

MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE
(Autonomous)

**ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABI**

MASTER OF TECHNOLOGY

**COMPUTER SCIENCE & ENGINEERING
(CSE)**



M.Tech Regular Two Year P. G. Degree Course

ACADEMIC REGULATIONS (R16) (2016-2017)

Applicable for students admitted to Master of Technology from 2016-17



**MADANAPALLE INSTITUTE OF
TECHNOLOGY & SCIENCE
(AUTONOMOUS)**

Affiliated to JNTUA, Anantapur & Approved by AICTE, New Delhi
Recognised Research Center
Accredited by NBA for CSE, ECE, EEE & ME
World Bank funded Institute
Recognised by UGC under the sections 2(f) and 12(B) of the UGC act 1956
Recognised as Scientific & Industrial Research Organization by DSIR of DST

1. Eligibility for Admissions

Admission to the M.Tech program shall be made subject to the eligibility, qualifications and specialization prescribed by the University for each Program, from time to time.

Admissions shall be made either on the basis of merit rank obtained by the qualified candidates at an Entrance Test conducted by the University or on the basis of GATE/ PGECET score, subject to reservations prescribed by the University or Government policies from time to time.

2. Program pattern

2.1 A candidate after securing admission must pursue the M.Tech program of study for four semesters.

2.2 Each semester shall be for a minimum of 90 instruction days including examinations.

2.3 A candidate admitted to a program should complete it within a period equal to twice the prescribed duration of the program from date of admission.

3. Attendance

3.1 A student shall be eligible to appear for Semester End examinations if he/she acquires a minimum of 75% of attendance in aggregate of all the courses in a semester.

3.2 Shortage of Attendance below 65% in aggregate shall in NO case be condoned.

3.3 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

3.4 Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.

3.5 A student will not be promoted to the next semester unless he/she satisfies the attendance requirements of the present semester, as applicable. They may seek readmission for that semester when offered next.

3.6 A stipulated fee shall be payable towards condonation of shortage of attendance to the Institution.

4. Evaluation

The performance of the candidate in each semester shall be evaluated course wise, with a maximum of 100 marks for Theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

4.1 For the theory courses 50 marks will be for the End Semester Examination.

While 30 marks will be for Internal tests, based on two Mid Term-tests held, one in the middle of the Semester (I-II units) and another immediately after the completion of

instruction (III, IV & V) units with three questions to be answered out of four in 2 hours, evaluated for 30 marks. Both tests shall carry equal weightage.

Another 20 marks will be based on submission of four assignments (5marks each).

The first and second assignments are to be submitted before I Mid-Term Examination and the third and fourth assignments are to be submitted before II Mid-Term Examination.

4.2 For practical courses, 50 marks shall be for the End Semester Examinations and 50 marks will be for internal evaluation based on the day to day performance.

4.3 For Seminar there will be an internal evaluation of 100 marks. A candidate has to secure a minimum of Grade D to be declared successful. The assessment will be made by a board consisting of HOD and two internal experts at the end of IV semester instruction.

4.4 The minimum letter grade required for pass in each theory/practical course is “P” (internal evaluation + End Semester Examination). However, in the end semester examination for a course (theory/practical) it is mandatory to secure a minimum of 40% of the total marks.

4.5 In case the candidate does not secure the minimum academic requirement in any of the courses (as specified in 4.4.) he has to reappear for the Semester Examination either Supplementary or regular in that course, or repeat the course when next offered or do any other specified course as may be required.

4.6 In case any student is unable to appear at any one of the two mid-term tests in any theory course for genuine reasons (for example; medical), the Principal, Head of the department and concern faculty at their discretion may permit the conduct of one additional mid-term test after the second mid-term test in that course only after satisfying himself of the genuineness of the reason given by the student supported by appropriate documentation.

5. Evaluation of Project Work

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the college/ institute.

5.1.1 Registration of Project work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses (theory and practical courses of I & II Sem).

5.1.2 An Internal Departmental Committee (I.D.C) consisting of HOD, Supervisor and one internal senior expert shall monitor the progress of the project work.

5.3 The work on the project shall be initiated in the penultimate semester and continued in the final semester. The duration of the project is for two semesters. The candidate can submit Project thesis with the approval of I.D.C. after 36 weeks from the date of registration at the earliest and one calendar year from the date of registration for the project work. Extension of time within the total permissible limit for completing the programme is to be obtained from the Head of the Institution.

5.4 The student must submit status report at least in three different phases during the project work period. These reports must be approved by the I.D.C before submission of the Project Report.

5.5 A candidate shall be allowed to submit the thesis / dissertation only after passing in all the prescribed courses (both theory and practical) and then take viva voce examination of

the project. The viva-voce examination may be conducted once in two months for all the candidates submitted during that period.

5.6 Three copies of the Thesis / Dissertation certified in the prescribed form by the supervisor & HoD shall be presented to the HoD. One copy is to be forwarded to the Principal.

5.7 The department shall submit a panel of three experts for a maximum of 5 students at a time. However, the thesis / dissertation will be adjudicated by one external examiner nominated by the Principal.

5.8 If the report of the examiner is favorable viva-voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the thesis / dissertation. The board shall jointly report candidates work in terms of letter grade as follows:

Performance	Letter Grade
Outstanding	O
Excellent	A+
Very Good	A
Good	B+
Above Average	B
Average	C
Pass	P
Fail	F
Absent	Ab

If the report of the viva-voce is not satisfactory (Grade F) the candidate will retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second viva-voce examination, he will not be eligible for the award of the degree unless the candidate is permitted to revise and resubmit the thesis.

6. Re-Registration for Improvement of Internal Evaluation Marks:

Following are the conditions to avail the benefit of improvement of internal evaluation marks.

- The candidate should have completed the course work and obtained examinations results for I & II semesters.
- He should have passed all the courses for which the internal evaluation marks secured are more than 50%.
- In those courses in which the student has failed in the end semester examination due to Internal evaluation marks secured being less than 50%, the candidate shall be given one chance for each Theory course and for a maximum of **three** Theory courses for Improvement of Internal evaluation marks.
- The candidate has to re-register for the chosen courses and fulfill the academic requirements.
- In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered courses stand cancelled.

7. Program Pattern

7.1 The entire program of study is for two academic years. Both the two academic years shall be on semester pattern.

7.2 A student eligible to appear for the end semester examination in a course, but absent or has failed in the end examination may appear for that course at the next supplementary examination when offered.

7.3 When a student is detained due to lack of credits/shortage of attendance he may be re-admitted when the semester is offered after fulfillment of academic regulations. In such case, he/she shall be in the academic regulations into which he/she is readmitted.

8. Programmes of Study

With the approval from AICTE & JNTUA, the M. Tech. Degree programme is offered at present with the following specializations;

S.No	Specialization	Code
1	Electrical Power Systems	07
2	Solar Power Systems	95
3	Advanced Manufacturing Systems	87
4	Machine Design	15
5	Digital Electronics and Communication Systems	38
6	Micro and Nano Electronics	86
7	Very Large Scale Integration & Embedded Systems	68
8	Computer Science and Engineering	58

9. Grading System

9.1 Letter Grades

9.1.1 Based on the student's performance during a given Semester, the students are awarded a final letter grade at the end of the Semester in each course. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade points	Absolute marks
O (Outstanding)	10	90 - 100
A+ (Excellent)	9	80 - 89
A (Very Good)	8	70 - 79
B+ (Good)	7	65 - 69
B (Above Average)	6.5	60 - 64
C (Average)	6	55 - 59
P (Pass)	5.5	50 - 54
F (Fail)	0	< 50
Ab (Absent)	0	

9.1.2 A student is considered to have completed a course successfully and earned the credits if he secures a letter grade other than F in that course. A letter grade F in any course implies that the candidate is yet to clear that course.

9.1.3 A course successfully completed cannot be repeated.

9.1.4 Grade Point Average (GPA) will be calculated according to the formula

$$GPA = \frac{\sum(C \times GP)}{\sum C}$$

Where C = credits for the course, GP = grade points obtained for the course and the sum \sum is taken over all the courses taken in that Semester.

Cumulative grade point average [CGPA] averaged over all the courses is calculated for the award of class.

9.1.5 The following other GPAs are calculated on similar lines

1. SGPA = Averaged over all the courses taken in a particular Semester.
2. CGPA = Averaged over all the courses taken up to any given point of time.

9.2 Award of Class

The following Class is awarded to the student on successful completion of the M.Tech Degree. Programme depending upon the CGPA obtained;

Class	CGPA	Based on the aggregate of grades secured from the total Credits.
First Class with Distinction	≥ 7.5 & 10.0	
First Class	≥ 6.5 & < 7.5	
Second Class	≥ 5.5 & < 6.5	

10. Transitory Regulations

Candidates who have discontinued or have been detained for want of attendance or who have failed after having undergone the program in earlier regulations or have discontinued and wish to continue the program are eligible for admission into unfinished Semester from the date of commencement of class work with the same or equivalent courses as and when such courses are offered, subject to 4.5 and 2.3 sections. Whereas they continue to be in the academic regulations into which they get readmitted.

11. Withholding of Results

If the candidate has any dues not paid to the institution or if any case of indiscipline or malpractice is pending against him, the result of the candidate shall be withheld and he will not be allowed/ promoted to the next higher Semester. The issue of awarding degree is liable to be withheld in such cases.

12. Minimum Instruction Days

The minimum instruction days including exams for each Semester shall be 90 days.

13. Student transfers

Student transfer shall be as per the guidelines issued by the Government of Andhra Pradesh from time to time.

14. Supplementary Examinations

At the end of each Semester there will be regular examinations for the current Semester. Those students who could not clear their courses in their previous attempt can appear for the examinations under supplementary category along with the regular students after registering

themselves at the examination branch. Supplementary examinations for the all the other Semesters other than the current one will also be conducted at the same time.

15. General

- 15.1 The academic regulations should be read as a whole for purpose of any interpretation.
- 15.2 Malpractice rules nature and punishments are appended.
- 15.3 Where the words “he”, “him”, “his” occur in the regulations, they also include “she”, “her”, “hers”, respectively.
- 15.4 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.
- 15.5 The Institute may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the Institute.

Rules for Disciplinary Action for Malpractices / Improper Conduct in Examinations

	Nature of Malpractices/Improper conduct	Punishment
	<i>If the candidate:</i>	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the course of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the course of the examination)	Expulsion from the examination hall and cancellation of the performance in that course only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that course only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.

2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester/year. The Hall Ticket of the candidate is to be cancelled.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The Candidate is also debarred for four consecutive semesters from classwork and all end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the courses of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that Semester/year. The candidate is also debarred for four consecutive Semesters from class work and all Semester end examinations if his involvement is established. Otherwise the candidate is debarred for two consecutive semesters from class work and all end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that Semester/year. The candidate is also debarred for two consecutive Semesters from class work and all Semester end examinations. The continuation of the
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		course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that course.
6.	Refuses to obey the orders of the any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that Semester. If candidate physically assaults the invigilator or/ officer in charge of the examination, then the candidate is also barred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that Semester/year. The candidate is also debarred for two consecutive Semesters from class work and all Semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.

8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that Semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that Semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that Semester/year.
11.	Copying detected on the basis of internal evidence, such as s , during vacation or during special scrutiny.	Cancellation of the performance in that course and all other courses the candidate has appeared including practical examinations and project work of that Semester examinations depending on the recommendation of the committee.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Principal for further action to award suitable punishment.	

Note: Whenever the performance of a student is cancelled in any course/ courses due to Malpractice, he has to register for the End Examination in those course/courses consequently and has to fulfill all the norms required for award of Degree.



DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

*M.Tech. Computer Science & Engineering [CSE]
Revised-Curriculum Structure (2016-17)*

I YEAR - I Semester

S. No	Course code	Course	Credits
1.	16CSE101	Advanced Operating Systems	4
2.	16CSE102	Advanced Data Structures and Algorithms	4
3.	16CSE103	Computer System Design	4
4.	16CSE104	Advanced Computer networks	4
5.	16CSE105	Object Oriented Analysis & Design Patterns	4
6.	Elective-I		4
	16CSE401	Software Engineering	
	16CSE402	Artificial Intelligence	
	16CSE403	Grid Computing	
7	16CSE201	Advanced Data Structures using Python Practicals	2
Total			26

I YEAR - II Semester

S. No	Course code	Course	Credits
1.	16CSE106	Big Data Analytics	4
2.	16CSE107	Web Technologies	4
3.	16CSE108	Mobile Computing	4
4.	16CSE109	Advanced Databases	4
5.	16CSE110	Information Security and Cyber Forensics	4
6.	Elective-II		4
	16CSE404	Cloud Computing	
	16CSE405	Research Methodologies in Computer Science	
	16CSE406	Software Quality Assurance and Testing	
7.	16CSE202	Data Analytics and Web Technologies Practicals	2
Total			26

II YEAR (III & IV Semesters)

S. No	Course code	Course	Credits
1	16CSE5011	Seminar	2
2	16CSE602	Project work	16

Marks Allocation

S.No	Description	Internal Marks			External Marks
1	Theory	Mid -Test	Assignment		50
		30	20		
2	Practical	Experiment	Record Work	Viva - voce	50
		30	10	10	
3	Seminar	50			50

M.Tech. I Year I Semester

16CSE101 ADVANCED OPERATING SYSTEMS

L	T	P	C
4	0	0	4

Course Description:

This course provides comprehensive and up-to-date coverage of the major developments in distributed Operating System, Multi-processor Operating System and Database Operating System. This course covers important theoretical foundations including Process Synchronization, Concurrency, Event ordering, Mutual Exclusion, Deadlock, Agreement Protocol, Security, Recovery and fault tolerance.

Course Objectives:

- To examine the fundamental principles of distributed operating systems
- To provide hands-on experiences in developing suitable algorithms for distributed system
- To emphasis on OS resource security and protection and database operating system

UNIT I: DISTRIBUTED OPERATING SYSTEMS

Overview, Synchronization Mechanisms, Architectures of Distributed Systems, Theoretical Foundations. Distributed Mutual Exclusion: Preliminaries, A Simple solution to distributed mutual exclusion, Non-Token Based Algorithm, Lamport's Algorithm, RicartAgrawala algorithm. Distributed Deadlock detection, Agreement Protocols: System Model, Classification of Agreement Problem, solution to byzantine agreement problem.

UNIT II: DISTRIBUTED RESOURCE MANAGEMENT

Distributed File Systems: Architecture, Mechanisms for building distributed file systems; Distributed Shared memory: Algorithms for implementing DSM, Memory Coherence, Coherence protocols; Distributed Scheduling – Issues in Load distribution, Components of load distributing algorithm, Load distributing algorithms.

UNIT III: FAULT TOLERANCE

Failure Recovery and Fault Tolerance-Recovery: Classification of Failures, Backward and forward error recovery, recovery in concurrent systems, Checkpointing; Fault Tolerance: Commit protocols, nonblocking commit protocols, voting protocols, dynamic voting protocols, Failure resilient processes.

UNIT IV: PROTECTION AND SECURITY

Protection and Security-Resource Security and protection: Introduction, Preliminaries, Access Matrix Model, Implementation of Access Matrix, safety in Access matrix model. Multiprocessor Operating systems-Multiprocessor System Architectures – Multiprocessor operating systems.

UNIT V: DATABASE OPERATING SYSTEMS

Database Operating Systems-Introduction to Database Operating systems, Concurrency Control, Theoretical Aspects, Concurrency Control Algorithms – Basic synchronization primitives, lock based algorithms, Timestamp based algorithms.

Course Outcomes:

At the end of the course, students will be able to:

1. Understand the basic foundation in the design of advanced operating systems.
2. Devise algorithms for distributed file systems, distributed shared memory and distributed scheduling.
3. Assess the basis of the design of advanced operating systems such as failure recovery and fault tolerance.
4. Find the solutions for the problems encountered in the design of advanced operating systems.
5. Analyze algorithms for database operating systems

Text Book:

MukeshSinghal, NiranjanaG.Shivaratri, Advanced Concepts in Operating Systems: Distributed Database, and Multiprocessor Operating Systems, Tata McGraw-Hill, 2001. ISBN: 0-07-047268-8.

Reference Books:

1. Pradeep K. Sinha, Distributed Operating Systems Concepts and Design, Prentice-Hall of India, 2005, ISBN: 81-203-1380-1
2. Mary Gorman, Todd Stubbs, and Introduction to Operating Systems: Advanced Course, Course Technology, 2001. ISBN: 0619059443.
3. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles, John Wiley and Sons, Seventh Edition, 2006. ISBN: 9812-53-176-9.

M.Tech. I Year I Semester

16CSE102 ADVANCED DATA STRUCTURES AND ALGORITHMS

L	T	P	C
4	0	0	4

Course Description:

This course covers data structures and algorithms. Data structures play a central role in modern computer science. You interact with data structures even more often than with algorithms (think Google, your mail server, and even your network routers). In addition, data structures are essential building blocks in obtaining efficient algorithms.

Course Objectives:

- To develop skills to design and analyze linear and non linear data structures.
- Develop algorithms for manipulating linked lists, stack, queues, trees, and graphs.
- Develop recursive algorithms as they apply to trees and graphs.
- To develop a base for advanced computer study.

UNIT-I

C++ Programming: Objects, Class Definition, Class Members, Access Control, Class Scope, Constructors and destructors, parameter passing methods, Inline functions, dynamic memory allocation and deal location (new and delete), exception handling. Function over Loading.

Object-based Programming: Generic Programming- Function and class templates, Inheritance basics, base and derived classes, inheritance types, base class access control, runtime polymorphism using virtual functions.

UNIT II

Data structures-Linear and non linear data structures, ADT concept, Linear List ADT, Array Representation, Linked representation, Representation of single, two dimensional arrays, sparse matrices and their representation. Singly linked lists -insertion, deletion, search operations, doubly linked lists-insertion, deletion operations, and circular lists.

UNIT III

Stack and Queue ADTs, array and linked list representations, infix to postfix conversion using stack.Implementation of recursion, Circular queue-insertion and deletion, Dequeue ADT, array and linked list representations, Priority queue ADT, implementation using Heaps, Insertion into a Max Heap, Deletion from a Max Heap.

UNIT IV

Searching–Linear and binary search methods, Hashing-Hash functions, Collision Resolution methods–Open Addressing, Chaining Sorting –Bubble sort, Insertion sort, Quick sort, Merge sort, Heap sort comparison of sorting methods.

UNIT V

Trees- Ordinary and Binary trees terminology, Properties of Binary trees, Binary tree ADT, representations, recursive and non recursive traversals Search trees- Binary search tree-

Binary search tree ADT, insertion, deletion and searching operations, Balanced search trees, AVL trees- Red Black trees .

Graphs- Graphs terminology, Graph ADT, representations, graph traversals/search methods- dfs and bfs,

Course Outcomes:

At the end of the course, students will be able to:

1. Apply the Object Oriented Programming Principles for problem solving.
2. Apply the Basic and advanced Data structures and their Implementations for real world applications.
3. Design algorithms and apply appropriate advanced data structures for solving computing problems efficiently.
4. Use the Searching and Sorting Techniques for real world applications.
5. Analyze and apply the suitable data structure for the given real world problem.

Text Books:

1. Data Structures and Algorithms using C++, Ananda Rao Akepogu and Radhoka Raju Palagiri, Pearson Education.
2. Data structures, Algorithms and Applications in C++, S.Sahni, University Press (India) Pvt.Ltd, 2nd edition, Universities Press Orient Longman Pvt. Ltd.

Reference Books:

1. Data structures and Algorithms in C++, Michael T.Goodrich, R.Tamassia and .Mount, Wiley student edition, John Wiley and Sons.
2. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education. Ltd., Second Edition.
3. Data Structures and algorithms in C++, 3rd Edition, Adam Drozdek, Thomson.
4. Data Structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.
5. Problem Solving with C++, The OOP, Fourth Edition , W. Savitch, Pearson education.
6. Data Structures using C++, D.S. Malik, Cengage Learning. India Edition.

M.Tech. I Year I Semester

16CSE103 COMPUTER SYSTEM DESIGN

L	T	P	C
4	0	0	4

Course Description:

This course covers computer functional units and their responsibility with the architectural details. It also covers the computer's control unit working and operational system concepts and security.

Course Objectives:

- To interpret the design of the various functional units of digital computers.
- To understand the basic processing unit and how they are connected and how it generates control signals (using hardwired and micro programmed approaches).
- To be familiar with multithreading and the concepts of memory management including virtual memory.
- To understand the issues related to file system interface and implementation, disk management with protection and security mechanisms.

UNIT I: BASIC STRUCTURE OF COMPUTER

Computer types, functional units, Basic Operational units, Bus Structure, software, performance, Multiprocessors and Multicomputers, Von-neumann architecture, Number System, Memory Operations

UNIT II: COMPUTER ARCHITECTURE

IA -32 Pentium- registers and addressing, input/output organization, interrupts, interrupt handlers, DMA, Buses, Interface circuits, I/O interfaces, Memory performance considerations

UNIT III: CONTROL & PROCESSING UNIT

Execution of a complete instruction, multiple bus organization, hardwired control, micro programmed control, Pipelining: data hazards, instruction hazards, influence on instruction sets, data path and control consideration, and introduction to RISC & CISC architectures, embedded systems and examples

UNIT IV: PROCESSES AND THREADS

Processes- components, states, scheduling, threads- types of threads, multi threading models, inter process communication, classical IPC problems, Deadlocks-necessary conditions, handling mechanisms

UNIT V: FILE SYSTEM AND SECURITY

Files structure, types, access mechanisms, space allocation, UNIX file system, program threats, intruders, accident data loss, basics of cryptography, user authentication.

Course Outcomes:

At the end of the course, students will be able to:

1. Learn about computer performance, computer design, and trade-offs between cost and performance as well as between hardware and software.

2. Analyze the performance requirements of system to formulate and solve
3. Infer the need and requirement of an interface with machine.
4. Apply the features of operating systems to solve memory & process management issues.
5. Interpret the concepts of programming constructs of modern operating systems

Text Books:

1. Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, Vth Edition, McGraw Hill.(UNIT I,II,III)
2. Modern Operating Systems, Andrew S Tanenbaum 2nd edition Pearson/PHI(UNIT IV,V)

Reference Books:

1. Computer Organization and Architecture – William Stallings Sixth Edition, pearson/PHI.
2. Morris Mano -Computer System Architecture –3rd Edition-Pearson Education.
3. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley.
4. Operating Systems – Internals and Design Principles Stallings, Fifth Edition–2005, Pearson Education/PHI.

M.Tech. I Year I Semester

16CSE104 ADVANCED COMPUTER NETWORKS

L	T	P	C
4	0	0	4

Course Description:

This course mainly focuses on advanced concepts of computer networks such as wireless sensor networks, optical networks and mobile IPs. It presents the fundamental concepts of computer networks and networking devices with the in detail knowledge of reference models. This course also encompasses the structures and functions of various computer networking protocols.

Course Objectives:

- To make the students recall the basics of computer networks and to discuss different computer networking protocols.
- To refresh the knowledge of networking devices and learn data link layer and LAN protocols in detail.
- To make the students learn the core concepts of cellular wireless networks.
- To introduce the concepts of optical networks and optical network protocols.
- To make the students learn wireless sensor networks and associated protocols

UNIT I: REVIEW OF COMPUTER NETWORKS AND NETWORKING DEVICES

History of Computer Networks and Internet, The Network edge and core, Access Networks and Physical media, Delay and Loss in Networks **Reference Layers:** 5-layer TCP/IP Model, 7-Layer OSI Model, Internet Protocols and Addressing **Networking Devices:** Multiplexers, Modems, Switches and Routers

UNIT II: INTERNETWORKING AND ROUTING

Internetworking, IPv4, IPv6, Transition from IPv4 to IPv6 Network–Layer Routing, Least-Cost-Path algorithms, Non-Least-Cost-Path algorithms, Intra and Inter domain Routing Protocols, Congestion Control at Network Layer **Multicasting Protocols:** Basic Definitions and Techniques, Intra and Inter domain Multicast Protocols

UNIT III: TRANSPORT AND APPLICATION LAYER PROTOCOLS

Transport Layer Services, Transmission Control Protocol (TCP), User Datagram Protocol (UDP), TCP Congestion Control **Application Layer:** Principles of Network Applications, The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, Domain Name System (DNS), P2P File Sharing, Socket Programming with TCP and UDP, Building a Simple Web Server.

UNIT IV: WIRELESS NETWORKS AND MOBILE IP

Infrastructure of Wireless Networks, Wireless LAN Technologies, Cellular Networks, Mobile IP, Wireless Mesh Networks (WMNs) **Optical Networks:** Overview of Optical Networks, Basic Optical Networking Devices, Large-Scale Optical Switches, Optical Routers, Case Study: An All-Optical Switch.

UNIT V: VPNS, OVERLAY NETWORKS

Virtual Private Networks (VPNs), Overlay Networks – **VoIP and Multimedia Networking:** Overview of IP Telephony, VoIP Signalling Protocols, Real-Time Media Transport Protocols
Mobile Ad-Hoc Networks: Overview of Wireless Ad-Hoc Networks, Routing in Ad-Hoc Networks, Routing Protocols for Ad-Hoc Networks
Wireless Sensor Networks: Sensor Networks and Protocol Structures, Clustering Protocols, Routing Protocols.

Course Outcomes:

At the end of the course, students will be able to:

1. Refresh their knowledge in basics of computer networks and TCP/IP and OSI reference models.
2. Learn about data link layer, routing, internetworking, multicasting protocols, transport and application layers.
3. Interpret channel assignments, handoffs, allocation, channel interference and power control.
4. Design optical mesh networks and understand the concepts of optical switches
5. Learn Wireless Sensor Networks (WSN) concepts, and multimedia networking

Text Books:

1. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, Keith W. Ross, Third Edition, Pearson Education, 2007. (UNITS-I, II, III).
2. Computer and Communication Networks, Nader F. Mir, Pearson Education, 2007. (UNIT-IV, V).

Reference Books:

1. Data Communications and Networking, Behrouz A. Forouzan, Fourth Edition, Tata McgrHill, 2007.
2. Guide to Networking Essentials, Greg Tomsho, Ed Tittel, David Johnson, Fifth Edition, Thomson.
3. An Engineering approach to computer Networking, K. Keshav, Pearson Education.
4. Campus Network Design Fundamentals, Diane Teare, Catherine paquet, Pearson Education (CISCO Press).

M.Tech. I Year I Semester

16CSE105 OBJECT ORIENTED ANALYSIS & DESIGN PATTERNS

L	T	P	C
4	0	0	4

Course Description:

The course covers object-oriented analysis and design using Unified Modeling Language (UML). This course provides the importance of modeling mechanisms, object-oriented concepts. Design patterns and their importance are discussed with the case study.

Course Objectives:

- To get clear idea on the fundamentals of UML, principles of modeling.
- To develop applications using UML.
- To learn and understand the concepts of design patterns and to design a document editor.

UNIT I: INTRODUCTION TO UML AND MODELING

Introduction to UML: The meaning of Object Orientation, object identity, Encapsulation, information hiding, polymorphism, generosity, importance of modeling, principles of modeling, object oriented modeling, conceptual model of the UML, Architecture.

UNIT II: BASIC STRUCTURAL MODELING

Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams. Class & Object Diagrams: Terms, concepts, modeling techniques for Class & Object Diagrams.

UNIT III: BEHAVIORAL MODELING

Interaction Diagrams, Common Modeling Techniques, Basic Behavioral Modeling: Use cases, Use case Diagrams, Activity Diagrams. Advanced Behavioral Modeling: Events and signals, state machines, processes and Threads, time and space, state chart diagrams. Architectural Modeling: Component, Deployment, Component diagrams and Deployment diagrams.

UNIT IV: INTRODUCTION TO DESIGN PATTERNS

Introduction to Design Patterns-Design Pattern Definition, Design Patterns in Small Talk MVC, Describing Design Patterns, Catalog of Design Patterns, Organizing the Catalog, Solving of Design Problems using Design Patterns, Selection of a Design Pattern, and use of Design Patterns.

UNIT V: CASE STUDY

Designing A Document Editor: A Case Study -Design problems, Document structure, Formatting, Embellishing the User Interface, Supporting Multiple Look and Feel standards, Supporting Multiple Window Systems, User Operations, Spelling Checking and Hyphenation.

Course Outcomes:

At the end of the course, students will be able to:

1. Understand the importance of modeling and conceptual model of UML.
2. Apply structural modeling mechanisms in developing an application.
3. Apply behavioral and architectural modeling in developing an application.

4. Analyze the design patterns.
5. Create a document editor.

Text Books:

1. The Unified Modeling Language User Guide By Grady Booch, James Rumbaugh, Ivar Jacobson 2nd Edition, Pearson Education.
2. Gamma, Helm, Johnson, “Design Patterns: Elements of Reusable Object Oriented Software”, 1995, PEA

Reference Books:

1. Fundamentals of Object Oriented Design in UML By Meilir Page-Jones, Pearson Education.
2. Object Oriented Analysis & Design By AtulKahate, The McGraw-Hill.
3. Michael Blaha and James Rumbaugh, “Object-oriented modeling and design with UML”, Prentice-Hall of India, 2005.

M.Tech. I Year I Semester – Elective - I

16CSE401 SOFTWARE ENGINEERING

L	T	P	C
4	0	0	4

Course Description:

This course covers various software process models, user interface design concepts and software modeling. It also covers object oriented concepts, product metrics and pattern based design methods of software engineering process.

Course Objectives:

- To understand variety of software process models.
- To learn the concepts of software requirements and modeling.
- To interpret software architecture and user interface design concepts.
- To apply pattern based design methods and software testing models for system design
- To understand the concepts of testing object oriented applications, software product matrices and software reengineering process.

UNIT I: SOFTWARE, SOFTWARE ENGINEERING AND PROCESS

The nature of Software, The unique nature of WebApps, Software engineering- A layered technology, The essence and principles of software engineering practice, Generic process model (framework), Process patterns, Process assessment and improvement, CMMI, Software myths. Process Models: Prescriptive process models: The waterfall model, Incremental process models, Evolutionary process models. The Unified process, Aspect oriented software development, Agile development: Agile process, Extreme programming.

UNIT II: SOFTWARE REQUIREMENTS

Introduction to functional and non-functional requirements, Requirements engineering activities, Eliciting requirements, Requirements modeling, Requirements validation, Software requirements specification (SRS), Requirements management. Requirements modeling: Structured view: Data modeling (ERD), Functional modeling (DFD), Behavioral modeling. Object oriented view: Use cases, CRC Modeling, Analysis classes, Collaborations, Responsibilities, Object relationship model, Object behavior model. Software Project Estimation: Empirical estimation models.

UNIT III: DESIGN CONCEPTS

Software design quality guidelines and attributes, Design concepts. Software Architecture: Architecture and its importance, Architectural Styles, Data design, Architectural design. Design : Structured view (Traditional view): Architectural mapping using data flow (Call and return architecture), Interface design, Function based component design. Object oriented view: OO Architecture, Class hierarchies, Message design, Class based component design. Performing User Interface Design: Golden rules, User interface analysis and design, interface analysis, interface design steps.

UNIT IV: PATTERN BASED DESIGN AND SOFTWARE TESTING

Design patterns, Pattern based software design, Architectural patterns, Component level design patterns, User interface design patterns. Testing : Software testing strategies: A strategic approach to software testing, Test strategies (Unit testing and integration testing) for conventional and object oriented software, Validation testing, System testing, The art of

debugging. Testing Conventional Applications: Software testing fundamentals, White-Box testing: basis path testing, condition (predicate) testing, data flow testing, loop testing, Black box testing: Equivalence partitioning, Boundary value analysis, Graph based testing methods.

UNIT V: TESTING OBJECT ORIENTED APPLICATIONS

OO testing methods, Testing methods applicable at class level, Interclass test case design. Umbrella Activities: Risk management, Software quality assurance, Software configuration management, Measurement and metrics: Size oriented metrics, Function oriented metrics, Metrics for software quality, Product metrics: Metrics for the requirements model, Metrics for the design model, Metrics for source code, Metrics for testing, Metrics for maintenance. Software Reengineering: A software reengineering process model, Software reengineering activities.

Course Outcomes:

At the end of the course, students will be able to:

1. Understand the principles of software engineering and process models.
2. Interpret software requirements and design requirements model.
3. Design Software Architecture.
4. Apply software design patterns, interface design patterns and use testing strategies
5. Apply object oriented testing methods and software reengineering activities.

TEXT BOOKS:

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 7th edition. McGraw-Hill International Edition.
2. Software Engineering- Sommerville , 7th edition, Pearson education.

REFERENCE BOOKS:

1. Software Engineering- K.K. Agarwal & Yogesh Singh, New Age International Publishers.
2. Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiely.
3. Systems Analysis and Design- Shely Cashman Rosenblatt, Thomson Publications.
4. Software Engineering principles and practice- Waman S Jawadekar, The McGraw- Hill Companies.

M.Tech. I Year I Semester – Elective - I

16CSE402 ARTIFICIAL INTELLIGENCE

L	T	P	C
4	0	0	4

Course Description:

This course is aimed to provide basic understanding of different intelligent agents in terms of Artificial Intelligence. This Course covers introduction to Artificial Intelligence, solving problems by various algorithms, Knowledge and Reasoning, Learning from Observations, and Neural networks.

Course Objectives:

- To make the students understand the fundamentals of AI and Intelligent Agents
- To make the students familiarize with AI Problem-Solving techniques
- To make the students understand knowledge representation and reasoning
- To make the students understand various learning methods

UNIT I: INTRODUCTION TO AI AND INTELLIGENT AGENTS

What is AI? The Foundations of Artificial Intelligence, The State of the Art, Agents and Environments, The Concept of Rationality, The Nature of Environments, The Structure of Agents

UNIT II: PROBLEM-SOLVING

Problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Local Search Algorithms and Optimization Problems, Adversarial Search, The minimax algorithm, Alpha-Beta Pruning, Constraint Satisfaction Problems

UNIT 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.

UNIT IV: LEARNING-I

Learning from Examples, Forms of Learning, Learning Decision Trees, Regression and Classification with Linear Models, Artificial Neural Networks, Nearest neighbor models.

UNIT V: LEARNING-II

Learning Probabilistic Models, Statistical Learning, Learning with Complete Data, Learning with Hidden Variables: The EM Algorithm, Reinforcement Learning, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning.

Course Outcomes:

At the end of the course, students will be able to:

1. Understand different types of AI agents
2. Choose and apply appropriate AI search algorithms

3. Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information
4. Apply knowledge representation, reasoning, and machine learning techniques to real-world problems

Text Books:

1. S. Russell and P. Norvig, “Artificial Intelligence – A Modern Approach”, Third Edition, Pearson Education, 2009

Reference Books:

1. E Rich, K Knight and Shivashankar B Nair, “Artificial Intelligence”, Third Edition, Tata McGraw Hill, 2009
2. David Poole, Alan Mackworth, Randy Goebel, “Computational Intelligence: a logical approach”, Oxford University Press, 2004.
3. G. Luger, “Artificial Intelligence: Structures and Strategies for complex problem solving”, Fourth Edition, Pearson Education, 2002.
4. Nils. J Nilsson, “Artificial Intelligence: A new Synthesis”, Morgan Kauffmann Publishers.

M.Tech. I Year I Semester – Elective - I

16CSE403 GRID COMPUTING

L	T	P	C
4	0	0	4

Course Description:

The course will provide an in-depth introduction to Grid technologies and its infrastructure. Web services and related technologies will be discussed. The technologies and software in the area of grid computing are undergoing enormous changes. This course will make students to learn the Grid services and its Toolkits.

Course Objectives:

- To make Students will learn about Grid Computing and its technologies.
- To make Students to implement web service and its related technologies.
- To make Students to understand the Grid Infrastructure and to use toolkits.

UNIT I: INTRODUCTION AND OVERVIEW OF GRID COMPUTING

Early Grid Activities, Current Grid Activities-An Overview of Grid Business Areas-Grid Applications, Grid Infrastructure.

UNIT II: WEB SERVICES AND RELATED TECHNOLOGIES

Service – Oriented Architecture, Web Service Architecture-XML, Related Technologies, and Their Relevance to Web services, XML Messages and Enveloping-Service Message Description Mechanisms, Relationship between Web Service and Grid Service, Web Service Interoperability and the Role of the WS-I Organization.

UNIT III: DISTRIBUTED OBJECT TECHNOLOGY FOR GRID COMPUTING (OGSA)

Introduction to Open Grid Services Architecture (OGSA), Commercial Data Center, National Fusion Collaboratory, The OGSA Platform Components.

UNIT IV: OPEN GRID SERVICES INFRASTRUCTURE (OGSI)

Introduction-Grid Services-A High-Level Introduction to OGSI, Introduction to Service Data Concepts, Grid Service: Naming and Change Management Recommendations.

UNIT V: OGSA BASIC SERVICES AND THE GRID COMPUTING TOOLKITS

Common Management Model (CMM), Security Architecture, GLOBUS GT3 Toolkit: Architecture- GLOBUS GT3 Toolkit: - Architecture, Programming model, High level services.

Course Outcomes:

At the end of the course, students will be able to:

1. Understand Grid Infrastructure and its applications.
2. Use XML and Grid related technologies.
3. Analyze OGSA Platform components.
4. Understand OGSI and Grid services.
5. Use Grid Computing toolkits.

Text Books:

Joshy Joseph & Craig Fellenstein, "Grid Computing", Pearson/PHI PTR-2003. Reference Books.

Reference Books:

1. Ahmar Abbas, "Grid Computing: A Practical Guide to technology and Applications", Charles River media – 2003.
2. Fran Berman, Geoffrey Fox, Anthony J.G. Hey, Grid Computing: Making The Global Infrastructure a Reality, Wiley, 2003.
3. Maozhen Li, Mark Baker, The Grid: Core Technologies, Wiley, 2005.

M.Tech. I Year I Semester

16CSE201 ADVANCED DATA STRUCTURES USING PYTHON PRACTICALS

L	T	P	C
0	0	3	2

Course Description:

This course will introduce the core data structures of the Python programming language. In this Course, Students are able to implement Data Structures using python Language.

Course Objectives:

- To develop skills to design and analyze the problems.
- To inculcate the programming skills of python language.
- To make the studentsto feel comfort with the object oriented programming.

LIST OF EXPERIMENTS:

1. Linked lists
2. Multistacks
3. Double Ended Queue (Deque) & Circular Queues
4. Min Heap
5. Deaps
6. Leftist Heap
7. AVL Tree
8. B:Tree
9. Quick Sort
10. Greedy algorithm
11. Knapsack using Dynamic Programming
12. Graph coloring using backtracking

Course Outcomes:

At the end of the course, students will be able to:

1. Students can learn python language constructs.
2. Students will learn OOP concepts which will be helpful for them in further semesters.
3. Students will have basic idea on data structures.

ReferenceBooks:

- 1) "Think Python" - How to Think Like a Computer Scientist, Version 2.0.13,June 2014.
- 2) "Data Structure and Algorithmic Thinking with Python", by NarasimhaKarumanchi.
- 3) "Problem Solving with Algorithms and Data Structures", by Brad Miller, David Ranum, Release 3.0.

Course Description:

This course teaches fundamental concepts and tools needed to understand the emerging role of Data analytics in Organizations.

Course Objectives:

- This course brings together several key big data technologies used for storage, analysis and manipulation of data.
- To recognize the key concepts of Hadoop framework, MapReduce, Pig, Hive.
- To prepare a sample project in Hadoop API.

UNIT I: INTRODUCTION TO BIG DATA

Introduction to Big Data. What is Big Data? Why Big Data is Important. Meet Hadoop. Data. Data Storage and Analysis. Comparison with other systems. A brief history of Hadoop. Apache hadoop and the Hadoop EcoSystem. Linux Refresher, VMWare Installation of Hadoop. The Design of HDFS. HDFS Concepts. Command Line Interface to HDFS. Hadoop File System.

UNIT II: HADOOP MAPREDUCE

A Weather Dataset, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop-Map and Reduce, Java MapReduce, Scaling Out, Combiner Functions, Hadoop Streaming.

UNIT III: INTRODUCTION OF DATA SCIENCE

Introduction of Data Science-Getting started with R- Exploratory Data Analysis- Review of probability and probability distributions-Supervised Learning, Unsupervised Learning.

UNIT IV: INTRODUCTION TO DATA ANALYSIS WITH SPARK

What Is Apache Spark, A Unified Stack, Programming with RDDs- RDD Basics, Creating RDDs, RDD Operations, Passing Functions to Spark, Common Transformations and Actions, Persistence (Caching). Machine Learning with MLlib- Machine Learning Basics.

UNIT V: PIG & HIVE

Installing and Running Pig, Comparison with Databases, Pig Latin, User Define Functions, Data Processing Operators, Installing and Running Hive, Hive QL, Tables, Querying Data, User-Defined Functions.

Course Outcomes:

At the end of the course, students will be able to:

- 1) Understand the Basic's in Big Data Technologies and its importance.
- 2) Analyze the Big Data set by using Map Reduce.
- 3) Understand the Basic Concepts in Data Science.
- 4) Understand the RDD's in Apache Spark.
- 5) Apply tools and techniques like Pig and Hive to analyze Big Data.

Text Books:

- 1) Tom White, "Hadoop: The Definitive Guide", 3rd Edition, O'reilly, 2012.
- 2) Noreen Burlingame and Lars Nielsen, "A Simple Introduction To Data Science", 2012.
- 3) Holden Karau "Learning Spark: Lightning-Fast Big Data Analysis", O'reilly.

Reference Books:

- 1) Chuck Lam , "HADOOP IN ACTION", 2nd Edition ,2016
- 2) VigneshPrajapati, "Big Data Analytics withR and Hadoop", Published by Packt Publishing Ltd.,2013.
- 3) Michael Minelli,MicheleChambers,AmbigaDhiraj ,"BIG DATA,BIG ANALYTICS", Published by John Wiley & Sons, Inc., Hoboken, New Jersey.2013

M.Tech. I Year II Semester

16CSE107 WEB TECHNOLOGIES

L	T	P	C
4	0	0	4

Course Description:

This course focuses on the phenomenon known as the World Wide Web (WWW or Web). Its focus is to present many of the core technologies that the Web is based upon. These core technologies include:

- HTML (Hypertext Markup Language) and CSS (Cascading Style Sheets)
- Client-side Programming Using JavaScript
- Server-side Programming Using Perl, CGI and Java
- Servlets and Java

Course Objectives:

- To make the students better understanding of web concepts.
- To learn Javascript, CSS, Perl and CGI.
- To learn about Java Object Oriented Features.
- To learn about Servlets and JSP.

UNIT I: HTML, JAVASCRIPT AND CSS

HTML – Basic HTML, Document body, Text, Lists, Images, Tables, Frames.

Introduction to JavaScript, Comments, Variables, String manipulation, Mathematical functions, Statements, Operators, Arrays, Regular expressions, Exception handling, Cookies.

Cascading Style Sheets – Introduction, Using Styles, Defining your own styles, Properties and values in styles.

UNIT II: WEB HOSTING AND PERL

Putting your page on Web – How web hosting works, Domain names, Getting Web Space, Transferring Files.

Why Perl?, The basic Perl Program, Scalars, Arrays, Hashes, Control Structures, Processing text, Regular expressions, Using files, subroutines.

UNIT III: CGI SCRIPTING

What is CGI?, Developing CGI Applications, Processing CGI, Returning a basic HTML Page, Introduction to CGI.pm, CGI.pm methods, Creating HTML pages dynamically, Using CGI.pm, Adding Robustness.

UNIT IV: JAVA

Java Fundamentals Classes, Inheritance, Packages, Interfaces, Exceptions Handling, Multithreading, Applets, Swing.

UNIT V: SERVLETS AND JSP

Servlets - Introduction, Lifecycle of a Servlet, JSDK, The Servlet API, The javax.servlet Package, Reading Servlet parameters, Reading initialization parameters.

JSP - Introduction, The Problem with Servlet. The Anatomy of a JSP Page, JSP Processing. JSP Application Design with MVC architecture.

Course Outcomes:

At the end of the course, students will be able to:

1. Create user friendly interface for static and dynamic web pages with help of HTML, Javascript and CSS.
2. Apply Perl and CGI syntaxes in real world applications.
3. Apply object oriented features to real world problems.
4. Implement programs using Servlets and JSP.

Text Books:

1. Chris Bates, "Web Programming: Building Internet Applications", 3rd Edition, John Wiley & Sons. (UNIT I, II, III)
2. Matthew MacDonald, "Creating a Web Site: The Missing Manual: The Missing Manual", O'Reilly Media, Inc. (Unit II)
3. Herbert Schildt, "Java The Complete Reference", 7th Edition, Tata McGraw-Hill Education. (UNIT IV, V)
4. Hans Bergsten, "JavaServer Pages", 3rd Edition, O'Reilly Media, Inc. (UNIT V)

Reference Books:

1. Robert W. Sebesta, "Programming With World Wide Web", 4th Edition, Pearson Education.
2. Subrahmanyam Allamaraju, Cedric Buest, "Professional Java Server Programming: J2EE 1.3 Edition", Apress, 2001.
3. Jason Hunter, William Crawford, "Java Servlet Programming", "O'Reilly Media, Inc.", 2001.
4. Jim Farley, William Crawford, David Flanagan, "Java Enterprise in a Nutshell: A Desktop Quick Reference", "O'Reilly Media, Inc.", 2002

M.Tech. I Year II Semester

16CSE108 MOBILE COMPUTING

L	T	P	C
4	0	0	4

Course Description:

This course introduces the basic concepts and principles of wireless and mobile communication. This covers discussions on wireless medium access control layer, Mobile network layer, mobile transport and application layer protocols. This also introduces selected topics on WWW support in mobile devices.

Course Objectives:

- To impart fundamental concepts in the area of mobile computing.
- To provide system perspective on the converging areas of wireless networking.
- To give insights of the key components and protocols involved in Mobile network, layer, transport and application layers.
- To explore the support of World Wide Web in mobile communication.

UNIT I: INTRODUCTION TO MOBILE COMMUNICATION AND COMPUTING

Emerging applications, A short history of wireless communication, A market for mobile communications. Wireless Transmission: Frequencies for radio transmission, Signals, Antennas, Signal propagation, Multiplexing, Modulation (ASK, FSK, PSK), spread spectrum.

UNIT II: (WIRELESS) MEDIUM ACCESS CONTROL

Motivation for a specialized MAC (Hidden and exposed terminals, near and far terminals), SDMA, FDMA, TDMA, CDMA. GSM: Mobile services, System architecture, Radio Interface, Protocols, Localization and calling, Handover, Security, New data Services.

UNIT III: MOBILE NETWORK LAYER

Mobile IP - Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, tunneling and encapsulation, Dynamic Host Configuration Protocol (DHCP), Properties and Applications of a MANETs: Routing – DSDV, DSR.

UNIT IV: MOBILE TRANSPORT AND APPLICATION LAYER

Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/Fast recovery, Transmission/time-out freezing, Selective retransmission, Transaction Oriented TCP.

UNIT V: SUPPORT FOR MOBILITY

World Wide Web; Wireless Application Protocol – Architecture, Wireless datagram protocol, Wireless transport layer security, Wireless transaction protocol, Wireless session protocol, Wireless application environment, Wireless markup language.

Course Outcomes:

At the end of the course, students will be able to:

1. Realize the basic concepts of mobile computing and wireless communication.
2. Describe the components and characteristics of Mobile IP for Mobility Management and illustrate traffic routing with mobile IP
3. Assess the various GSM mobile services
4. Explore the characteristics of Mobile transport and application layer protocols
5. Analyze the framework for wireless and mobile web access

Text Books:

1. Jochen Schiller, "Mobile Communications", Addison-Wesley. (Chapters I,II,III,IV,V), Second edition, 2004.
2. Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2002.

Reference Books:

1. Theodore S. Rappaport, Wireless Communications Principles and Practice, Second Edition, Pearson Education, India. ISBN 978-81-317-3186-4, 2010.
2. Adelstein, Frank, Gupta, Sandeep KS, Richard III, Golden, Schwiebert, Loren, "Fundamentals of Mobile and Pervasive Computing", ISBN: 0071412379, McGraw-Hill Professional, 2005.
3. Hansmann, Merk, Nicklous, Stober, "Principles of Mobile Computing", Springer, second edition, 2003.

M.Tech. I Year II Semester

16CSE109 ADVANCE DATABASES

L	T	P	C
4	0	0	4

Course Description:

This course covers the core principles and techniques of data and information management. The potential topics covered include distributed DBMS, query processing, and parallel databases. This course also discusses trendy applications under the umbrella of database systems.

Course Objectives:

- To understand conceptual modeling techniques, database design and implementation.
- To get insights of DBMS system architecture and its design issues
- To have knowledge on state of the art applications of distributed database systems.

UNIT I: INTRODUCTION

Database system concepts and architecture, Data modeling using E-R model, Relational model, Relational algebra, ER to Relational model mapping, Schema Refinement, Functional Dependencies, Normal forms based on primary keys, Second and Third normal forms, Boyce-Codd normal form, properties of decompositions. Normalization, Schema refinement in database design, multivalued dependencies, fourth normal form, Join Dependencies, fifth normal form.

UNIT II: DISTRIBUTED DBMS

Introduction, Distributed DBMS architecture, DBMS standardization, Architecture models for distributed DBMSs, Distributed DBMS Architecture, Distributed database design, design strategies, design issues, fragmentation, allocation, semantic data control, view management, data security, semantic integrity control.

UNIT III - QUERY PROCESSING AND OPTIMIZATION

Query processing problem, objectives, characterization of query processors, layers of query processing, query decomposition, localization of distributed data, query optimization, centralized query optimization, join ordering in fragment queries, distributed query optimization algorithms.

UNIT IV - PARALLEL DATABASE AND DISTRIBUTED OBJECT DATABASE SYSTEMS

Database servers, Parallel architectures, Parallel DBMS techniques, Parallel execution problems, Parallel execution for hierarchical architecture, Fundamental object concepts and object models, Object distributed design, Architectural issues, Object management, Distributed object storage, Object query processing, Transaction management.

UNIT V: CURRENT ISSUES

Data warehousing–data mining, mobile database, multimedia database, geographic information systems, genome data management, Peer-to-Peer Data Management, Web Data Management-Streaming Data and Cloud Computing

Course Outcomes:

At the end of the course, students will be able to:

1. Construct the conceptual model and relational model for the given database application and Refine the schema using Functional dependencies and normal forms
2. Investigate the concepts in distributed database system design and maintenance of data integrity
3. Optimize the query processing by exploiting a large amount of useful information about the data
4. Exhibit the advantages and disadvantages of the various parallel database system architectures.
5. Apply the knowledge on state of the art applications which are based on database model

Text Books:

1. RamezElmasri&Shamkant B. Navethe, Fundamentals of Database Systems, fourth Edition, Pearson Education, 2004. (Unit I)
2. Tamer Ozs. M., Patrick Valduriez, Principles of Distributed Database Systems, Third Edition, Springer, 2011. (Unit II, III, IV, & V)

Reference Books:

1. Abraham Silberchatz, Henry F. Korth, S.Sudarsan, Database System Concepts, Fifth Edition, McGraw-Hill, 2006. (Unit I)
2. Stefano Ceri, Giuseppe Pelagatti, Distributed Databases Principles and Systems, McGraw-Hill International Editions, 1985.
3. Rajesh Narang, Object Oriented Interfaces and Databases, Prentice Hall of India, 2002.

M.Tech. I Year II Semester

16CSE110 INFORMATION SECURITY AND CYBER FORENSICS

L	T	P	C
4	0	0	4

Course Description:

The course provides a comprehensive view of symmetric and asymmetric cryptographic schemes, the network security principles and measures to prevent vulnerabilities and security attacks in the networks, knowledge in the various functions of Operating Systems and methods to secure operating systems, Forensic Incident, duplication, file system, Network Forensics.

Course Objectives:

1. Understand the classic & public key cryptosystems, hash functions.
2. Learn and understand the next generation Internet protocol.
3. Acquire fundamental knowledge on the concepts of securing operating systems
4. Become knowledgeable in various methods and protocols to maintain E-mail security , and web security
5. Plan and prepare for all stages of a Cyber & Forensic Incidents and Network Forensics

UNIT - I: INTRODUCTION

Services, Mechanisms and attacks-the OSI security architecture-Network security model classical Encryption techniques, Data Encryption Standard-Block cipher principles, Advanced Encryption Standard (AES), Principles of public key cryptosystems-The RSA algorithm-Key management -Diffie Hellman Key exchange, Authentication functions-Message authentication codes-Hash functions-Hash Algorithms (Secure Hash Algorithm)

UNIT-II: NEXT GENERATION INTERNET PROTOCOL

Introduction to IPv6 – IPv6 Advanced Features –V4 and V6 header comparison – V6 Address types –Stateless auto configuration – IPv6 routing protocols – IPv4-V6 Tunneling and Translation Techniques.

UNIT-III: OPERATING SYSTEM SECURITY

Security in Windows and LINUX/Unix: Protection system, authorization, security analysis and vulnerabilities- The security kernel- Secure communications processor – Retrofitting security into operating systems

UNIT-IV: WEB SECURITY

SSL/TLS Basic Protocol Plan and prepare for all stages of a Forensic Incidents and Network Forensics-computing the keys- client authentication-PKI as deployed by SSL Attacks fixed in v3- Exportability-Encoding-Secure Electronic Transaction (SET), Kerberos, Security Services for E-mail-attacks possible through E-mail-Pretty Good Privacy-S/MIME.

UNIT-V: CYBER & FORENSICS

Cyber Security and its problem-Intervention Strategies: Redundancy, Diversity and Autarchy, Cyber security in Society, Security in cyber laws. Forensics Incident - Incident Response Methodology, Forensic duplication, Forensic Analysis of File Systems, Network Forensics: Network Protocols - Email Tracing - Internet Fraud, Ethical Issues - Cybercrime.

Course Outcomes:

At the end of the course, students will be able to:

1. Understand the classic & public key cryptosystems, hash functions.
2. Identify & compare the next generation Internet protocol.
3. Able to apply the security concepts on operating systems
4. Chose various methods and protocols to maintain E-mail security, and web security.
5. Illustrate for all the stages of Cyber & Forensic Incidents and Network Forensics

TEXT BOOKS-

1. William Stallings, "Cryptography and Network Security", Pearson Education, 6th Edition, 2013, ISBN 10: 0133354695
2. Kevin Mandia, Chris Prorise, "Incident Response and computer forensics", Tata McGrawHill, 2006

REFERENCE BOOKS:

1. Trent Jaeger, Operating Systems Security, Morgan & Claypool Publishers, 2008
2. Michael J. Palmer, Guide to Operating Systems Security, Thomson/Course Technology, 2004
3. Jonathan Rosenoer, "Cyber Law: The law of the Internet", Springer-Verlag, 1997

M.Tech. I Year II Semester – Elective II

16CSE404 CLOUD COMPUTING

L	T	P	C
4	0	0	4

Course Description:

Cloud computing is a key distributed systems paradigm that has grown popular in the last few years. Cloud technologies are pervasive, touching our daily lives any time we access the World Wide Web, use a mobile app, or make a retail purchase. Clouds are also the de facto infrastructure for "Big Data" applications.

Course Objectives:

- To impart fundamental concepts in the area of cloud computing.
- To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.
- To enable students exploring some important cloud computing driven commercial systems such as GoogleApps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.

UNIT I: CLOUD COMPUTING BASICS

Cloud Computing Overview, Applications, Intranets and the Cloud, First Movers in the Cloud, Your Organization and Cloud Computing-When You Can Use Cloud Computing, Benefits, Limitations, Security Concerns, Regulatory Issues, Cloud Computing with the Titans, The Business Case for going to the Cloud-Cloud Computing Services, How Those Applications Help Your Business, Deleting Your Datacenter, Salesforce.com

UNIT II: CLOUD COMPUTING TECHNOLOGY

Hardware and Infrastructure, Accessing the Cloud, Cloud Storage, Standards.

UNIT III: CLOUD COMPUTING AT WORK

Software as a Service, Driving Forces, Company Offerings, Industries. Software plus Services.

UNIT IV: DEVELOPING APPLICATIONS

Developing Applications-Google, Microsoft, Intuit QuickBase, Cast Iron Cloud, Bungee Connect, Development, Troubleshooting, Application Management. Local Clouds and Thin Clients- Virtualization in Your Organization, Server Solutions, Thin Clients.

UNIT V: MIGRATING TO THE CLOUD

Cloud Services for Individuals, Cloud Services Aimed at the Mid-Market, Enterprise-Class Cloud Offerings, Migration. Best Practices and the Future of Cloud Computing-Analyze Your Service.

Course Outcomes:

At the end of the course, students will be able to:

- 1) Understand the systems, protocols and mechanisms to support cloud computing.
- 2) Understand the hardware and Infrastructure necessary for cloud computing

- 3) Understand the importance of software as a Service in Cloud Computing.
- 4) Design and implement a novel cloud computing application.
- 5) Understand the Migrations of the Cloud Computing.

Text Books:

1. “Cloud Computing, A Practical Approach”, by Toby Velte , Anthony Velte , Robert C. Elsenpeter , Published by The McGraw-Hill.
2. “Cloud Computing: From Beginning to End” , by Mr. Ray J Rafaels.

Reference Books:

1. Cloud Computing: Concepts, Technology & Architecture, 1st Edition , by Thomas Erl, Ricardo Puttini , Zaigham Mahmood.
2. Amazon Web Services For Dummies, 1st Edition , by Bernard Golden.
3. Handbook of Cloud Computing, by Borko Furht ,Armando Escalante, Published by Springer

M.Tech. I Year II Semester

16CSE405 RESEARCH METHODOLOGIES IN COMPUTER SCIENCE

L	T	P	C
4	0	0	4

Course Description:

This course introduces the students for doing research in general and for formulating research problems and thesis topics in particular. It covers the research methodologies, data collection and analysis, ethical and professional issues and oral and written communication skill.

Course Objectives:

- Inspiring the students towards research activities
- Encouragement of the students to deeply study research subjects and domains of their choice
- Analyze the data using technical tools
- Learning to write a research paper and thesis

UNIT I: RESEARCH APTITUDE

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is done.

UNIT II: RESEARCH PROCESS

Reviewing the literature, Formulation of research problem, Nature and type of variables, Hypothesis - meaning, types, development of hypothesis and its testing, Meaning & Functions of Research Design

UNIT III: DATA ANALYSIS & RESEARCH METHODS

Sources, acquisition and interpretation of data, Quantitative and qualitative data, Graphical representation and mapping of data, Optimization with EXCEL Solver, Summarizing Data with Histograms and Descriptive Statistics. Research methods – Experimental method, Simulation method and Theoretical method.

UNIT IV: REPORT WRITING

Different Steps in writing Report, Layout of the Research Report, Types of Reports, Mechanics of Writing a Research Report, Art of scientific writing- Steps to better writing, flow method, organization of material and style, Drawing figures, graphs, tables, footnotes, references etc. in a research paper

UNIT V: USING INTERNET FOR RESEARCH

Use of internet networks in research activities in searching material, paper downloading, submission of papers, relevant websites for journals and related research work. Introduction to Patent laws etc., process of patenting a research finding, Copy right, Cyber laws.

Course Outcomes:

At the end of the course, students will be able to:

1. Recognize the main research methodologies used in computer science and choose the appropriate research methodology.
2. Perform an appropriate literature review.
3. Describe the most common data collection and analysis methods used in Computer Science research.
4. Communicate both orally and in writing as a manuscript and submission of manuscript through Internet by following the Cyber laws.
5. How to patent the research

References:

1. *Research Methodology Methods and Techniques*, Kothari, C. R., Wiley Eastern Ltd.
2. *Microsoft Excel Data Analysis and Business Modeling*, Wayne L. Winston, Microsoft Press, ISBN: 0735619018
3. *From Algorithms to Z-Scores: Probabilistic and Statistical Modeling in Computer Science*, Professor Norm Matloff, University of California, Davis, 2013.
4. *Research Methodology: a step-by-step guide for beginners*, Kumar, Pearson Education.
5. *Practical Research Methods*, Dawson, C., UBSPD Pvt. Ltd.
6. *Research Methodology*, Sharma, N. K., KSK Publishers, New Delhi.

M.Tech. I Year II Semester – Elective II

16CSE406 SOFTWARE QUALITY ASSURANCE AND TESTING

L	T	P	C
4	0	0	4

Course Description:

This course covers the software quality assurance frame work with different software quality metrics and methodologies. It also covers the concepts of optimistic testing techniques and a variety of testing tools.

Course Objectives:

- To learn the concepts of software quality assurance framework
- To understand the process of software testing throughout the software development process
- To analyze software quality assurance metrics, difficulties and limitations
- To interpret the knowledge of testing tools

UNIT I: SOFTWARE QUALITY ASSURANCE FRAMEWORK AND PLAN

Software Quality Assurance Framework and Standards SQA Framework: What is Quality? Software Quality Assurance, Components of Software Quality Assurance – Software Quality Assurance Plan: Steps to develop and implement a Software Quality Assurance Plan – Quality Standards: ISO 9000 and Companion ISO Standards

UNIT II: SOFTWARE QUALITY ASSURANCE METRICS AND MEASUREMENT SOFTWARE QUALITY METRICS

Product Quality metrics, In-Process Quality Metrics, Metrics for Software Maintenance, Examples of Metric Programs.

UNIT III: SOFTWARE QUALITY METRICS

Software Quality metrics methodology: Establish quality requirements, Identify Software quality metrics, Implement the software quality metrics, analyze software metrics results, validate the software quality metrics – Software quality indicators – Fundamentals in Measurement theory .

UNIT IV: SOFTWARE TESTING TECHNIQUES

Black-Box, Boundary value, Bottom-up, Branch coverage, Cause-Effect graphing, CRUD, Database, Exception, Gray-Box, Histograms, Inspections, JADs, Pareto Analysis, Prototyping, Random Testing, Risk-based Testing, Regression Testing, Structured Walkthroughs, Thread Testing, Performance Testing, White-Box Testing .

UNIT V: SOFTWARE TESTING TOOLS

Taxonomy of Testing tools, Methodology to evaluate automated testing tools, Load Runner, Win runner and Rational Testing Tools, Java Testing Tools, JMetra, JUNIT and Cactus.

Course Outcomes:

At the end of the course, students will be able to:

1. Understand the effective strategies, methods and technologies of software testing
2. Design test plan and test cases to perform automatic testing

3. Apply effective software testing techniques in software development
4. Report clear and correct software defectives
5. To select distinguished tool for software testing

Text Books:

1. Effective Methods for Software Testing, 2nd Edition, William E. Perry , Second Edition, Wiley India, 2006.
2. Software Quality, Mordechai Ben-Menachem/Garry S. Marliss, Thomson Learning publication,1997.

Reference books:

1. Testing and Quality Assurance for Component-based Software, by Gao, Tsao and Wu, Artech House Publishers
2. Software Testing Techniques, by Borjes Beizer, Second Edition, Dreamtech Press
3. Handbook of Software Quality Assurance, by G. Gordon Schulmeyer, James I.McManus, Second Edition, International Thomson Computer Press
4. Metrics and Models for Software Quality Engineering, by Stephen H. Kan, by Pearson Education Publication.
5. Software Testing Tools, K.V.K.K. Prasad, Dream tech press, 2008.

M.Tech. I Year II Semester

16CSE202 DATA ANALYTICS AND WEB TECHNOLOGIES PRACTICALS

L	T	P	C
0	0	3	2

Course Description:

Big Data Analytics Practical's will make students work on Different Eco Systems in Hadoop and make students to analyze the different Data Sets. Web Technologies course is intended to teach the basics involved in publishing content on the World Wide Web. This includes the following.

- HTML (Hypertext Markup Language) and CSS (Cascading Style Sheets)
- Client-side Programming Using JavaScript
- Server-side Programming Using Perl, CGI and Java
- Servlets and Java

Course Objectives:

- Understand Hadoop HDFS Commands.
- Learn Basic Map Reduce in Hadoop
- Understand the Basics in R.
- Learn Apache Spark.
- Understand Pig and Hive concepts
- To learn HTML, Javascript, CSS and Perl
- To learn about Java, Servlets and JSP.

LIST OF EXPERIMENTS: DATA ANALYTICS

Week 1

Implement the following file management tasks in Hadoop:

- 1) Adding files and directories
- 2) Retrieving files
- 3) Deleting files

Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.

Week 2

Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.

Week 3

Data Analysis using R

- 1) Verify an R installation
- 2) Work with R scripts and objects from the R console
- 3) Create visualizations from R
- 4) Create and access data within R data structures

Week 4

Data Analysis using Apache Spark

Install and Run Spark then write Python scripts to Creating RDD's , group, join, project, and filter your data.

Week 5,6 PIG

Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.

Week 7,8: HIVE

Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes

LIST OF EXPERIMENTS: WEB TECHNOLOGIES

Week 1

- a) Creation of college website
- b) Develop an Image gallery web page. Use Javascript & CSS

Week 2

- a) Write a javascript program to validate user credentials through cookies.
- b) Write perl programs for client side validation on registration page.

Week 3

Write a CGI script to validate user credentials through cookies.

Week 4

- a) Develop an applet that displays a simple message.
- b) Develop an applet that receives an integer in one text field, and computes its factorial value and returns it in another text field, when the button named - Compute is clicked.

Week 5

- a) Design a registration page with help of java swing.
- b) Design and Develop a simple Calculator with the help of user defined packages.

Week 6

- a) Write a java program to connect to a database server using JDBC and insert 10 students information of user choice in to student table.
- b) Develop a Servlet to validate user name and password stored in database. Display authorized user if she/he is authorized else display unauthorized user.

Week 7

Write JSP Program to store student information sent from registration page into database table.

Week 8

Develop a program to validate username and password that are stored in Database table using JSP.

Course Outcomes:

At the end of the course, students will be able to

1. Apply HDFS Commands.
2. Apply Map Reduce algorithms for various problems.
3. Design a program that uses Map Reduce to apply on structured data.
4. Design static and dynamic web pages with help of HTML, Javascript and CSS.
5. Apply Perl and CGI syntaxes in real world applications.
6. Create Java, Servlet and JSP programs that solve simple business problems.

Reference Books:

1. Chris Bates, “Web Programming: Building Internet Applications”, 3rd Edition, John Wiley & Sons.
2. Herbert Schildt, “Java The Complete Reference”, 7th Edition, Tata McGraw-Hill Education.
3. Hans Bergsten, “JavaServer Pages”, 3rd Edition, O’Reilly Media, Inc.
4. Tom White, “Hadoop: The Definitive Guide”, 3rd Edition, O’reilly, 2012.
5. Holden Karau, “Learning Spark: Lightning-Fast Big Data Analysis”, O’reilly