ACHARYA NAGARJUNA UNIVERSITY

A State Government University, Accredited with "A" Grade by NAAC

Nagarjuna Nagar - 522 510, Guntur, Andhra Pradesh, India.

M.Tech. Computer Science and Engineering

SYLLABUS

2023 - 2024 onwards

Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

PROGRAM CODE: ANUCETPG04

Revised Regulations,
Scheme of Instructions,
Examination and Syllabi

for

COMPUTER SCIENCE AND ENGINEERING

2-Year M.Tech. Degree Course
(Semester System)

w.e.f. 2023-2024

ABOUT UNIVERSITY

ACHARYA NAGARJUNA UNIVERSITY (ANU)

- A Brief Profile

Acharya Nagarjuna University, a State University established in 1976, has been constantly striving towards achieving progress and expansion during its existence for over four decades, in terms of introducing new courses in the University Colleges, affiliated colleges and professional colleges. Spread over 300 acres of land on the National High Way (NH-16) between Vijayawada and Guntur of Andhra Pradesh, the University is one of the front ranking and fastest expanding Universities in the state of Andhra Pradesh. The University was inaugurated on 11th September, 1976 by the then President of India, Sri Fakruddin Ali Ahmed and celebrated its Silver Jubilee in 2001. The National Assessment and Accreditation Council (NAAC) awarded "A" grade to Acharya Nagarjuna University and also has achieved 108 International ranks, 39 National ranks UI Green Metrics rankings and many more It is named after Acharya Nagarjuna – one of the most brilliant preceptors and philosophers, whose depth of thought, clarity of perception and spiritual insight were such that even after centuries, he is a source of inspiration to a vast number of people in many countries. The University is fortunate to be situated on the very soil where he was born and lived, a soil made more sacred by the aspiration for light and a state of whole someness by generations of students. With campus student strength of over 5000, the University offers instruction for higher learning in 68 UG & PG programs and guidance for the award of M.Phil. and Ph.D. in 48 disciplines spread over six campus colleges and one PG campus at Ongole. It also offers 160 UG programs in 440 affiliated colleges in the regions of Guntur and Prakasam Districts. It has a Centre for Distance Education offering 87 UG & PG programs. Characterized by its heterogeneous students and faculty hailing from different parts of the state and the country, the University provides most hospitable environment for pursuing Higher Learning and Research. Its aim is to remain connected academically at the forefront of all higher educational institutions. The University provides an excellent infrastructure and on- Campus facilities such as University Library with over one lakh books & 350 journals; Computer Centre; University Scientific Instrumentation Centre; Central Research Laboratory with Ultra-modern Equipment; Well-equipped Departmental Laboratories; Career Guidance and Placement Cell; Health Centre; Sports Facilities with Indoor & Outdoor Stadiums and Multipurpose Gym; Sports Hostel; Separate hostels for Boys, Girls, Research Scholars and International Students; Pariksha Bhavan (Examinations Building); Computers to all faculty members; Wi-Fi connectivity to all Departments and Hostels; Canteen, Student Centre & Fast-food Centre; Faculty Club; Dr. H.H. Deichmann & Dr. S.John David Auditorium cum Seminar Hall; Post office; Telecom Centre; State Bank of India; Andhra Bank; Energy Park; Silver Jubilee Park; Fish ponds; internet center; xerox center; cooperative stores; Water harvesting structures.

VISION, MISSION & OBJECTIVES OF THE UNIVERSITY

ACHARYA NAGARJUNA UNIVERSITY

VISION

To generate sources of knowledge that dispels ignorance and establish truth through teaching, learning and research.

MISSION

To promote a bank of human talent in diversified faculties – Commerce & Management Studies, Education, Engineering & Technology, Humanities, Law, Natural Sciences, Pharmacy, Physical Education & Sports Sciences, Physical Sciences and Social Sciences that would become an investment for a prosperous society.

OBJECTIVES

- To inspire and encourage all who would seek knowledge through higher education and research.
- To provide quality instruction and research for the advancement of science and technology.
- To promote teaching and research studies in disciplines of societal relevance.
- To bridge the gap between theory and practice of the principles of higher education.
- To develop human talent necessary for the industry.
- To open up avenues of higher education and research through non-formal means.
- To invite and implement collaborations with other institutes of higher learning on a continuous basis for mutual academic progress.
- To motivate and orient each academic department/center to strive for and to sustain advanced levels of teaching and research so that the university emerges as an ideal institute of higher learning.
- To focus specially on the studies involving rural economy, justifying its existence in the rural setting.

VISION
&
MISSION OF THE COLLEGE

ACHARYA NAGARJUNA UNIVERSITY

Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

ABOUT ANUCET

The ANU college of Engineering & Technology is established in the academic year 2009-2010 in the University campus under the able leader ship of the Vice-chancellor, Prof. Hara Gopal Reddy. The College offers UG and PG courses that include B.Tech. and M.Tech. The college commenced its operations with an annual intake of 60 into 5 branches of B.Tech. (Civil Engineering, Computer Science Engineering, Electronics & Communication Engineering, Electrical & Electronics Engineering & Mechanical Engineering) and 20 into 5 branches of M.Tech. The institution has been growing from strength to strength and got recognition in limited period.

VISION OF THE COLLEGE

ANU College of Engineering & Technology is started with an aim of imparting technical values in the students, who can change the shape of global scenario in engineering arena.

MISSION OF THE COLLEGE

- To educate students for careers of leadership, innovation in engineering and its related fields.
- To expand the base of engineering knowledge through original research and by developing technology to serve the needs of society.

OBJECTIVES

- ★ To inspire and encourage all knowledge seekers of higher education and research.
- ★ To provide quality instruction and research for the advancement of science and technology.
- ★ To promote teaching and research studies in disciplines of societal relevance.
- ★ To bridge the gap between theory and practice.
- ★ To develop human talent necessary for the industry.

VISION & MISSION OF THE DEPARTMENT

ACHARYA NAGARJUNA UNIVERSITY

Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

M.Tech. Computer Science and Engineering

VISION OF THE DEPARTMENT:

To be in the frontiers of Computer Science and Engineering with academic excellence and Research.

MISSION OF THE DEPARTMENT:

M1: Educate students with the best practices of Computer Science by integrating the latest research into the curriculum.

M2: Develop professionals with sound knowledge in theory and practice of Computer Science and Engineering.

M3: Facilitate the development of academic-industry collaboration and societal outreach programs.

M4: Prepare students for full and ethical participation in a diverse society and encourage lifelong learning.

ACHARYA NAGARJUNA UNIVERSITY

Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

M.Tech. Computer Science and Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEO's):

- **PEO1:** Practice engineering in a broad range of industrial, societal and real world applications.
- **PEO2:** Pursue advanced education, research and development, and other creative and innovative efforts in science, engineering, and technology, as well as other professional careers.
- **PEO3**: Conduct themselves in a responsible, professional, and ethical manner.
- **PEO4**: Participate as leaders in their fields of expertise and in activities that support service and economic development throughout the world.

PROGRAM OUTCOMES (PO's):

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO1	An ability to Understand the theoretical and mathematical concepts to analyze real time problems.
PSO2	An Ability to Design and Analyze systems based on the theoretical and Practical Knowledge

ACHARYA NAGARJUNA UNIVERSITY:: NAGARJUNA NAGAR

REVISED REGULATIONS FOR TWO - YEAR M.TECH. DEGREE COURSE
(CHOICE BASED CREDIT SYSTEM)

(With effect from the batch of students admitted during the A.Y. 2023-2024)

1.1 ELIGIBILITY FOR ADMISSION

1.2 The candidates, both non-sponsored and sponsored, for Admissioninto M.Tech programme shall have one of the following qualifications.

S.No.	Programme	Qualifications
1.	Chemical Engineering	Bachelor Degree in Chemical Engineering / Chemical Technology / Biotechnology or its equivalent Degree recognized by Acharya Nagarjuna University
2.	Civil Engineering	Bachelor Degree in Civil Engineering or its equivalent Degree recognizedby Acharya Nagarjuna University
3.	Computer Science & Engineering	B.Tech / B.E Computer Science and Engineering / Information Technology / M.C.A / M.Sc., Computers / M.Sc., Electronics / M.Sc., Mathematics or its equivalent Degree recognized by Acharya Nagarjuna University.
4.	Electrical and Electronics Engineering	Bachelor Degree in Electrical & Electronics Engineering / Electrical Engineering / Electrical Power Engineering / AMIE (Electrical Engineering) or its equivalent Degree recognized by Acharya Nagarjuna University.
5.	Electronics and Communication Engineering	Bachelor Degree in Electronics & Communication / Electronic & Instrumentation Engineering / AMIE or its equivalent Degree recognized by Acharya Nagarjuna University.
6.	Information Technology	B.Tech / B.E Computer Science and Engineering / Information Technology / M.C.A / M.Sc., Computers / M.Sc., Electronics / M.Sc., Mathematics or its equivalent Degree recognized by Acharya Nagarjuna University.
7.	Mechanical Engineering	Bachelor Degree in Mechanical Engineering or its equivalent Degree recognized by Acharya Nagarjuna University.

1.3 Admission of Non-sponsored category students: Admission of non-sponsored category students is made on the basis of GATE/PGECET rank. When GATE/PGECET qualified candidates are not available, admission will be on the basis of merit in the qualifying examination. Students with or without GATE/PGECET rank should have obtained a minimum of 50% marks in the qualifying examination to become eligible for admission.

Reservation of seats to the candidates belonging to Scheduled Castes and Scheduled Tribes is as prescribed by the State Govt./University fromtime to time. If suitable candidates are not available to fill all the seats reserved for S.T category, they shall be filled by students S.C. Category and vice-versa.

If suitable candidates are not available for reserved seats, they shall be filled by the general category candidates.

1.4 Admission of Sponsored Category students: Sponsored categorystudents should have at least 50% marks in the qualifying examinationto become eligible for admission to the Post Graduate Program.Preference will be given to those candidates who are GATE/PGECET qualified.

The candidates must have a minimum of two years of full-time work experience in a registered firm / company/ industry / educational and research institutions / any government department or government autonomous organizations in the relevant field in which the admission is being sought.

A letter from the employer must be furnished stating that the candidate is being sponsored to get admission. The employer should also indicate that the candidate will not be withdrawn midway till the completion of the course. The rule of reservation shall not apply to the admission of sponsored category students.

1.5 The total number of full-time candidates admitted into a course withor without GATE/PGECET rank should not exceed the sanctioned strength.

2.0 MEDIUM OF INSTRUCTION, DURATION AND STRUCTURE

2.1. The total number of full-time candidates admitted into a course withor without GATE/PGECET rank should not exceed the sanctioned strength.

2.2. The medium of instruction shall be in English.

2.3. The minimum and maximum period for completion of the P.G. Program is 4 Semesters for full time students.

2.4. Each Semester shall normally spread over sixteen weeks.

(a) The Programme may consist of
    i. Core Courses
    ii. Elective Courses
    iii. Seminars
    iv. Internship
    v. Project Work

(b) The structure of the Programme comprises of two semesters of course work consisting of 6 Core subjects + 6 Elective subjects and 3 Lab courses + 1 Mini Project / Seminar (or) 2 Lab courses + 2 Seminars / Mini Project, followed by two semesters of Project work. In summer break, the student should undergo internship for four weeks duration. The student should present a seminar on the project work done at the end of the third semester. At the end of fourth semester the students should submit Project Thesis.

(c) Core subjects are fixed in each semester and a student must opt them without any choice. Whereas electives can be chosen by a student from the list of electives given (minimum 18 and maximum 24) according to his choice.

2.5. Project work shall be carried out under the Supervision of a Faculty Member in the concerned department.

2.6. A candidate may, however, in certain cases, be permitted to workon his Project/Dissertation at the place of employment, any recognized Institution/R&D Organization/Industry with the approval of the Head of the Department concerned and Head of the Organization. In such cases, the Project Work shall be jointly supervised by a member of the faculty and a person from the Organization holding a minimum of P.G. Degree in the concerned area of specialization.

2.7. Five copies of the Project Report certified by the Supervisor(s) and the Head of the Department concerned shall be submitted within one Calendar Year after completion of the second semester.

2.8. The student is eligible for the submission of M.Tech. Project Report at the end of fourth semester if he/she passed all the course work in the first & second semesters.

2.9. In a special case, if any candidate unable submit his/her Project Report at the end of fourth semester due to ill health or any other reason permitted by the head of the institution, he/she will be allowed submit at a later date and the viva-voce examination will be conducted, if clause 2.7is satisfied.

3.1 ATTENDANCE

3.2 The candidate shall put up a minimum of 75% attendance in each subject.

3.3 Condonation of shortage in attendance up to 10% in any subject may be condoned by the University on the recommendations of the Principal of the concerned College for reasons of ill health and the application is submitted at the time of actual illness and is supported by acertificate from the authorized Medical Officer approved by the Principal.

3.4 If the candidate does not satisfy the attendance requirement in any subject he or she shall not be permitted to appear for the University examination in that subject and has to repeat that subject when next offered or study any other specified subject as may be required. In case of repetition the new internal marks will be taken intoamount.

3.5 Failure in securing minimum prescribed attendance in any subject of previous Semester (s) is no bar for enrollment to the next semester.

4.1 EVALUATION

4.2 The performance of the candidate in each semester shall be evaluated subject wise. The maximum marks for each subject, seminar etc, will be as prescribed in the curriculum. The Internal Evaluation for Theory subjects shall be based on two mid-term examinations and two assignments. In every theory subject, out of 40 sessional marks, 30 marks are allotted to mid-term examination and 10 marks for assignments. The best of the performances in the two midterm examinations, one held in the middle of the semester and another held immediately after the completion of the instruction, will be considered.The internal evaluation for practical subjects is based on the day-to-day performance and semester end internal practical Examination.

4.3 The marks for Seminar will be awarded by internal evaluation made by two staff members of the faculty of the department concerned.

4.4 For taking the University examination in any theory or practical subject, candidates shall be required to obtain a minimum of 50% marks in Internal evaluation in that subject failing which he/she shall be requiredto repeat the course in that subject when next offered or study any other specified subject as may be required. In case of repetition the newinternal marks will be taken into amount.

4.5 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he or she secures a minimum of50% marks in internal evaluation.

4.6 In case the candidate does not secure the minimum academic requirement in any subject he/she has to reappear in the University examination in that subject or any equivalent subject prescribed.

4.7 Failure to attain the minimum academic requirement in any subject of previous semester (s) is no bar for enrollment to the next semester.

4.8 The performance of the students in each semester shall be evaluated subject wise The distribution of marks between sessional work (based on internal assessment) and University Examination will be as follows:

Nature of the subject	Sessional	University
	Marks	Exam. Marks
Theory subjects	40	60
Practical's	40	60
Seminar / Internship / Project Seminar	100	--
Project work	50	150 (viva voce)

5.0 AWARD OF CREDITS

Credits are awarded for each Theory/Practical/Seminar/Project Subjects. Each theory subject is awarded 4 credits and each practical/Seminar subjects is awarded 2 credits. Project seminar in III Semester is awarded 8 credits and Project Viva-voce at the end of IV Semester is awarded 16 credits.

6.1 AWARD OF GRADES

S.No.	Range of Marks	Grade	Grade Points
1	≥85%	S	10.0
2	75%-84%	A	9.0
3	65%-74%	B	8.0
4	60%-64%	C	7.0
5	55%-59%	D	6.0
6	50%-54%	E	5.0
7	≤49%	F(Fail)	0.0
8	The grade 'W' represents withdrawal / absent (subsequently changed into pass or E to S or F grade in the same semester)	W	0.0

A Student securing 'F' grade in any subject there by securing 0 grade points has to reappear and secure at least 'E' grade at the subsequent examinations in that subject

'W' denotes withdrawal/absent for a subject:

- After results are declared and Grade sheets will be issued to each student which will contain the following details:
- The list of subjects in the semester and corresponding credits and Grade obtained

- The Grade point average(GPA) for the semester and

- The Cumulative Grade Point Average(CGPA) of all subjects put together up to that semester from first semester onwards

GPA is calculated based on the fallowing formula:

$$\frac{\text{Sum of [No.Credits X Grade Point]}}{\text{Sum of Credits}}$$

CGPA will be calculated in a similar manner, considering all the subjects enrolled from first semester onwards.

7.0 AWARD OF DEGREE AND CLASS

A candidate who becomes eligible for the award of the degree shall be placed in the following three divisions based on the CGPA secured by him/her for the entire Programme

S.No.	Class	CGPA
1	First Class With Distinction	8.0 or more
2	First Class	6.5 or more but less than 8.0
3	Second Class	5.0 or more but less than 6.5

8.1 WITH-HOLDING OF RESULTS

The result of a candidate may be withheld in the following cases.

i. The candidate has not paid dues to the institution.
ii. A case of indiscipline is pending against the candidate.
iii. A case of malpractice in examination is pending against the candidate The issue of degree is liable to be withheld in such cases.

9.1 GENERAL

9.2 The University reserves the right of altering the regulations as and when necessary.

9.3 The regulations altered will be applicable to all the candidates on the rolls Irrespective of the fact that the regulations at the time of admission of the student to the programme are different.

9.4 The Academic Regulations should be read as a whole for purpose of any Interpretation Whenever there is a dispute regarding interpretation of regulations, the decision of the Vice-Chancellor is final.

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ACHARYA NAGARJUNA UNIVERSITY, NAGARJUNA NAGAR

SCHEME OF EXAMINATION AND INSTRUCITON FOR

M.TECH (COMPUTER SCIENCE AND ENGINEERING)FIRST

SEMESTER

S.No.	Code No. & Subject	Hours / Week		Credits	Evaluation of Marks		Total
		L	P		INT	EXT	
1	CSE 511: Advanced Data Structures & Algorithms	4	--	4	40	60	100
2	CSE 512: Principles of Cloud Computing	4	--	4	40	60	100
3	CSE 513: Data Analytics	4	--	4	40	60	100
4	Elective Subject – 1	4	--	4	40	60	100
5	Elective Subject – 2	4	--	4	40	60	100
6	Elective Subject – 3	3	2	4	40	60	100
7	CSE 551: Advanced Data Structures & Algorithms Lab	--	3	2	40	60	100
8	CSE 552:Data Analytics Lab	--	3	2	100	--	100
TOTAL		**24**	**6**	**28**	**380**	**420**	**800**

SECOND SEMESTER

S.No.	Code No. & Subject	Hours / Week		Credits	Evaluation of Marks		Total
		L	P		INT	EXT	
1	CSE-514:Machine Learning	4	--	4	40	60	100
2	CSE-515: High Performance Computing	4	--	4	40	60	100
3	CSE-516: Cyber Security	4	--	4	40	60	100
4	Elective Subject – 4	4	--	4	40	60	100
5	Elective Subject – 5	4	--	4	40	60	100
6	Elective Subject – 6	3	2	4	40	60	100
7	CSE-553: Machine Learning Lab	--	3	2	40	60	100
8	CSE-554: Term Paper	--	3	2	100	--	100
TOTAL		**24**	**6**	**28**	**380**	**420**	**800**

LIST OF ELECTIVE SUBJECTS:

I Semester Subjects		II Semester Subjects	
Subject Code	**Subject Title**	**Subject Code**	**Subject Title**
CSE 611	Image Processing	CSE 623	Block Chain Technology
CSE 612	Information Retrieval	CSE 624	Geographic Information System
CSE 613	Mobile Communications	CSE 625	Digital Forensics
CSE 614	Artificial Intelligence	CSE 626	Natural Language Processing
CSE 615	Semantic Web Technologies	CSE 627	Software Defined Networks
CSE 616	Information Security	CSE 628	Social Network Analysis
CSE 617	Software Project Management	CSE 629	Software Testing and Quality Assurance
CSE 618	Multimedia Computing	CSE 630	Concurrent Programming
CSE 619	Open Source Programming	CSE 631	Data Visualization
CSE 620	Bioinformatics	CSE 632	Deep Learning
CSE 621	Mobile Application Development	CSE 633	Full Stack Development
CSE 622	Internet of Things	CSE 634	Visual Programming

THIRD SEMESTER

S.No.	Code No. & Subject	Hours / Week		Credits	Evaluation of Marks		Total
		L	P		INT	EXT	
1	CSE-711: Internship/MOOCs	--	--	2	100	--	100
2	CSE-712: Project Seminar	--	--	6	100	--	100
TOTAL		**--**	**--**	**8**	**200**	**--**	**200**

FOURTH SEMESTER

S.No.	Code No. & Subject	Hours / Week		Credits	Evaluation of Marks		Total
		L	P		INT	EXT	
1	CSE-713 Project	--	--	16	50	150	200

Core Subject

CSE 511 ADVANCED DATA STRUCTURES & ALGORITHMS

L	T	P	C
4	0	0	4

Course Objectives:

1. To learn and implement hashing techniques.
2. To understand the concepts of data structures such as disjoint sets, Binary Search trees, and balanced search Trees.
3. To understand the working of graph algorithms like finding shortest paths and minimum spanning trees.
4. To learn greedy and dynamic programming algorithms.
5. To understand the string matching algorithms.

Course Outcomes:

1. Implement hashing techniques for solving the given problem.
2. Implement the concepts of data structures such as disjoint sets, Binary Search trees and balanced search Trees.
3. Implement graph algorithms like finding shortest paths and minimum spanning trees.
4. Implement greedy and dynamic programming algorithms.
5. Implement the string matching algorithms.

Course Content:

UNIT-1: 12 Hours

Hash Tables: Direct-address tables, Hash tables, Hash functions, Open addressing, perfect hashing.

Binary Search Trees: What is a binary search tree? Querying a binary search tree, Insertion and deletion, randomly built binary search trees**.**

UNIT-2: 12 Hours

Red-Black Trees: Properties of red-black trees, Rotations, Insertion, Deletion.

B-Trees: - Definition of B-trees, Basic operations on B-trees, Deleting a key from a B-tree.

Binomial Heaps: Binomial trees and binomial heaps, Operations on binomial heaps.

UNIT-3: 12 Hours

Data Structures for Disjoint Sets: Disjoint-set operations.

Elementary Graph Algorithms: Representation of graphs, Breadth-first search, Depth-first search.

Minimum Spanning Trees: Growing a minimum spanning tree, The algorithms of Kruskal and Prim.

UNIT-4: 12 Hours

Single-Source Shortest Paths: The Bellman-Ford algorithm, Single-source shortest paths in directed acyclic graphs, Dijkstra's algorithm - All-Pairs Shortest Paths -The Floyd-Warshall algorithm.

Dynamic Programming: Matrix-chain multiplication, Elements of dynamic programming, Longest common subsequence, Optimal binary search trees.

UNIT-5: 12 Hours

Greedy Algorithms: An activity-selection problem, Elements of the greedy strategy, Huffman codes, A task-scheduling problem.

String Matching: The naive string-matching algorithm, The Rabin-Karp algorithm, String matching with finite automata, The Knuth-Morris-Pratt algorithm.

Text Book(s):

1. Charles E. Leiserson, Clifford Stein, Ronald Rivest, and Thomas H. Cormen, Introduction to Algorithms, 3rd Edition, Prentice Hall India Learning Private Limited, 2010.

Reference(s):

- ★ Brad Miller and David Ranum, Problem Solving with Algorithms and Data Structures, Franklin, Beedle& Associates Inc, 2nd edition.
- ★ E.Horowitz and Sahani, Fundamentals of Data Structures.

Core Subject

CSE 512	PRINCIPLES OF CLOUD COMPUTING	L	T	P	C
		4	0	0	4

Course Objectives:

1. Different Cloud Deploy Models & Service Models in enterprise cloud environment.
2. Cloud Virtual Machines Migration and Cloud Architecture and Programming in Cloud.
3. Cloud Applications with Threads and Task Model.

Course Outcomes:

1. Understanding the key dimensions of the challenge of Cloud Computing.
2. Explain cloud computing, virtualization and classify services of cloud computing
3. Illustrate architecture and programming in cloud
4. Describe the platforms for development of cloud applications and List the application of cloud.
5. Implement Programming applications with threads and task model.

Course Content:

UNIT-1: 12 Hours

Introduction, Cloud Computing at a Glance: Introduction ,Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments, Distributed Systems, Virtualization, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka Virtualization, Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples**.**

Xen: Para virtualization, VMware: Full Virtualization, Microsoft Hyper-V.

UNIT-2: 12 Hours

Cloud Computing Architecture: Cloud Computing Architecture, Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Definition, Cloud Interoperability and Standards Scalability and Fault Tolerance Security, Trust, and Privacy Organizational.

Aspects Aneka: Cloud Application Platform, Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid Cloud Deployment Mode, Cloud Programming and Management, Aneka SDK, Management Tools.

UNIT-3: 12 Hours

Concurrent Computing: Thread Programming, Introducing Parallelism for Single Machine Computation, Programming Applications with Threads, what is a Thread? Thread APIs, Techniques for Parallel Computation with Threads, Multithreading with Aneka, Introducing the Thread Programming Model, Aneka Thread vs. Common Threads, Programming

Applications with Aneka Threads, Aneka Threads Application Model, Domain Decomposition: Matrix Multiplication.

Functional Decomposition: Sine, Cosine, and Tangent. High-Throughput Computing: Task Programming, Task Computing, characterizing a Task, Computing Categories, Frameworks for Task Computing, Task-based Application Models, Embarrassingly Parallel Applications, Parameter Sweep Applications, MPI Applications, Workflow Applications with Task Dependencies, Aneka Task-Based Programming, Task Programming Model, Developing Applications with the Task Model, Developing Parameter Sweep Application, Managing Workflows.

UNIT-4: **12 Hours**

Data Intensive Computing: Map-Reduce Programming, what is Data-Intensive Computing? Characterizing Data-Intensive Computations, Challenges Ahead, Historical Perspective, Technologies for Data-Intensive Computing, Storage Systems, Programming Platforms, Aneka Map Reduce Programming, Introducing the Map Reduce Programming Model, Example Application

UNIT-5: **12 Hours**

Cloud Platforms in Industry: Cloud Platforms in Industry, Amazon Web Services, Compute Services, Storage Services, Communication Services, Additional Services, Google AppEngine, Architecture and Core Concepts, Application Life-Cycle, Cost Model, Observations, Microsoft Azure, Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance. Cloud Applications Scientific

Applications, Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Biology: Gene Expression Data Analysis for Cancer Diagnosis, Geoscience: Satellite Image Processing, Business and Consumer Applications, CRM and ERP, Productivity, Social Networking, Media Applications, Multiplayer Online Gaming.

Text Book(s):

1. Rajkumar Buyya, Christian Vecchiola, and ThamaraiSelvi Mastering Cloud. Computing McGraw Hill Education

Reference(s):

1. Dan C. Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, Elsevier 2013.

Core Subject

CSE 513	DATA ANALYTICS	L	T	P	C
		4	0	0	4

Course Objectives:

1. Identify the field of data analytics-background and key concepts.
2. Know the basics of statistical analytics.
3. Develop and gain an understanding of probability distributions and hypothesis testing.
4. Have the knowledge of predictive analytics.
5. Analyze components and forecast the time series data.

Course Outcomes:

1. Explain the basic concepts of Data Analytics.
2. Apply probability and Sampling distributions for data modelling.
3. Develop forecasting and analytical models
4. Solve linear optimization applications by using linear optimization techniques.
5. Discuss Utilities and Decision Strategies by using decision analysis.

Course Content:

UNIT-1: 12 Hours

Introduction to Big Data Analytics: Big Data Overview, Analyst perspective on Data Repositories, State of the Practice in Analytics, Current Analytical Architecture, Emerging Big Data ecosystem and a New Approach to Analytics .

Data Analytic Life Cycle: Overview, phase 1- Discovery, Phase 2- Data preparation, Phase 3- Model Planning, Phase 4- Model Building, Phase 5- Communicate Results, Phase 6- Opearationalize.

UNIT-2: 12 Hours

Descriptive Analytics

Review of Basic Data Analytic Methods: Introduction to R,Exploratory Data Analysis, Statistical Methods for Evaluation-Hypothesis Testing, Power and Sample Size ,Type-I,II Errors, ANOVA.

Probability Distributions and Data Modeling: Basic concepts of probability, Random variables and probability distribution, Discrete Probability Distributions, Continuous Probability Distributions.

Sampling and Estimation: Statistical Sampling, Estimating Population parameters, sampling Error, Sampling Distributions, Interval Estimates, Confidence Intervals and sample size, Predictive intervals.

UNIT-3: 12 Hours

Predictive Analytics

Trend lines and Regression Analysis: Simple Linear Regression-Least –Squares Regression, Simple Linear Regression with Excel, Testing Hypothesis for Regression Coefficients.

Forecasting Techniques: Statistical Forecasting Models, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Selecting appropriate Time-Series-Based Forecasting models.

UNIT-4: 12 Hours

Advanced Analytical Theory and Methods:

Time Series Analysis: Overview of Time Series Analysis, ARIMA Model-Autocorrelation Function (ACF), Autoregressive Models, Moving Average Models.

Text Analysis: Text analysis Steps with example, Collecting Raw Text, Term Frequency-Inverse Document Frequency (TFIDF), and Categorizing Documents by Topics.

UNIT-5: **12 Hours**

Prescriptive Analytics

Linear Optimization: Building Linear Optimization Models-Identifying Elements for an Optimization model, Translating Model information into Mathematical Expression, Characteristics of Linear Optimization Models, Solving Linear Optimization Models.

Applications of Linear Optimization-Types of Constraints in optimization Models, Process Selection Models, Blending Models.

Decision Analysis: Formulating Decision Problems, Decision Strategies without Outcome Probabilities, and Decision Strategies with Outcome Probabilities, the value of information, Utility and decision making.

Text Book(s):

1. EMC Education Services (Editor) ,"Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley, March 2015.
2. James Evans, "Business Analytics, Second Edition, Pearson Publications, 2017.

Reference(s):

1. Hastie, Trevor, et al. "The elements of statistical learning." Vol. 2. No. 1. New York: springer, 2009
2. Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons, 2010.
3. SeemaAcharya R N Prasad, "Fundamentals of Business Analytics", 2nd Edition, Wiley Publications, 2016

E-resources and other digital material:

1. Ingo Mierswa, CTO & Co-Founder at RapidMiner, "From Predictive to Prescriptive Analytics",Jan 26, 2016 https://www.youtube.com/watch?v=lXdCnOQCCAE
2. Rahul, CEO, Treasury Consulting LLP, "Data Analytics - Descriptive , Predictive and Prescriptive Analytics", Dec 3,2018 https://www.youtube.com/watch?v=qYdNFqWHKQA

CSE 551	Advanced Data Structures & Algorithms Lab	L	T	P	C
		0	0	3	2

Course Objectives:

1. To learn and implement hashing techniques.
2. To understand the concepts of data structures such as disjoint sets, Binary Search trees, and balanced search Trees.
3. To understand the working of graph algorithms like finding shortest paths and minimum spanning trees.
4. To learn greedy and dynamic programming algorithms.
5. To understand the string matching algorithms.

Course Outcomes:

1. Implement hashing techniques for solving the given problem.
2. Implement the concepts of data structures such as disjoint sets, Binary Search trees and balanced search Trees.
3. Implement graph algorithms like finding shortest paths and minimum spanning trees.
4. Implement greedy and dynamic programming algorithms.
5. Implement the string matching algorithms.

List of Experiments

1. Write a C program to implement hashing techniques
    a. Separate chaining.
    b. Open addressing.
2. Write a C program to implement the following operations on a binary search tree
    a. Insert a node.
    b. Delete a node.
    c. Find a node.
    d. Traverse the tree.
3. Write a C program to implement the following
    a. Disjoint sets operations.
    b. Breadth First Search and Depth First Search using adjacency list.
4. Write a C program to implement insertion and deletion operations on a B-tree.
5. Write a C program to find minimum spanning tree of a given graph using Kruskal's algorithm.
6. Write a C program to find minimum spanning tree of a given graph using Prim's algorithm.
7. Write a C program to find the lengths of the shortest paths from a source in the given weighted graph using Bellman-Ford algorithm.
8. Write a C program to find the length of the shortest path in the given weighted graph using Dijkstra's algorithm.
9. Write a C program to solve all pairs shortest path problem using Floyd-Warshall algorithm.
10. Write a C program to implement the string matching algorithms:
    a. Naïve.
    b. Robin-Karp.
    c. KMP

CSE 552	Data Analytics Lab	L	T	P	C
		0	0	3	2

Course Objectives:

1. Identify the field of data analytics-background and key concepts.
2. Know the basics of statistical analytics.
3. Develop and gain an understanding of probability distributions and hypothesis testing.
4. Have the knowledge of predictive analytics.
5. Analyze components and forecast the time series data.

Course Outcomes:

1. Explain the basic concepts of Data Analytics.
2. Apply probability and Sampling distributions for data modelling.
3. Develop forecasting and analytical models
4. Solve linear optimization applications by using linear optimization techniques.
5. Discuss Utilities and Decision Strategies by using decision analysis.

List of Experiments

1. Introduction to R: Installing R in windows, R Console (R window to edit and execute R Commands), Commands and Syntax (R commands and R syntax), Packages and Libraries (Install and load a package in R), Help In R, Workspace in R.

2. Familiarity of Data Structures in R: Introduction to Data Types (Why Data Structures?,Types of Data Structures in R), Vectors, Matrices, Arrays, Lists, Factors, Data Frames, Importing and Exporting Data.

3. Graphical Analysis: Creating a simple graph (Using plot() command), Modifying the points and lines of a graph (Using type, pch, font, cex, lty, lwd, col arguments in plot() command), Modifying Title and Subtitle of graph (Using main, sub, col.main, col.sub, cex.main, cex.sub, font.main, font.sub arguments in plot() command).

4. Descriptive Statistics: Measure of Central Tendency (Mean, Median and Mode), Measure of Positions (Quartiles, Deciles, Percentiles and Quantiles), Measure of Dispersion (Range, Median, Absolute deviation about median, Variance and Standard deviation), Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts, Using Box Plots to compare distribution).

5. Descriptive Analytics:
   i) Generating Discrete Probability Distribution-Bernoulli distribution,Binomial distribution,Poisson Distribution
   ii) Generating Continuous Probability Distributions-Uniform distribution, Normal Distribution)

6. Comparing Population: Test of Hypothesis (Concept of Hypothesis testing, Null Hypothesis and Alternative Hypothesis), Cross Tabulations (Contigency table and their use, Chi-Square test)

7. One Sample t test (Concept, Assumptions, Hypothesis, Verification of assumptions, Performing the test and interpretation of results),.

8. Independent Samples t test (Concept, Type, Assumptions, Hypothesis, Verification of

assumptions, Performing the test and interpretation of results), Paired Samples t test (Concept, Assumptions, Hypothesis, Verification of assumptions, Performing the test and interpretation of results).

9. One way ANOVA (Concept, Assumptions, Hypothesis, Verification of assumptions, Model fit, Hypothesis testing, Post hoc tests: Fisher's LSD, Tukey's HSD).
10. Perform Time series analysis on the given data set and identify the pattern in it for forecasting.

Elective Subject

CSE 611	IMAGE PROCESSING	L	T	P	C
		4	0	0	4

Course Objectives:

1. To create basic understanding of fundamental concepts in digital image processing and enhancement in the spatial domain.
2. To demonstrate the approaches used in enhancement in the frequency domain and image segmentation.
3. To teach image restoration and image compression techniques.
4. To analyse morphological transformations, and image representation of real world Objects

Course Outcomes:

1. Define image processing systems and develop algorithms for image enhancement techniques in the spatial domain.
2. Implement enhancement techniques in the frequency domain and image segmentation
3. Develop image restoration, and image compression techniques.
4. Analyse morphological transformation algorithms, and select various descriptors for image representation.

Course Content:

UNIT-1: **12 Hours**

Introduction: Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System.

Digital Image Fundamentals: Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some basic Relationships between Pixels.

Image Enhancement in the Spatial Domain: Some Basic Grey Level Transformation, Histogram Processing, Enhancement Using Arithmetic/Logic Operations.

UNIT-2: **12 Hours**

Image Enhancement in the Spatial Domain: Basics of Spatial Filtering, Smoothing spatial Filters, Sharpening spatial Filters.

Image Enhancement in the Frequency Domain: Introduction to the Fourier Transform and the Frequency Domain, Smoothing frequency domain Filters.

UNIT-3: **12 Hours**

Image Enhancement in the Frequency Domain: Sharpening frequency-domain Filters, Holomorphic Filtering, Implementation.

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation.

UNIT-4: **12 Hours**

Image Restoration: A Model of the Image Degradation/Restoration Process, Linear, Position-Invariant Degradations, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.

Image Compression: Image Compression Models, Error-free Compression, Lossy Compression, Image Compression Standards.

UNIT-5: **12 Hours**

Morphological Image Processing: Dilation and Erosion, The Hit-or-Miss Transformation, Some basic Morphological Algorithms, Extension to Gray-Scale Images.

Representation and Description: Representation, Boundary Descriptors, Regional Descriptors.

Text Book(s):

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing' Addison Wesley Pubs (Second Edition).

Reference(s):

1. "Image Processing. Analysis, and Machine Vision ", Milan Sonka, Vaclav Hlavac, Roger Boyle (Second Edition).
2. A.K.Jain, 'Fundamentals of Digital Image Processing' PHI.

Elective Subject

CSE 612	INFORMATION RETRIEVAL	L	T	P	C
		4	0	0	4

Course Objectives:

1. Learn to write code for text indexing and retrieval. and to evaluate information retrieval systems
2. Learn to analyze textual and semi-structured data sets and evaluate information retrieval systems
3. Learn about text similarity measure
4. Understanding about search engine and Text Classification

Course Outcomes:

1. To Understand Document as Vector
2. Performance evolution metric for IR
3. To understand search Engine functionality
4. Various Supervised and Unsupervised learning Method

Course Content:

UNIT-1: **12 Hours**

Overview of text retrieval systems: Boolean retrieval, The term vocabulary and postings lists, Dictionaries and tolerant retrieval, Index construction and compression.
Retrieval models and implementation: Vector Space Models, TF-IDF Weight, Evaluation in information retrieval.

UNIT-2: **12 Hours**

Query expansion and feedback: Relevance feedback, pseudo relevance feedback, Query Reformulation.
Probabilistic models: Statistical language models, Okapi/BM25, Language models, KL-divergence, Smoothing.

UNIT-3: **12 Hours**

Text classification & Text clustering: The text classification problem, Naive Bayes text classification, k- nearest neighbors, Support vector Machine, Feature Selection.
Vector-space clustering: K-means algorithm, Hierarchical clustering, DBSCAN algorithm, PAM and PAMK, EM algorithm

UNIT-4: **12 Hours**

Web search basics, crawling, indexes, Link analysis: Web Characteristic, Crawling ,Web As a graph, Page Rank, Hubs and Authorities

UNIT-5: **12 Hours**

IR applications: Information extraction, Question answering, Opinion summarization, Social Network

Text Book(s):

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008.

Reference(s):

1. ChengXiang Zhai, Statistical Language Models for Information Retrieval (Synthesis Lectures Series on Human Language Technologies), Morgan & Claypool Publishers, 2008.

Elective Subject

CSE 613	MOBILE COMMUNICATIONS	L	T	P	C
		4	0	0	4

Course Objectives:

1. To study about Simplified Reference model, MAC Control and applications in Mobile Communications.
2. To know about the predominant communication systems in wireless domain.
3. To understand wireless LAN technologies.
4. To learn about the protocols used in Wireless Networks.

Course Outcomes:

1. Understand the basics of Wireless Transmission Technology and media access technologies.
2. Know about Wireless communication system GSM.
3. Know about satellite and digital broadcast systems and acquire knowledge of wireless LAN technologies.
4. Be aware of mobile IP, the extension of IP Protocol for mobile users.
5. Know the Architecture of WAP, the wireless application protocol used for wireless and mobile access using different transport systems.

Course Content:

UNIT-1: 12 Hours

Introduction: Applications, A short History of wireless communication, A market for mobile communications, A simplified reference model.

Wireless transmission: Frequencies for radio transmission, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum.

Medium access control: Motivation for a specialized MAC, SDMA, FDMA, TDMA, CDMA, Comparison of S/T/F/CDMA.

UNIT-2: 12 Hours

Telecommunication System: GSM- Radio Interface of GSM, Protocols of GSM, Localization and Calling, Handover, Security, New data Services- General packet radio service, High-speed circuit switched data.

Mobile Network layer: Mobile IP- IP Packet delivery, Agent Discovery, Registration, Tunneling and encapsulation, Optimizations, Dynamic host configuration protocol.

UNIT-3: 12 Hours

Mobile Transport Layer: Classical TCP improvements- Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission/time-out freezing, Selective retransmission, Transaction-oriented TCP, TCP over 2.5G/3G mobile networks.

Database and Mobile Computing: Data Organization, Database Transactional Models-ACID Rules, Query Processing, Data Recovery process, Database hoarding Techniques, Data caching, Client-Server Computing for Mobile Computing and Adaptation, Adaptation Software for Mobile Computing, Power-aware Mobile Computing, Context-aware Mobile Computing.

UNIT-4: 12 Hours

Data Dissemination and Systems for Broadcasting: Communication Asymmetry, Classification of data-delivery mechanisms, Data Dissemination broadcast models, Selective tuning and Indexing techniques, Digital Audio broadcasting(DAB), Digital video broadcasting.

Data Synchronization in Mobile Computing Systems: Synchronization, Synchronization software for Mobile devices, Synchronization protocols, SyncML-Synchronization language for mobile computing, Sync4J (Funambol), Synchronized Multimedia Markup language.

UNIT-5: **12 Hours**

Mobile Devices: Mobile Agent, Application framework, Application server, Gateways, Service discovery, Device management, Mobile file systems, Security.

Mobile Wireless Short-range Networks and Mobile Internet: Wireless LAN 802.11 Architecture and protocol layers, Wireless application protocol(WAP), Wireless application protocol WAP 2.0, Bluetooth-enabled devices network, Layers in Bluetooth protocol, Security in Bluetooth protocol, IrDA protocols, ZigBee

Text Book(s):

1. Jochen Schiller, "Mobile Communications ", 2nd ed., Pearson Education, 2003.
2. Raj Kamal, Mobile Computing, Oxford University Press.

Reference(s):

1. William Stallings, Wireless Communication Networks.
2. UWE Hansmann, LotherMerk, Martin S.Nicklous, Thomas Stober, Principles of Mobile Computing, 2nd Edition.
3. Yu-KwongR.Kwok and Vincent K.N.Lau, Wireless internet and Mobile computing, John Wiley & sons, 2007.
4. Asoke K Talukder, et al, Mobile Computing, Tata McGraw Hill, 2008.

Elective Subject

CSE 614	ARTIFICIAL INTELLIGENCE	L	T	P	C
		4	0	0	4

Course Objectives:

1. To apply a given AI technique to a given concrete problem.
2. To Implement non-trivial AI techniques in a relatively large systems.
3. To understand uncertainty and Problem solving techniques.
4. To understand various symbolic knowledge representation to specify domains and reasoning tasks of a situated software agent.
5. To understand different logical systems for inference over formal domain representations, and trace how a particular inference algorithm works on a given problem specification.
6. To understand various learning techniques and agent technology.

Course Outcomes:

1. Design intelligent agents for problem solving, reasoning, planning, and decision making, and learning. Specific design and performance constraints, and when needed, design variants of existing algorithms.
2. Apply AI technique on current applications.
3. Problem solving, knowledge representation, reasoning, and learning.
4. Demonstrating how to write a programs for Artificial Intelligence
5. Analysing and Solving Artificial Intelligence programs by using Backtracking methods

Course Content:

UNIT-1: 12 Hours

Artificial Intelligence: The AI Problems, The Underlying assumption, What is an AI Technique? The Level of the model, Criteria for success, some general references, One final word and beyond.

Problems, problem spaces, and search: Defining, the problem as a state space search, Production systems, Problem characteristics, Production system characteristics, Issues in the design of search programs, Additional Problems.

Intelligent Agents: Agents and Environments, The nature of environments, The structure of agents.

UNIT-2: 12 Hours

Heuristic search techniques: Generate-and-test, Hill climbing, best-first search, Problem reduction, Constraint satisfaction, Mean-ends analysis.

Knowledge representation issues: Representations and mappings, Approaches to knowledge representation, Issues in knowledge representation, The frame problem.

Using predicate logic: Representing simple facts in logic, representing instance and ISA relationships, Computable functions and predicates, Resolution, Natural Deduction.

Logical Agents: Knowledge –based agents, the Wumpus world, Logic-Propositional logic, Propositional theorem proving, Effective propositional model checking, Agents based on propositional logic.

UNIT-3: 12 Hours

Symbolic Reasoning Under Uncertainty: Introduction to non-monotonic reasoning, Logic for non-monotonic reasoning, Implementation Issues, Augmenting a problem-solver, Implementation: Depth-first search, Implementation: Breadth-first search.

Statistical Reasoning: Probability and bayes Theorem, Certainty factors and rule-based systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy logic.

Quantifying Uncertainty: Acting under uncertainty, Basic probability notation, Inference using full joint distributions, Independence, Bayes' rule and its use, The Wumpus world revisited.

UNIT-4: **12 Hours**

Weak Slot-and-filter structures: Semantic Nets, Frames.
Strong slot-and –filler structures: Conceptual dependency, scripts, CYC.
Adversarial Search: Games, Optimal Decision in Games, Alpha-Beta Pruning, Imperfect Real- Time Decisions, Stochastic Games, Partially Observable Games, State-Of-The-Art Game Programs, Alternative Approaches.

UNIT-5: **12 Hours**

Learning From examples: Forms of learning, Supervised learning, Learning decision trees, Evaluating and choosing the best hypothesis, The theory of learning ,PAC, Regression and Classification with linear models, Nonparametric models, Support vector machines, Ensemble learning.
Learning Probabilistic Models: Statistical learning, learning with complete data, learning with hidden variables: The EM algorithm.

Text Book(s):

1. Elaine Rich, Kevin Knight, Shiva Shankar B Nair, Artificial Intelligence, Tata MCGraw Hill 3rd edition. 2013. Chapter 1,2,3,4,78,9 & 10.
2. Stuart Russel, Peter Norvig, Artificial Intelligence, A Modern Approach, Pearson 3rd edition 2013.Chapter 2,5,6,13,18 & 20.

Reference(s):

1. Nils J. Nilsson, Principles of Artificial Intelligence, Elsevier, ISBN-13: 9780934613101.
2. George F.Luger, Artificial Intelligence Structures and Strategies for Complex Problem Solving, Pearson Education .PHI, 2002.

Elective Subject

CSE 615	SEMANTIC WEB TECHNOLOGIES	L	T	P	C
		4	0	0	4

Course Objectives:

1. To explain the analysis of the social Web and the design of a new class of applications that combine human intelligence with machine processing.
2. To describe how the Semantic Web provides the key in aggregating information across heterogeneous sources.
3. To understand the benefits of Semantic Web by incorporating user-generated metadata and other clues left behind by users.

Course Outcomes:

1. Be able to demonstrate the basics of Semantic Web and Social Networks.
2. Be able to understand electronic sources for network analysis and different Ontology languages.
3. Be able to modelling and aggregating social network data.
4. Be able to build up social-semantic applications.
5. Be able to evaluate Web- based social network and Ontology.

Course Content:

UNIT-1: 12 Hours

Introduction to the Semantic Web and Social Networks: The Semantic Web- Limitations of the current Web, The semantic solution, Development of the Semantic Web, The emergence of the social web.

Social Network Analysis: What is network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis.

UNIT-2: 12 Hours

Web data, Semantics and Knowledge Representation on the Semantic Web: Electronic sources for network analysis- Electronic discussion networks, Blogs and online communities, Web- based networks.

Knowledge Representation on the Semantic Web- Ontologies and their role in the Semantic Web, Ontology languages for the Semantic Web (RDF, OWL).

UNIT-3: 12 Hours

Modelling and aggregating social network data: State-of-the-art in network data representation, Ontological representation of social individuals, Ontological representation of social relationships, Aggregating and reasoning with social network data.

UNIT-4: 12 Hours

Developing social-semantic applications: Building Semantic Web applications with social network features, Flink: the social networks of the Semantic Web community, open academia: distributed, semantic-based publication management

UNIT-5: 12 Hours

Evaluation of web-based social network extraction and Ontologies are us: Differences between survey methods and electronic data extraction, Context of the empirical study, Data collection, Preparing the data, Optimizing goodness of fit, Comparison across methods and networks, Predicting the goodness of fit, Evaluation through analysis. Ontologies are us: A tripartite model of Ontologies, Case studies, Evaluation.

Text Book(s):

1. Peter Mika, Social Networks and the Semantic Web, Springer, 2007.

Reference(s):

1. J.Davies, R.Studer, P.Warren, Semantic Web Technologies, Trends and Research in Ontology Based Systems, John Wiley & Sons.
2. Liyang Lu Chapman and Hal, Semantic Web and Semantic Web Services, l/CRC Publishers, (Taylor & Francis Group)
3. Heine rStucken Schmidt, Frank Van Harmelen, Information Sharing on the semantic Web, Springer Publications.
4. T.Segaran, C.Evans, J.Taylor, Programming the Semantic Web, O‟Reilly, SPD.

Elective Subject

CSE 616	INFORMATION SECURITY	L	T	P	C
		4	0	0	4

Course Objectives:

1. To understand key terms and critical concepts of information security.
2. To describe how risk is identified and assessed.
3. To identify the technology that enable sthe use of firewall sand virtual private networks.
4. To discuss the placement, nature and execution of the domain and tethods used in cryptosystems.

Course Outcomes:

1. To enumerate the phases of the system security development life cycle.
2. To recognize the existing conceptua lframeworks for evaluating risk controls and formulate a cost benefit analysis.
3. To recognize the import anceof access control in computerized information systems and identify widely used intrusion detection and prevention systems.
4. To describe the operating principles of the most popular cryptographic tools.
5. To describe the significance of the project manager's role in the success of an information Security project and review procedures intoinformation security maintenance.

Course Content:

UNIT-1: 12 Hours

Introduction to Information Security: What is Information Security? CNSS Security Model, Components of information security, Balancing information Security and Access, The Security SDLC**.**

Need for Security: Business Needs, Threats, Attacks, And Secure Software Development.

UNIT-2: 12 Hours

Risk Management: Introduction, Overview of risk management, Risk Identification, Risk Assessment, Risk Control Strategies.

Security Technology: Firewalls and VPNs. Introduction, Access Control, Firewalls, Protecting Remote Connections**.**

UNIT-3: 12 Hours

Security Technology: Intrusion Detection and Prevention Systems, Introduction, Intrusion Detection and Prevention systems, Honeypots and Honey nets and Padded cell systems, Scanning and analysis tools, Biometric Access Controls.

Cryptography: Cryptographic Tools, Protocols for Secure Communications, Attacks on Crypto systems.

UNIT-4: 12 Hours

Implementing Information Security: Introduction, Information Security Project management, Technical aspects of implementation, Information Systems Security Certification and accreditation.

Security and Personnel: Introduction, Positioning and staffing these curity functions, Credentials for information Security Professionals.

UNIT-5: **12 Hours**

Information Security Maintenance: Introduction, Security Management Maintenance Protocols, Digital Forensics.

Text Book(s):

1. Michael EWhitman and Herbert J Mattord, Principles of Information Security,Vikas PublishingHouse, New Delhi, 2003.

Reference(s):

1. MickiKrause, HaroldF. Tipton, Hand book of Information Security Management, a. Vol1-3CRCPressLLC, 2004.
2. StuartMcClure, Joel Scrambray, GeorgeKurtz, Hacking Exposed, TataMcGraw-Hill,2003.
3. MattBishop, Computer Security Art and Science, Pearson.

Elective Subject

CSE 617	SOFTWARE PROJECT MANAGEMENT	L	T	P	C
		4	0	0	4

Course Objectives:

1. To Introduce the basics of software project management and taught the Four basic building blocks of software project management
2. To Demonstrate about successful software projects that support organization's strategic goals and Match organizational needs to the most effective software development model
3. To Explain how to plan and manage projects at each stage of the software development life cycle (SDLC)
4. To teach the skills for tracking and controlling software deliverables.
5. To understand project plans that address real-world problems.

Course Outcomes:

1. Plan and manage projects at each stage of the SDLC.
2. Apply theoretical knowledge on project management and software development into practice
3. Gain knowledge on ethical issues related to software project management and can apply this ethical knowledge in practical situations.
4. Understands how different management and development practices affect software and process quality.
5. Create Software project teams and project management that address real-world challenges.

Course Content:

UNIT-1: 12 Hours

Project Evaluation & Project Planning: Importance of Software Project Management – Activities Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

UNIT-2: 12 Hours

Project Life Cycle & Effort Estimation: Software process and Process Models – Choice of Process models – mental delivery – Rapid Application development – Agile methods – Extreme Programming – SCRUM – Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points – COCOMO II A Parametric Productivity Model – Staffing Pattern.

UNIT-3: 12 Hours

Activity Planning & Risk Management: Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Monitoring – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical patterns – Cost schedules.

UNIT-4: 12 Hours

Project Management & Control: Framework for Management and control – Collection of data Project termination – Visualizing progress – Cost monitoring – Earned Value Analysis-Project tracking – Change control- Software Configuration Management – Managing contracts – Contract Management.

UNIT-5: **12 Hours**

Staffing in Software Projects: Managing people – Organizational behaviour – Best methods of staff selection – Motivation – The Oldham-Hackman job characteristic model – Ethical and Programmed concerns – Working in teams – Decision making – Team structures – Virtual teams
– Communications genres – Communication plans.

Text Book(s):

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management, Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

Reference(s):

1. Robert K. Wysocki, Effective Software Project Management, Wiley Publication,2011.
2. Walker Royce, Software Project Management, Addison-Wesley, 1998.
3. Gopalaswamy Ramesh, Managing Global Software Projects, McGraw Hill Education (India), Fourteenth Reprint 2013.

Elective Subject

CSE 618	MULTIMEDIA COMPUTING	L	T	P	C
		4	0	0	4

Course Objectives:

1. To learn the basics and Fundamentals of Multimedia.
2. To introduce Multimedia components and Tools.
3. To understand how Multimedia can be incorporated
4. To design and create interactive multimedia products
5. To identify the current and future issues related to multimedia technology.

Course Outcomes:

1. Understand multimedia components using various tools and techniques.
2. Discuss about different types of media format and their properties.
3. Describe how to use text-related element in multimedia design correctly.
4. Justify the right way of manipulating multimedia systems.
5. Analyse and interpret Multimedia data.
6. Create a multimedia project for the desktop or Internet.

Course Content:

UNIT-1: **12 Hours**

Multi Media Fundamentals: What is multimedia, where to use multimedia, Delivering multimedia?

Text: The Power of Meaning, About Fonts and Faces, Using Text in Multimedia, Computers and Text, Font Editing and Design Tools, Hypermedia and Hypertext, Hypertext Tools.

Image: Making Still Images, Color, Image File Formats.

UNIT-2: **12 Hours**

Sound: The Power of Sound, Digital Audio, MIDI Audio, MIDI vs. Digital Audio, Audio File Formats.

Animation: The Power of Motion, Principles of Animation, Animation by Computer.

Video: Using Video, How Video Works and Is Displayed, Digital Video Containers.

UNIT-3: **12 Hours**

Making Multimedia: The Stages of a Multimedia Project, What You Need: Hardware, What You Need: Software. What You Need: Authoring Systems.

Interrupts: Micro Processor Architecture, Interrupt Basics, The shared data problem, Interrupt Latency

UNIT-4: **12 Hours**

Survey of Software Architectures: Round-Robin, Round-Robin with Interrupts, Function Queue-Scheduling Architecture, Real Time Operating System Architecture, Selecting an Architecture.

The Internet and Multimedia: Internet History, Internetworking, Multimedia on the Web.

UNIT-5: **12 Hours**

Designing for the World Wide Web: Developing for the Web, Text for the Web, Images for the Web, Sound for the Web, Animation for the Web, Video for the Web.

Text Book(s):

1. Tay Vaughan, Multimedia: Making it Work, 8th Edition, McGraw Hill Education.

2. David E. Simon, An Embedded Software Primer, Pearson Education Asia., 2000.

Reference(s):

1. Ranjan Parekh, Principles of Multimedia, 2nd Edition, McGraw Hill Education, 2013.
2. D. Gajski, F. Vahid, Narayan, J. Gong, Specification and Design of Embedded Systems,Prentice Hall of India Pvt. Ltd. 2. Raj Kamal, Embedded Systems.

	Elective Subject	L	T	P	C
CSE 619	**OPEN SOURCE PROGRAMMING**	**3**	**0**	**2**	**4**

Course Objectives:

1. To learn the foundational principles of open-source programming.
2. To create code for open-source web applications.
3. To comprehend the potential risks linked to open-source code.
4. To create CGI scripts with a focus on security.

Course Outcomes:

1. Understand the fundamentals of Open source Programming.
2. Develop codes in open source web applications
3. Understand the risks associated with the open source codes
4. Write secure CGI scripts

Course Content:

UNIT-1: 12 Hours

INTRODUCTION: Introduction to open source programming languages, advantages and drawbacks of open source programming, threats and vulnerabilities in open source languages, Operating System – Ubuntu Linux – Introduction to shell programming.

UNIT-2: 12 Hours

PHP: PHP Language Basics, Functions - calling a function, variable function, and anonymous function, Strings - cleaning, encoding and escaping, and comparing strings, Arrays – storing data in arrays, extracting multiple values, traversing, and sorting arrays, Objects – creation, introspection, and serialization, Web Techniques – processing forms and maintaining state.

UNIT-3: 12 Hours

WEB DATABASE APPLICATIONS: Three-tier architecture, Introduction to Object oriented programming with PHP 5, Database basics, MYSQL – querying web databases, writing to web databases, validation with Javascript, Form based authentication, protecting data on the web.

UNIT-4: 12 Hours

PERL, TCL: Numbers and Strings, Control Statements, Lists and Arrays, Files, Pattern matching, Hashes, Functions. Introduction to TCL/TK

UNIT-5: 12 Hours

SECURITY IN WEB APPLICATIONS: Recognizing web application security threats, Code Grinder, Building functional and secure web applications, Security problems with Javascript, vulnerable GCI scripts, Code Auditing and Reverse Engineering, types of security used in applications

Text Book(s):

1. Kevin Tatroe, Peter MacIntyre, Rasmus Lerdorf, “Programming PHP”, O’Reilly Media, 2012.
2. Michael Cross, “Developer’s Guide to Web Application Security”, Syngres Publishers, 2007.
3. Hugh E. Williams, David Lane, “Web Database applications with PHP and MYSQL”, Second Edition, O’Reilly Media, 2004.

Reference(s):

1. Tom Christiansen, Brian D Foy, Larry Wall, Jon Orwant, “Programming Perl”, Fourth Edition, O’Reilly Media, 2012.
2. Mark Lutz, “Programming Python”, Fourth Edition, O’Reilly Media, 2010.

Elective Subject

CSE 620	BIOINFORMATICS	L	T	P	C
		3	0	2	4

Course Objectives:

1. Concepts of biological sequence and structural databases.
2. Concepts ofgenome information and DNA sequence.
3. To apply their ability to Compare pair-wise and multiple sequence alignment methods.
4. To demonstrate their ability on secondary structures on DNA data.

Course Outcomes:

1. Understand the biological sequence and structural databases.
2. Analyze the genome information and DNA sequence.
3. Compare pair-wise and multiple sequence alignment methods.
4. Apply secondary structures on DNA data.

Course Content:

UNIT-1: **12 Hours**

Introduction: Definitions, Sequencing, Biological sequence/structure, Genome Projects, Pattern recognition and prediction, Folding problem, Sequence Analysis, Homology and Analogy.

Protein Information Resources: Biological databases, Primary sequence databases, Protein Sequence databases, Secondary databases, Protein pattern databases, and Structure classification databases.

UNIT-2: **12 Hours**

Genome Information Resources: DNA sequence databases, specialized genomic resources

DNA Sequence analysis: Importance of DNA analysis, Gene structure and DNA sequences, Features of DNA sequence analysis, EST (Expressed Sequence Tag) searches, Gene hunting, Profile of a cell, EST analysis, Effects of EST data on DNA databases

UNIT-3: **12 Hours**

Pair wise alignment techniques: Database searching, Alphabets and complexity, Algorithm and programs, Comparing two sequences, sub-sequences, Identity and similarity, The Dot plot, Local and global similarity, different alignment techniques, Dynamic Programming, Pair wise database searching.

UNIT-4: **12 Hours**

Multiple sequence alignment: Definition and Goal, The consensus, computational complexity, Manual methods, Simultaneous methods, Progressive methods, Databases of Multiple alignments and searching.

UNIT-5: **12 Hours**

Secondary database searching: Importance and need of secondary database searches, secondary database structure and building a sequence search protocol

Analysis packages: Analysis package structure, commercial databases, commercial software, comprehensive packages, packages specializing in DNA analysis, Intranet Packages, Internet Packages.

Text Book(s):

1. T K Attwood & D J Parry-Smith, Introduction to Bioinformatics, Addison Wesley Longman. Bioinformatics –A Beginners Guide by Jean-Michel Claveriw, CerdricNotredame, WEILEY dreamtech India Pvt. Ltd.

Reference(s):

1. Bioinformatics- A Beginner's Guide, Jean-Michel Claveriw, CerdricNotredame, WILEY DreamTech India Pvt. Ltd
2. Sequence Analysis in A Nutshell, Scott Markel &Darryl Leon, O'REILLY

Elective Subject

CSE 621	MOBILE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	2	4

Course Objectives:

1. To demonstrate their understanding of the fundamentals of Android operating systems.
2. To demonstrate their skills of using Android software development tools.
3. To demonstrate their ability to develop software with reasonable complexity on mobile platform.
4. To demonstrate their ability to deploy software to mobile devices.
5. To demonstrate their ability to debug programs running on mobile devices.

Course Outcomes:

1. Develop the basic Android App using Activity Lifecycle methods.
2. Design Android User Interfaces & Event Handling mechanisms.
3. Implement the different Intents and Notifications.
4. Design and Implement back end Android App using SQLite database.
5. Develop advanced Android App using location based services.

Course Content:

UNIT-1: **12 Hours**

Android Programming: What Is Android? Obtaining The Required Tools, Creating Your First Android Application**.**

Android studio for Application development: Exploring IDE, Using code completion, Debugging your Application, Generating a signed APK.

UNIT-2: **12 Hours**

Activities, Fragments, and Intents: Understanding Activities, Linking Activities Using Intents, Fragments, Displaying Notifications.

Android User Interface: Components of a Screen, Adapting To Display Orientation, Managing Changes to Screen Orientation, Utilizing the Action Bar, Creating the User Interface Programmatically, Listening For UI Notifications.

UNIT-3: **12 Hours**

User Interface With Views: Using Basic Views, Using Picker Views, Using List Views To Display Long Lists, Understanding Specialized Fragments**.**

Pictures and Menus with Views: Using Image Views to Display Pictures, Using Menus with Views, Using Web View.

Notifications – Creating and Displaying notifications, Displaying Toasts.

UNIT-4: **12 Hours**

Data Persistence: Saving and Loading User Preferences, Persisting Data to Files, Creating And Using Databases**.**

Content Providers: Using a Content Provider, Creating Your Own Content Providers.

Messaging: SMS Messaging, Sending E-Mail.

UNIT-5: **12 Hours**

Location-Based Services: Displaying Maps, Getting Location Data, Monitoring A Location.

Developing Android Services: Creating Your Own Services, Establishing Communication between a Service and an Activity, Binding Activities to Services, Understanding Threading.

Text Book(s):

1. Beginning Android Programming with Android Studio, J.F.DiMarzio, Wiley India (Wrox), 2017.

Reference(s):

1. Wei-Meng Lee, Beginning Android 4 Application Development, Wiley India (Wrox), 2012.
2. Reto Meier, Professional Android 4 Application Development, Wiley India, (Wrox), 2012.
3. James C Sheusi, Android Application Development for Java Programmers, Cengage Learning, 2013.

Elective Subject

CSE 622	INTERNET OF THINGS	L	T	P	C
		3	0	2	4

Course Objectives:

1. To demonstrate their understanding of the internet of Things and its hardware and software components
2. Concepts of Interface FO devices ,sensors & communication modules
3. To design Remotely monitor data and control devices
4. To develop real life IoT based projects

Course Outcomes:

1. Understand internet of Things and its hardware and software components
2. Interface FO devices ,sensors & communication modules
3. Remotely monitor data and control devices
4. Develop real life IoT based projects

Course Content:

UNIT-1: 12 Hours

Introduction to Internet of Things: Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking,

UNIT-2: 12 Hours

M2M and IoT Technology Fundamentals: Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.

UNIT-3: 12 Hours

Elements of Hardware Components: Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces.
Software Components: Programming API's (using Python/Node.js/Arduino) for Communication Protocols- MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

UNIT-4: 12 Hours

IoT Application Development: Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage-Unstructured data storage on cloud / local server, Authentication, authorization of devices.

UNIT-5: 12 Hours

IoT Case Studies: IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation.

Text Book(s):

1. Vijay Madisetti, Arshdeep Bahga, Internet of Things,"A Hands on Approach",University Press
2. Dr.SRNReddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: Apractical Approach ", ETILabs

Reference(s):

1. Pethuru Rajand Anupama C.Raman, "TheInternet of Things: Enabling Technologies,Platforms, and Use Cases", CRC Press
2. JeevaJose, "Internet of Things", Khanna Publishing House, Delhi
3. Adrian McEwen, "Designing the Internet of Things ", Wiley
4. RajKamal, "Internet of Things: Architecture and Design ", McGrawHill

Core Subject

CSE 514	MACHINE LEARNING	L	T	P	C
		4	0	0	4

Course Objectives:

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To develop skills of using recent machine learning strategies for solving practical problems.

Course Outcomes:

1. Explain fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
2. Implement machine learning techniques and computing environment that are suitable for the applications.
3. Evaluate learning models generated from data.
4. Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
5. Analyze existing learning algorithms, including well-studied methods for classification, regression, structured prediction, clustering, and representation learning

Course Content:

UNIT-1: **12 Hours**

Introduction: Why Machine Learning? Why Python?, scikit-learn, Essential Libraries and Tools, A First Application: Classifying Iris Species.

Supervised Learning: Classification and Regression, Generalization, Over-fitting, and Under fitting, Supervised Machine Learning Algorithms, Uncertainty Estimates from Classifiers,

UNIT-2: **12 Hours**

Unsupervised Learning and Pre-processing: Types of Unsupervised Learning, Challenges in Unsupervised Learning, Pre-processing and Scaling, Dimensionality Reduction, Feature Extraction, and Manifold Learning, Clustering,.

UNIT-3: **12 Hours**

Representing Data and Engineering Features: Categorical Variables, One Hot Encoder and Column Transformer, Convenient Column Transformer creation with make column transformer,

Binning, Discretization, Linear Models, and Trees, Interactions and Polynomials, Univariate Nonlinear Transformations, Automatic Feature Selection, Utilizing Expert Knowledge

UNIT-4: **12 Hours**

Model Evaluation and Improvement: Cross-Validation, Grid Search, Evaluation Metrics and Scoring.

Algorithm Chains and Pipelines: Parameter Selection with Pre-processing, Building Pipelines,

Using Pipelines in Grid Searches, Interface, Grid, Grid-Searching Which Model To Use.

UNIT-5: **12 Hours**

Working with Text Data: Types of Data Represented as Strings, Example Application: Sentiment Analysis of Movie Reviews, Representing Text Data as a Bag of Words,Stopwords, Rescaling the Data with tf–idf, Investigating Model Coefficients, Bag-of-Words with More Than One Word (n-Grams), Advanced Tokenization, Stemming, and Lemmatization, Topic Modeling and Document Clustering.

Text Book(s):

1. Andreas C. Müller, Sarah Guido, Introduction to Machine Learning with Python, O'Reilly Media.

Reference(s):

1. Christopher.M. Bishop, Pattern Recognition and Machine Learning, Springer Publications, October 2007.
2. EthenAlpaydin, Introduction to Machine Learning, Second Edition, MIT Publishers, 2010.

Core Subject

CSE 515	HIGH PERFORMANCE COMPUTING	L	T	P	C
		4	0	0	4

Course Objectives:

1. Concepts of high performance computing architectures.
2. Concepts of Cluster computers and parallel scalability.
3. Concepts of parallel programming using MPI.

Course Outcomes:

5. Analyse the functionality of Modern Processor.
6. Comprehend and implement various optimization techniques for serial code.
7. Design the concept of parallel computing paradigm.

Course Content:

UNIT-1: 12 Hours

Modern Processors-Stored- Program Computer Architecture, General-Purpose cache- based microprocessor architecture - Performance metrics and benchmarks, Moore's Law, Pipelining, Super scalarity, SIMD, Memory hierarchies- cache, Cache mapping, Pre-fetch, Multicore processors, Multithreaded processors, Vector Processors

UNIT-2: 12 Hours

Requirements and General Issues-Scalable parallel computer Architectures, A cluster computer and its Architecture, clusters classifications, Commodity components for clusters, Network services/Communication SW, Cluster middleware and single system Image(SSI),Resource Management and Scheduling(RMS),Programming environments and Tools, Representative cluster Systems.

High speed Networks: Design issues, Fast Ethernet, High Performance parallel interface (HPPI), Asynchronous transfer mode (ATM), Myrinet.

UNIT-3: 12 Hours

Parallel Computers: Taxonomy of parallel computing paradigm, Shared memory computers, Distributed memory computers, Hierarchical systems, Basics of parallelization.

UNIT-4: 12 Hours

Parallel Scalability- Factors that limit parallel execution-, Scalability metrics, Simple scalability laws, parallel efficiency, serial performance vs Strong scalability, refined performance models-, Choosing the right scaling baseline, Case Study: Can slow processors compute faster- Load balance.

UNIT-5: 12 Hours

Distributed memory parallel programming with MPI: Message Passing, Messages' and point-to point communication - collective communication – Non-blocking point-to-point communication virtual topologies, MPI parallelization of Jacobi solver- MPI implementation – performance properties. Efficient MPI Programming-MPI performance tools, communication parameters, Synchronization, serialization.

Text Book(s):

1. Georg Hager, Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, Chapman & Hall / CRC Computational Science series.

2. High Performance cluster computing,Volume1: Architecture and Systems, Rajkumar Buyya, Pearson Education.

Reference(s):

1. Gene Wagenbreth and John Levesque, High performance Computing: Programming and Application, CRC press, Taylor and francis group.
2. MaciejBrodowicz, Matthew Anderson, and Thomas Sterling, High Performance Computing:Modern Systems and Practices, Morgankaufmann publishers.

Core Subject

CSE 516	CYBER SECURITY	L	T	P	C
		4	0	0	4

Course Objectives:

1. To introduce the security posture and incident response process.
2. To impart the cyber security kills chain process and reconnaissance techniques.
3. Describe various methods of system compromising techniques.
4. Discuss the security polices, user awareness, policy enforcement and compliance techniques.
5. Explain the vulnerability management strategy and log analysis.

Course Outcomes:

1. Create an incident response process by analysing the organizational information security threats.
2. Implement external and internal reconnaissance techniques.
3. Describe the attacks against computers, servers, and websites.
4. Review and enforce security policy of an entire organization.
5. Apply log analysis techniques and vulnerability management tools.

Course Content:

UNIT-1: 12 Hours

Security Posture: The current threat landscape - The credentials – authentication and authorization -Apps -Data Cyber Security challenges - Old techniques and broader results – The shift in the threat landscape, enhancing your security posture, The Red and Blue Team – Assume breach.

Incident Response Process: Reasons to have an IR process in place -Creating an incident response process -Incident response team -Incident life cycle, handling an incident -Best practices to optimize incident handling -Post-incident activity -Real-world scenario -Lessons learned, Incident response in the cloud - Updating your IR process to include cloud.

UNIT-2: 12 Hours

Understanding the Cyber Security Kill Chain: Scanning, NMap -Metasploit - John the Ripper - THC Hydra -Wireshark -Aircrack-ng - Nikto – Kismet- Cain and Abel, Access and privilege escalation- Vertical privilege escalation, Horizontal privilege escalation, Threat life cycle management.

External reconnaissance: Dumpster diving -Social media -Social engineering -Pretexting - Diversion theft - Phishing - Phone phishing (vishing) - Spear phishing - Water holing - Baiting - Quid pro quo – Tailgating.

Internal reconnaissance: Sniffing and scanning -Prismdump -tcpdump -NMap -Wireshark - Scanrand -Cain and Abel -Nessus -Metasploit -Aircrack-ng –Wardriving

UNIT-3: 12 Hours

Compromising the System: Analyzing current trends -Extortion attacks -Data manipulation attacks -IoT device attacks - Backdoors -Mobile device attacks -Hacking everyday devices - Hacking the cloud ,Phishing - Exploiting a vulnerability, Zero-day -Fuzzing -Source code analysis -Types of zero-day exploits - Buffer overflows -Structured exception handler overwrites.

Performing the steps to compromise a system -Deploying payloads-Installing and using a vulnerability scanner-Using Metasploit-Compromising web-based systems-SQL injection - Cross-site scripting-Broken authentication-DDoS attacks

UNIT-4: **12 Hours**

Security Policy: Reviewing your security policy, Educating the end user -Social media security guidelines for users -Security awareness training, Policy enforcement -Application whitelisting -Hardening ,Monitoring for compliance, Investigating an Incident, Scoping the issue -Key artifacts, Investigating a compromised system on-premises, Investigating a compromised system in a hybrid cloud -Search and you shall find it, Lessons learned.

UNIT-5: **12 Hours**

Vulnerability Management Creating a vulnerability management strategy -Asset inventory -Information management - Risk assessment -Scope -Collecting data -Analysis of policies and procedures -Vulnerability analysis -Threat analysis -Analysis of acceptable risks -Vulnerability assessment -Reporting and remediation tracking -Response planning -Vulnerability management tools -Asset inventory tools –Peregrine tools –LAN Desk Management Suite –Still Secure –Foundstone's Enterprise –Information management tools -Risk assessment tools -Vulnerability assessment tools -Reporting and remediation tracking tools -Response planning tools.

Log Analysis: Data correlation, Operating system logs -Windows logs -Linux logs, Firewall logs, Web server logs'

Text Book(s):

1. Cyber Security – Attack and Defense Strategies by Yuri Diogenes and ErdalOzkaya.

Reference(s):

1. Martti Lehto, Pekka Neittaanmäki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland 2015
2. NASSCOM Handbook Study Material
3. George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press.

CSE 553	MACHINE LEARNING LAB	L	T	P	C
		0	0	3	2

Course Objectives:

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To develop skills of using recent machine learning strategies for solving practical problems.

Course Outcomes:

1. Explain fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
2. Implement machine learning techniques and computing environment that are suitable for the applications.
3. Evaluate learning models generated from data.
4. Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
5. Analyze existing learning algorithms, including well-studied methods for classification, regression, structured prediction, clustering, and representation learning

List of Experiments

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples.
2. Implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm.
4. Build an Artificial Neural Network by implementing the Back-propagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Write a program to implement k-Nearest Neighbour algorithm to classify the given data set.
7. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task.
8. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.
9. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points.

CSE 554	TERM PAPER	L	T	P	C
		0	0	3	2

Course Objectives:

1. Describe what your research is trying to achieve and explain why you are pursuing it. They summarize the approach and purpose of your project and help to focus your research. Your objectives should appear in the introduction of your research paper, at the end of your problem statement.

Course Outcomes:

1. Identify a real world problem in specific domain
2. Understand requirements and specifications of the problem.
3. Explore the existing technologies/ Methodologies
4. Formulate a real world problem and develop its requirements
5. Express technical ideas strategies and methodologies in written form.
6. Prepare and conduct oral presentations

Term Paper work

It is aimed as a precursor to the project work done in the second semester of the second year M.Tech. It should help the students to identify their Research area/topic and should form the groundwork and preliminary research required for the project work. The student should select some research article published in the latest journals of IEEE, ACM and other related journals. Each student should refer to a minimum of SEVEN reference sources outside their prescribed textbooks. The student must gain an understanding of the research tools used and the related material, available both in printed and digital formats. Each student must make the presentation for two rounds on the same research article about their understanding, conclusion and if possible propose the extensions for the work.

At the end of the semester, the student must submit a report in IEEE format, on the work they have pursued throughout the semester containing

- The aim and objective of the study.
- The Rationale behind the study.
- The work already done in the field and identified.
- Hypothesis, experimentation and discussion.
- Conclusion and further work possible.
- Appendices consisting of illustrations, Tables, Graphs etc.,

Evaluation is to be done for the two presentations made and the report submitted. Method of Continuous Assessment (CA):

1.	Day to day work -	30 marks
2.	Seminar – I -	20 marks
3.	Term Paper Report -	30 marks
4.	Seminar – II -	20 marks
		=======
	TOTAL	**100 marks**

A comprehensive report on the lines of IEEE Format is to be submitted at the end of the semester, which is certified by the concerned guide and the HOD.

Elective Subject

CSE 623	BLOCK CHAIN TECHNOLOGIES	L	T	P	C
		4	0	0	4

Course Objectives:

1. Realize the working of block chain systems.
2. To securely interact with them.
3. Design, build, and deploy smart contracts and distributed applications,
4. Integrate ideas from block chain technology into their own projects.

Course Outcomes:

1. Summarize the functioning of Block chain technology.
2. Examine the working of Smart Contracts.
3. Illustrate and simplify the working of Hyper ledger.
4. Apply the knowledge of solidity on Ethereum.
5. Define and distinguish between various concesus algorithms.
6. Design, build, and deploy a block chain application.

Course Content:

UNIT-1: **12 Hours**

Distributed System Concepts: Distributed Database, Two General Problem, Byzantine General Problem and Fault Tolerance, P2P Systems
Cryptography: Digital Signatures, Hashing, public & private key cryptosystems.
Block chain Basics: Blockchain, Blockchain Networks, History of block chain, Blockchain Challenges, Block chain Transactions. Private and Public blockchain, Life of Blockchain application.

UNIT-2: **12 Hours**

Distributed Consensus: The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW), Proof of Stake (PoS) - Hybrid models (PoW + PoS).

UNIT-3: **12 Hours**

Bitcoin: Bitcoin Mining, Bitcoin Wallets, Decentralization, MerkleTree, double spending - mathematical analysis of properties of Bitcoin, Distributed Ledger, Bitcoin protocols.
Ethereum - Ethereum Virtual Machine (EVM), Construction, DAO, GHOST, Consensus Mechanisms, Solidity - Smart Contracts - some attacks on smart contracts.

UNIT-4: **12 Hours**

Hyper ledger: Distributed Ledger Challenges, projects in hyper ledger, Hyper ledger Fabric, Hyper ledger Composer.
Solidity Programming: Smart Contract languages, Installing Solidity &Ethereum Wallet, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types (Int, Real, String, Bytes, Arrays, Mapping, Enum, address)

UNIT-5: **12 Hours**

Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.
Trends: Zero Knowledge proofs and protocols in Blockchain ,Zero Knowledge proofs and protocols in Blockchain.

Text Book(s):

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction,Princeton University Press (July 19, 2016).

Reference(s):

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger," Yellow paper.2014.
4. Nicola Atzei, Massimo Bartlett, and TizianaCimoli, A survey of attacks on Ethereumsmart contracts.
5. Antonopoulos and G. Wood, Mastering Ethereum.
6. D.Drescher, Blockchain Basics. Apress, 2017.

Elective Subject

CSE 624	GEOGRAPHIC INFORMATION SYSTEM	L	T	P	C
		4	0	0	4

Course Objectives:

1. To learn the basic concepts of spatial and non-spatial data.
2. To understand and analyse database issues in GIS.
3. To create design principles for developing DEM and TIN
4. To apply various real time problems in GIS

Course Outcomes:

1. Understand the basic concepts of spatial and non-spatial data.
2. Analyse database issues in GIS.
3. Create design principles for developing DEM and TIN
4. Apply various real time problems in GIS

Course Content:

UNIT-1: **12 Hours**

GIS: Definitions and Development – Computer Components of GIS (Hardware and Software) – General Data Base concepts of Spatial and Non Spatial data - Elements of Spatial data - Sources of Spatial data – Data quality for GIS – Errors and Error variations in GIS

UNIT-2: **12 Hours**

GIS Data Management: Data Base Management Systems (DBMS) Data Base Models. Data input methods – Spatial Data structures: Raster data and Vector data – Structures

UNIT-3: **12 Hours**

GIS Data Analysis: Spatial measurement methods Reclassification – Buffering – Overlay Analysis

UNIT-4: **12 Hours**

Modelling Surfaces: Generation of DEM, DTM and TIN models – Spatial Interpolation – GIS output generation – Integration of Remote Sensing and GIS Principles of Global Positioning System (GPS).

UNIT-5: **12 Hours**

GIS applications: GIS as a Decision Support System – GIS as a Land Information System GIS as a Disaster Management and Emergency Response System - Resource management applications - Facility Management application – Urban Management application.

Text Book(s):

1. Aronoff S. Geographic Information System: A Management Perspective, DDL Publication, Ottawa. 1989.
2. Burrough P.A. Principles of Geographic Information Systems for Land Resource Assessment. Oxford University Press, New York, 1986.

Reference(s):

1. Fraser Taylor D.R. Geographic Information System. Pergamon Press, Oxford, 1991.
2. Maquire D. J.M.F. Goodchild and D.W. Rhind (eds.) Geographic Information Systems : Principles and Application. Taylor & Francis, Washington, 1991.

Elective Subject

CSE 625	DIGITAL FORENSICS	L	T	P	C
		4	0	0	4

Course Objectives:

1. Comprehend the principles associated with issues in cyber forensics.
2. Examine the procedures employed by different forensic systems.
3. Examine the mechanism for capturing evidence and the steps involved in its recovery.
4. Assess and document evidence from electronic communications.

Course Outcomes:

1. Understand the concepts of cyber forensics related Issues.
2. Analyse the process of various forensic systems.
3. Analyse Evidence capture mechanism and Recovery steps
4. Evaluate and Report electronic communications evidences.

Course Content:

UNIT-1: 12 Hours

Forensic overview: Introduction, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/ Employment Proceedings, Forensics Services, Benefits of Professional Forensics Methodology, Steps Taken by Computer Forensics Specialists.

Types of Forensics Systems: Internet Security Systems, Intrusion Detection Systems, Firewall Security Systems, Storage Area Network Security Systems, Network Disaster Recovery Systems, Public Key Infrastructure Systems.

UNIT-2: 12 Hours

Data Recovery: Definition, Data Backup and Recovery, The Role of Backup in Data Recovery, The Data-Recovery Solution, Hiding and Recovering Hidden Data

Evidence Collection and Data Seizure, Need of collection, Collection Options, Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps.

UNIT-3: 12 Hours

Duplication and Preservation of Digital Evidence, Preserving the Digital Crime Scene, Computer Evidence Processing Steps, Legal Aspects of Collecting and Preserving Computer Forensic Evidence, Special Needs of Evidential Authentication.

Computer Image Verification and Authentication: Special Needs of Evidential Authentication, Practical Consideration, Practical Implementation.

UNIT-4: 12 Hours

Reconstructing Past Events: Introduction, Useable File Formats, Unusable File Formats, Converting Files.

Forensic Analysis: Computer Forensic Analysis, Discovery of Electronic Evidence,

UNIT-5: 12 Hours

Electronic Document Discovery: A Powerful New Litigation Tool, Identification of Data, Timekeeping, Forensic Identification and Analysis of Technical Surveillance Devices.

Network Forensics Scenario: A Technical Approach, Destruction of Email, Damaging Computer Evidence, Tools Needed for Intrusion Response to the Destruction of Data, System Testing

Text Book(s):

1. Marjie T.Britz, “Computer Forensics and Cyber Crime”: An Introduction”, Pearson Education, 3rd Edition, 2015.
2. John R. Vacca, “Computer Forensics, Computer Crime Investigation”, Firewall Media, 2005.

Reference(s):

1. Nelson, Phillips Enfinger, Steuart “Computer Forensics and Investigations”, CENGAGE, 2015

Elective Subject

CSE 626	NATURAL LANGUAGE PROCESSING	L	T	P	C
		4	0	0	4

Course Objectives:

1. Comprehend the fundamental symbols and representations in the realm of natural language processing.
2. Address NLP subtasks through the utilization of tokenization and tagging techniques.
3. Utilize diverse parsing techniques in the context of natural language processing (NLP).
4. Examine the semantics of sentences.

Course Outcomes:

1. Understand the basic Notation in natural language processing.
2. Solve NLP sub problems using tokenizing and tagging.
3. Apply various Parsing Techniques in NLP.
4. Analyse the semantic of sentences.

Course Content:

UNIT-1: 12 Hours

Introduction – Models and Algorithms, Regular Expressions and Automata - Regular Expression - Basic Regular Expression Patterns, Disjunction, grouping, and precedence, Finite State Automata – using an FSA to recognize sheeptalk, formal languages, Non-Deterministic FSAs, Using an NFAs to accept strings, Recognition as search, Relating Deterministic and Non Deterministic Automata. Regular Languages and FSAs,

Morphology and Finite-State Transducers survey of English Morphology - Inflectional Morphology, Derivational Morphology, Finite-State Morphological Parsing – The lexicon and Morphotactics, Morphological parsing with finite state transducers, orthographic rules and finite state transducers, Combining an FST Lexicon and Rules, thePorter Stemmer, Human Morphological Processing.

UNIT-2: 12 Hours

N-grams- Counting Words in Corpora, Unsmoothed N-grams, Smoothing – Add- One smoothing, witten-Bell Discounting, Good-Turing Discounting, Backoff, Deleted Interpolation, N-Grams for spelling and Pronunciation, context-sensitive spelling error correction, N-grams for pronunciation Modelling.

Word Classes and Part-of-Speech Tagging- English Word Classes, Tagsets for English, Part of Speech Tagging, Rule-Based Part of Speech Tagging, Stochastic Part of Speech Tagging

UNIT-3: 12 Hours

Context Free Grammars for English- Constituency, Context-Free Rules and Trees, Sentence- Level Constructions, the Noun Phrase, Coordination, Agreement, The Verb phrase and Sub Categorization, Auxiliaries, spoken language syntax, grammar equivalence and normal form, finite state and context free grammars, grammars and human processing.

UNIT-4: 12 Hours

Parsing with Context Free Grammars – Parsing as Search – top-down parsing, bottom-up parsing, comparing top-down and bottom-up parsing, A Basic Top-Down Parser, problems with the basic top down parser, left recursion, ambiguity, repeated parsing of subtrees, The Earley Algorithm, Finite State Parsing Methods.

UNIT-5: **12 Hours**

Semantic Analysis –Syntax, Driven Semantic Analysis – semantic augmentations to context free grammar rules, quantifier scoping and the translation for complex terms, attachments for a fragment of English, sentences, noun phrases, verb phrases, prepositional phrases, integrating semantic analysis into the early parser.

Lexical Semantics: Relations among lexemes and their senses, homonymy, polysemy, synonymy, hyponymy, wordnet, the internal structures of words.

Text Book(s):

1. D. Jurafsky and J. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition" low price edition, Pearson Education, 2005.

Reference(s):

1. C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press,1999.
2. James Allen. "Natural Language Understanding", Addison Wesley, 1995.

Elective Subject

CSE 627	SOFTWARE DEFINED NETWORKS	L	T	P	C
		4	0	0	4

Course Objectives:

1. To learn the fundamentals of software defined networks.
2. To understand the separation of the data plane and the control plane.
3. To study about the SDN Programming.
4. To study about the various applications of SDN

Course Outcomes:

1. Analyse the evolution of software defined networks
2. Express the various components of SDN and their uses
3. Explain the use of SDN in the current networking scenario
4. Design and develop various applications of SDN

Course Content:

UNIT-1: **12 Hours**

INTRODUCTION: History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes.

UNIT-2: **12 Hours**

OPEN FLOW & SDN CONTROLLERS: Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor- Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts

UNIT-3: **12 Hours**

DATA CENTERS: Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE

UNIT-4: **12 Hours**

SDN PROGRAMMING: Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications

UNIT-5: **12 Hours**

SDN: Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration.

Text Book(s):

1. Paul Goransson and Chuck Black, ―Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.
2. Thomas D. Nadeau, Ken Gray, ―SDN: Software Defined Networks, O'Reilly Media, 2013.

Reference(s):

1. Siamak Azodolmolky, ―Software Defined Networking with Open Flow, Packet Publishing, 2013.
2. Vivek Tiwari, ―SDN and Open Flow for Beginners‖, Amazon Digital Services, Inc., 2013.
3. Fei Hu, Editor, ―Network Innovation through Open Flow and SDN: Principles and Design, CRC Press, 2014.

Elective Subject

CSE 628	SOCIAL NETWORK ANALYSIS	L	T	P	C
		4	0	0	4

Course Objectives:

1. To understand the concept of semantic web and related applications.
2. To learn knowledge representation using ontology.
3. To understand human behavior in social web and related communities.
4. To learn visualization of social networks.
5. To have access to a variety of descriptive measures for networks and software to calculate them, and have the ability to interpret the results.

Course Outcomes:

1. Ability to design and develop semantic web related applications
2. Ability to represent knowledge using ontology
3. Ability to predict human behavior in social web and related communities
4. Ability to visualize social networks

Course Content:

UNIT-1: 12 Hours

INTRODUCTION: introduction to Semantic Web: Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Social Network analysis: Development of Social Network Analysis – Key concepts and measures in network analysis – Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities – Web-based networks – Applications of Social Network Analysis.

UNIT-2: 12 Hours

MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION: Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modelling and aggregating social network data: State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.

UNIT-3: 12 Hours

EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS Extracting evolution of Web Community from a Series of Web Archive – Detecting communities in social networks – Definition of community – Evaluating communities – Methods for community detection and mining – Applications of community mining algorithms – Tools for detecting communities social network infrastructures and communities – Decentralized online social networks – Multi-Relational characterization of dynamic social network communities.

UNIT-4: 12 Hours

PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES: Understanding and predicting human behavior for social communities – User data management – Inference and Distribution – Enabling new human experiences – Reality mining – Context – Awareness – Privacy in online social networks – Trust in online environment – Trust models based on subjective logic – Trust network analysis – Trust transitivity analysis – Combining trust and reputation – Trust derivation based on trust comparisons – Attack spectrum and counter measures.

UNIT-5: **12 Hours**

VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing online social networks, visualizing social networks with matrix-based representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications – Cover networks – Community welfare – Collaboration networks – Co-Citation networks.

Text Book(s):

1. Peter Mika, ―Social Networks and the Semantic Web, First Edition, Springer 2007.
2. Borko Furht, ―Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010.

Reference(s):

1. Guandong Xu ,Yanchun Zhang and Lin Li,-Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.
2. Dion Goh and Schubert Foo,-Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling, IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, -The Social Semantic Web, Springer, 2009.

Elective Subject

CSE 629	SOFTWARE TESTING & QUALITY ASSURANCE	L	T	P	C
		4	0	0	4

Course Objectives:

1. To understand the basics of testing, test planning &design and test team organization.
2. To study the various types of test in the life cycle of the software product.
3. To build design concepts for system testing and execution.
4. To learn the software quality assurance, metrics, defect prevention techniques
5. To learn the techniques for quality assurance and applying for applications.

Course Outcomes:

1. Understand software testing and quality assurance as a fundamental component of software life cycle.
2. Explain system testing and test execution process.
3. Create test strategies and plans, design test cases, prioritize and execute them.
4. Discuss the quality assurance process and its role in software development.
5. Analyze the impact of maturity models on software quality and testing.

Course Content:

UNIT-1: 12 Hours

SOFTWARE TESTING - CONCEPTS, ISSUES, AND TECHNIQUES: Quality Revolution, Verification and Validation, Failure, Error, Fault, and Defect, Objectives of Testing, Testing Activities, Test Case Selection White-Box and Black, test Planning and design, Test Tools and Automation, . Power of Test. Test Team Organization and Management-Test Groups, Software Quality Assurance Group, System Test Team Hierarchy, Teambuilding.

UNIT-2: 12 Hours

SYSTEM TESTING: System Testing - System Integration Techniques-Incremental, Top Down Bottom Up Sandwich and Big Bang, Software and Hardware Integration, Hardware Design Verification Tests, Hardware and Software Compatibility Matrix Test Plan for System Integration. Built- in Testing. Functional testing - Testing a Function in Context. Boundary Value Analysis, Decision Tables. acceptance testing - Selection of Acceptance Criteria, Acceptance Test Plan, Test Execution Test. software reliability - Fault and Failure, Factors Influencing Software, Reliability Models

UNIT-3: 12 Hours

SYSTEM TEST CATEGORIES: System test categories Taxonomy of System Tests, Interface Tests Functionality Tests. GUI Tests, Security Tests Feature Tests, Robustness Tests, Boundary Value Tests Power Cycling Tests Interoperability Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Regulatory Tests. Test Generation from FSM models- State-Oriented Model. Finite-State Machine Transition Tour Method, Testing with State Verification. Test Architectures-Local, distributed, oordinated, Remote. System test design- Test Design Factors Requirement Identification, modeling a Test Design Process Test Design Preparedness, Metrics, Test Case Design Effectiveness. system test execution- Modeling Defects, Metrics for Monitoring Test Execution .Defect Reports, Defect Causal Analysis, Beta testing, measuring Test Effectiveness.

UNIT-4: **12 Hours**

SOFTWARE QUALITY: : Five Views of Software Quality , McCall's Quality Factors and Criteria , Quality Factors , Quality Criteria, Relationship between Quality Factors and Criteria ,Quality Metrics, Quality Characteristics , ISO 9000:2000 Software Quality Standard

UNIT-5: **12 Hours**

MATURITY MODELS: : Basic Idea in Software Process , Capability Maturity Model , CMM Architecture , Five Levels of Maturity and Key Process Areas, Application of CMM , Capability Maturity Model Integration (CMMI) , Test Process Improvement ,Testing Maturity Model.

Text Book(s):

1. Software Testing and Quality Assurance-Theory and Practice, Kshirasagar Nak Priyadarshi Tripathy, John Wiley & Sons Inc,2008.

Reference(s):

1. Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement, Jeff Tian, John Wiley & Sons, Inc., Hoboken, New Jersey. 2005.
2. Software Quality Assurance - From Theory to Implementation, Daniel Galin, Pearson Education Ltd UK, 2004
3. Software Quality Assurance, MilindLimaye, TMH, New Delhi, 2011
4. WilliamPerry,Effective Methods of Software Testing, Third Edition, Wiley Publishing 2007.
5. Srinivasan Desikanand Gopalaswamy Ramesh, Software Testing Principles and Practices, Pearson Education,2007.

Elective Subject

CSE 630	CONCURRENT PROGRAMMING	L	T	P	C
		4	0	0	4

Course Objectives:

1. Principles for programming secure reliable and robust software in a multi-threaded or Multi-process environment.
2. Introduce students to the fundamental theoretic and practical principals of concurrency, with emphasis on the correctness, design and implementation of models of concurrent computation using shared memory architectures.

Course Outcomes:

1. Ability to implement the mechanisms for communication and co-ordination among concurrent processes.
2. Develop an outline of a concurrent program with shared variables using mutual exclusion and condition synchronization to synchronize threads such as locks, condition variables, barriers, semaphores and monitors.
3. Understand and apply mutual exclusion and condition synchronization in multithreaded programs with shared variables.
4. Ability to implement the locking and non-blocking mechanisms

Course Content:

UNIT-1: **12 Hours**

Introduction - Shared Objects and Synchronization, A Fable, Properties of Mutual Exclusion, The Moral, The Producer–Consumer Problem, The Harsh Realities of Parallelization.
Mutual Exclusion - Time, Critical Sections, 2-Thread Solutions, The Peterson Lock, The Filter Lock, Lamport's Bakery Algorithm.

UNIT-2: **12 Hours**

Concurrent Objects -Concurrency and Correctness, Sequential Objects, Quiescent consistency, Sequential Consistency, Linearizability, Linearization Points, Formal Definitions Linearizability, Compositional Linearizability, The Nonblocking Property, Progress conditions, Dependent Progress Conditions, The Java Memory Model, Locks and synchronized Blocks, Volatile Fields, Final Fields.

UNIT-3: **12 Hours**

Synchronization Operations - Consensus Numbers, Consensus Protocols, the compar And Set() Operation, Introduction Universality, A Lock-Free Universal, Construction Wait- Free Universal Construction, Spin Locks, Test-And-Set Locks

UNIT-4: **12 Hours**

Linked Lists: The Role of Locking, Introduction, List-Based Sets, Concurrent Reasoning, Coarse-Grained Synchronization, Fine-Grained Synchronization, Optimistic Synchronization, Lazy Synchronization, Non-Blocking Synchronization

UNIT-5: **12 Hours**

Concurrent Queues and the ABA Problem - Concurrent Stacks and Elimination, Transactional Memories

Text Book(s):

1. The Art of Multiprocessor Programming, by Maurice Herlihy and NirShavit, Morgan Kaufmman Publishers, 1st Edition, Indian Reprint 2012.

Reference(s):

1. Java Concurrency in Practice by Brian Goetz, Tim Peierls, Joshua Block, Joseph Bowbeer,David Holmes and Doug Lea, Addison Wesley, 1st Edition, 2006.
2. Concurrent Programming in Java™: Design Principles and Patterns, Second Edition by Doug Lea, Publisher: Addison Wesley, Pub Date: October 01, 1999.

Elective Subject

CSE 631	DATA VISUALIZATION	L	T	P	C
		3	0	2	4

Course Objectives:

1. Recognize and distinguish the visual perception and representation of data.
2. Provide information about the projections of various perspectives on objects.
3. Utilize various interaction and visualization methods.
4. Examine various sets of data for visualization purposes.
5. Assess visual representations.

Course Outcomes:

1. Identify and recognize visual perception and representation of data.
2. Illustrate about projections of different views of objects.
3. Apply various Interaction and visualization techniques.
4. Analyze various groups for visualization.
5. Evaluate visualizations.

Course Content:

UNIT-1: 12 Hours

INTRODUCTION TO DATA VISUALIZATIONS AND PERCEPTION: Introduction of visual perception, visual representation of data, Gestalt principles, Information overload..

UNIT-2: 12 Hours

VISUAL REPRESENTATIONS: Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

UNIT-3: 12 Hours

CLASSIFICATION OF VISUALIZATION SYSTEMS: Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

UNIT-4: 12 Hours

VISUALIZATION OF GROUPS: Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization. Various visualization techniques, data structures used in data visualization.

UNIT-5: 12 Hours

VISUALIZATION OF VOLUMETRIC DATA AND EVALUATION OF VISUALIZATIONS: Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations.

Text Book(s):

1. Ward, Grinstein, Keim, *Interactive Data Visualization: Foundations, Techniques, and Applications.* Natick, 2nd edition,A K Peters, Ltd 2015.

Reference(s):

1. Tamara Munzner,*Visualization Analysis & Design* ,1st edition,AK Peters Visualization Series 2014
2. Scott Murray,*Interactive Data Visualization for the Web* ,2nd Edition, 2017

Elective Subject

CSE 632	DEEP LEARNING	L	T	P	C
		3	0	2	4

Course Objectives:

1. To make students comfortable with tools and techniques required in handling large amounts of datasets.
2. To learn various deep learning methods in NLP, Neural Networks etc.
3. To learn several libraries and datasets publicly available will be used to illustrate the application of these algorithms.
4. To developing skills required to gain experience of doing independent research and study.

Course Outcomes:

1. To familiarize students with the tools and techniques necessary for managing extensive datasets.
2. To acquire knowledge in various deep learning techniques within the realms of Natural Language Processing (NLP), Neural Networks, and related areas.
3. Utilizing various publicly accessible libraries and datasets will be employed to demonstrate the practical implementation of these algorithms.
4. To cultivate the necessary skills for acquiring hands-on experience in conducting independent research and study.

Course Content:

UNIT-1: **12 Hours**

Introduction to Deep learning & Neural Networks: What is Deep Learning? , Applications of Deep learning, Types of Neural Networks, Applications of Neural Networks, Introduction to Keras.

UNIT-2: **12 Hours**

Artificial Neural Networks (ANN): Introduction to ANN, Perceptron and it's use, Multi-Layer Perceptron (MLP), Feed-Forward Neural Network, Deep Neural Network , Activation Function, Cost Function, Gradient Descent, Back propagation, Regularization.

UNIT-3: **12 Hours**

Convolution Neural Network (CNN): Introduction to CNN, Important Elements of CNN, Convolution, Max Pooling, Flattening, Full Connection, Hands-On : CNN using Keras.

UNIT-4: **12 Hours**

Recurrent Neural Network (RNN): Introduction to RNN, Training RNNs, Deep RNNs, Sentiment Analysis

UNIT-5: **12 Hours**

Natural Language Processing (NLP): What is NLP? Applications of NLP, Techniques used in NLP, Syntactic Analysis, Semantic Analysis

Text Book(s):

1. Hands-On Unsupervised learning with Python by Giuseppe Bonaccorso – Packt publication
2. Python Deep Learning by Daniel Slater, Gianmario Spacagna and Peter Roelants – Packt Publication

Reference(s):

1. Machine Learning with Tensorflow by Nishant Shukla
2. Deep Learning with Keras byAntonio Gulli and Sujit Pal
3. Machine Learning for OpenCV by Micheal Beyeler

Elective Subject

CSE 633	FULL STACK DEVELOPMENT	L	T	P	C
		3	0	2	4

Course Objectives:

1. Develop a WEB-API using Node.JS.
2. Work with NOSQL databases like MongoDB
3. Develop a front-end in Angular that consumes web-services
4. Develop a responsive front-end in Angular

Course Outcomes:

1. Create a web API using Node.js.
2. Work with non-relational databases such as MongoDB.
3. Develop a user interface using Angular to interact with web services.
4. Create a dynamic user interface using Angular that adapts seamlessly to different screen sizes

.

Course Content:

UNIT-1: **12 Hours**

Getting Started with Node.js, Using Events, Listeners, Timers, and Callbacks in Node.js, Handling Data I/O in Node.js, Accessing the File System from Node.js, Implementing HTTP Services in Node.js,

UNIT-2: **12 Hours**

Express with Node.js, Routes, Request and Response objects, Template engine.
Understanding middleware, Query middleware, Serving static files, Handling POST body data, Cookies, Sessions, and Authentication.

UNIT-3: **12 Hours**

Understanding NoSQL and MongoDB, Getting Started with MongoDB, Getting Started with MongoDB and Node.js, Manipulating MongoDB Documents from Node.js, Accessing MongoDB from Node.js.

UNIT-4: **12 Hours**

Typescript- types, interfaces, classes, modules, functions,
Angular- understanding Angular, separation of responsibilities, Angular CLI, Basic Angular application, Components, Expressions,

UNIT-5: **12 Hours**

Data binding, Built-in directives, Events and change detection- Browser events, Custom events, Observables, Angular services- Understanding Angular services, Built-in services, GET and PUT Requests, A simple mock server, Changing views with the router service.

Text Book(s):

1. Node.js, MongoDB and Angular Web Development (Second Edition), Brad Dayley, Brendan Dayley Caleb Dayley, by Pearson Education, Inc.

Reference (s):

1. Getting MEAN with Mongo, Express, Angular, and Node, Manning Publications, ISBN-10 : 1617294756,
2. Beginning Node.js, Express & MongoDB Development
3. Beginning Node.js, Basarat Syed, APress

Elective Subject

CSE 634	VISUAL PROGRAMMING	L	T	P	C
		3	0	2	4

Course Objectives:

1. The C# language and the .NET Framework.
2. Working of Microsoft Visual Studio Development Environment.
3. Windows Forms applications with rich, highly responsive user interfaces.
4. Development of web applications and Services using ASP.NET.
5. The use of Language Integrated Query (LINQ).

Course Outcomes:

1. Apply basic concepts of C# programming.
2. Apply advanced concepts of C# programming.
3. Develop and deploy windows applications.
4. Develop and deploy web applications and web services using ASP.NET.
5. Develop database driven applications using XML and LINQ.

Course Content:

UNIT-1: **12 Hours**

Introducing C#: What is the .NET Framework, what is C#.
Variables and Expressions: Basic C# syntax, Basic C# Console Application Structure, Variables, Expressions.
Flow Control: Boolean Logic, Branching, Looping.
More about Variables: Type Conversion, Complex Variable Type, String Manipulation.
Functions: Defining and Using Functions, Variable Scope, The Main () Function, Struct Functions, Function Overloading, Using Delegates.

UNIT-2: **12 Hours**

Debugging and Error Handling: Error Handling.
Introduction to Object-Oriented Programming: What is Object-Oriented Programming, OOP Techniques.
Defining Classes: Class Definitions in C#, System. Object, Constructors and Destructors.
Defining Class Members: Member Definitions, Additional Class Member Topics, Interface Implementation.
Collections, Comparisons and Conversions: Collections- Using Collection, Defining Collections, Dictionaries, Iterators.

UNIT-3: **12 Hours**

Generics: What are Generics, Using Generics, Defining Generic Types.
Basic Desktop Programming: XAML, the Playground, Control Layout, the Game Control.
Advanced Desktop Programming: The Main Window, Creating and styling Controls.

UNIT-4: **12 Hours**

Advanced Cloud Programming and Deployment: Creating an ASP.NET WebAPI, Deploying and Consuming an AP.NET web API on Microsoft Azure.
XML and JSON: XML Basics, JON Basic, XML Schemas, XML Document Object Model, Converting XML to JSON, searching XML with XPath.

UNIT-5: **12 Hours**

LINQ: LINQ to XML, LINQ Providers, LINQ Query Syntax, LINQ Method Syntax, Ordering Query Results, Aggregates, Select Distinct Query, Group Queries, Joins.

DATABASES: Using Databases, Entity Framework, a code First Database, Using LINQ with Database, Navigates Database relationships, Creating and Querying XML from an Existing Database

Text Book(s):

1. Karli Watson, Christian Nagel, Jacob Hammer Pedersen, Jon Reid, and Morgan Skinner, BEGINNING VISUAL C# 2015, Wiley Publishing, Inc.

Reference(s):

1. Stephen C. Perry, Core C# and .NET, Pearson Education, 2006.
2. Herbert Scheldt, C#: The Complete Reference, TATA McGraw Hill Publishing.
3. Andrew Troelsen, Pro C# and the .NET Platform, A! Press.
4. Kevin Hoffman, Microsoft Visual C# 2005 Unleashed, Sams Pearson India.