours**

Device Characteristics, types, device controller, operations, buffering & types of buffering, clock, disk, management, disk arm scheduling policies, RAID, File system, server, management, design, organization, directory, sharing, blocking, management, allocation, file system reliability

Security & Protection **09 Hours**

Overview, goals, security threats, attacks, design issues, protection structure, intruders, authentication, malicious programs, encryption: symmetric encryption, public key encryption.

Text books:

1. Operating System Principles, Abraham Silberschatz, Peter Galvin, Greg Gagne, Wiley-India.
2. Operating Systems, A concept–based evolutionary approach, P Chakraborty, Jaico publishing house.

Reference Books:

1. Modern Operating Systems**,** Andrew S Tanenbaum, PHI.
2. Operating Systems**,** Deitel, Deitel, Choffnes, PHI.
3. Operating Systems, Internals & design principles**,** William Stallings, PHI.

IS430 UNIX PROGRAMMING

Total Teaching hours: 50 **No. of credits: 05**

Syllabus

Fundamental & System programming concepts **10 Hours**

The Core Operating System: The Kernel, The Shell, Users and Groups, Single Directory Hierarchy, Directories, Links, and Files. File I/O Model, Processes, Memory Mappings. Static and Shared Libraries. Interprocess Communication and Synchronization. System Calls, Library Functions, The Standard C Library; The GNU C Library (*glibc*), Handling Errors from System Calls and Library Functions

I/O Model **10 Hours**

Overview, File operations: Reading from a File, Writing to a File, Closing a File Changing the File Offset. Operations Outside the Universal I/O Model. Atomicity and Race Conditions,File Control Operations, Open File Status Flags. Relationship Between File Descriptors and Open Files, Duplicating File Descriptors, File I/O at a Specified Offset: *pread()* and *pwrite(),* Scatter-Gather I/O: *readv()* and *writev(),* Truncating a File: *truncate()* and *ftruncate(),* Nonblocking I/O, I/O on Large Files, The /dev/fd Directory, Creating Temporary Files

Process control I **10 Hours**

UNIX file systems: file types, file systems, file attributes, Inodes in UNIX system UNIX file APIs: General File APIs, File and Record Locking, Directory File APIs, Device File APIs, FIFO File APIs, Symbolic Link File APIs. PROCESS CREATION: Overview of *fork(), exit(), wait(),* and *execve(),* Creating a New Process: *fork(),* File Sharing Between Parent and Child, Memory Semantics of *fork(),* The *vfork()* System Call, Race Conditions After *fork(),* Avoiding Race Conditions by Synchronizing with Signals.

Process control II **10 Hours**

MONITORING CHILD PROCESSES: Waiting on a Child Process, Orphans and Zombies, The SIGCHLD Signal. PROGRAM EXECUTION: Executing a New Program: *execve(),* The *exec()* Library Functions, Interpreter Scripts, File Descriptors and *exec().* PROCESS TERMINATION: Terminating a Process: *_exit()* and *exit(),* Details of Process Termination, Exit Handlers, Interactions Between *fork(), stdio* Buffers, and *_exit()*

Inter process communication **10 Hours**

A Taxonomy of IPC Facilities, Communication Facilities, Synchronization Facilities, Comparing IPC Facilities, PIPES AND FIFOS: Overview, Creating and Using Pipes, Pipes As a Method of Process Synchronization, Using Pipes to Connect Filters, Talking to a Shell Command via a Pipe: *popen()* and *pclose()* Pipes and stdio Buffering, FIFOs: A Client-Server Application Using FIFOs Nonblocking I/O, Semantics of *read()* and *write()* on Pipes and FIFOs

Text books:

1. Sumitabha Das, UNIX Concepts and Applications**,** 4th edition, Tata McGraw Hill, 2006
2. Richard Stevens: Advanced Programming in the UNIX Environment, Addison-Wesley, 1993.

Reference books:

1. Advanced Programming in the UNIX Environment, 3rd ed, W. Richard Stevens & Steven Rago; Addison-Wesley; 2005.
2. The Linux Programming Interface – A Linux and UNIX System Programming Handbook, Michael Kerrisk, 2010

IS440 THEORY OF COMPUTATION

Total Teaching hours: 50 **No. of credits: 05**

Syllabus

Finite Automata **10 Hours**

Introduction- Basic Mathematical Notation and techniques- Finite State systems – Basic Definitions – Finite Automaton – DFA & NDFA – Finite Automaton with €-moves – Regular Languages- Regular Expression – Equivalence of NFA and DFA – Equivalence of NDFA's with and without €-moves – Equivalence of finite Automaton and regular expressions –Minimization of DFA- - Pumping Lemma for Regular sets – Problems based on Pumping Lemma.

Grammers **10 Hours**

Grammar Introduction– Types of Grammar - Context Free Grammars and Languages– Derivations and Languages – Ambiguity- Relationship between derivation and derivation trees – Simplification of CFG – Elimination of Useless symbols - Unit productions - Null productions – Greiback Normal form – Chomsky normal form – Problems related to CNF and GNF

Pushdown Automata **10 Hours**

Pushdown Automata- Definitions – Moves – Instantaneous descriptions – Deterministic pushdown automata – Equivalence of Pushdown automata and CFL - pumping lemma for CFL – problems based on pumping Lemma

Turing Machine **10 Hours**

Turing Machines- Introduction – Formal definition of Turing machines – Instantaneous descriptions- Turing Machine as Acceptors – Turing Machine as Transducers Computable Languages and functions – Turing Machine constructions – Modifications of Turing Machines

Computational Complexity **10 Hours**

Undecidability- Basic definitions- Decidable and undecidable problems - Properties of Recursive and Recursively enumerable languages – Introduction to Computational Complexity: Definitions-Time and Space complexity of TMs – complexity classes – introduction to NP-Hardness and NP-Completeness.

Text Book:

1. Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory,Languages and Computations", Second Edition, Pearson Education, 2008.

References Books:

1. John.C.Martin, "Introduction to Languages and the Theory of Computation", McGraw-Hill Education, 01-May-2010.

2. Michael Sipser, “Introduction to the Theory of Computation” Cengage Learning, 2012.
3. Peter Linz , “An introduction to formal languages and automata”, Jones & Bartlett Learning, 2001.