CURRICULUM FRAMEWORK AND SYLLABUS

FOR OUTCOME BASED EDUCATION IN

Master of Computer Applications (M.C.A) Degree Program (2Years)

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2022-2023 ONWARDS

under Choice Based Credit System

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2000 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

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BOS meeting approved: 01-06-2022 Approved in 63rd Academic Council meeting on 25-06-2022

THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI 625 015

DEPARTMENT OF COMPUTER APPLICATIONS

VISION

"Be the very pinnacle of academic and research excellence in Computer Applications"

MISSION

As a Department, We are committed to

- Achieve academic excellence in Computer Applications through innovative teaching and learning processes.
- To prepare the students to be professionally competent to face the challenges in the industry.
- Promote inter-disciplinary research among the faculty and the students to create state of art research facilities.
- To promote quality and ethics among the students.
- Motivate the students to acquire entrepreneurial skills to become global leaders.

Programme Educational Objectives (PEO)

Post graduates of MCA program will be

PEO1: Utilizing strong technical aptitude and domain knowledge to develop smart software solutions for the upliftment of society.

PEO2: Applying research and entrepreneurial skills augmented with a rich set of communication, teamwork and leadership skills to excel in their profession.

PEO3: Showing continuous improvement in their professional career through life-long learning, appreciating human values and ethics.

Graduate Attributes for MCA Programme (GA)

1. Computational Knowledge:
Apply knowledge of computing fundamentals, computing specialization, mathematics, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.

2. Problem Analysis:
Identify, formulate, research literature, and solve *complex* computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.

3. Design /Development of Solutions:
Design and evaluate solutions for *complex* computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

4. Conduct Investigations of Complex Computing 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.

5. Modern Tool Usage:
Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to *complex* computing activities, with an understanding of the limitations.

6. Professional Ethics:
Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice.

7. Life-long Learning:
Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.

8. Project management and finance:
Demonstrate knowledge and understanding of the computing 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.

9. Communication Efficacy:
Communicate effectively with the computing community, and with society at large, about *complex* computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.

10. Societal and Environmental Concern:
Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.

11. Individual and Team Work:
Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.

12. Innovation and Entrepreneurship
Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

Programme Outcomes (PO) for Master of Computer Applications

On completion of MCA programme, the students are expected to

PO1: Apply knowledge of computing fundamentals, computing specialization, mathematics, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.

PO2: Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.

PO3: Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PO4: 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: Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.

PO6: Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice.

PO7: Recognise the need, and have the ability, to engage in independent learning for continual development as a computing professional.

PO8: Demonstrate knowledge and understanding of the computing 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.

PO9: Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations,

and give and understand clear instructions.

PO10: Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.

PO11: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.

PO12: Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

PEO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	■	■	■	■	■		■	■		■		
PEO2	■	■	■	■					■		■	■
PEO3	■	■	■		■	■	■	■		■	■	

PO-GA MAPPING:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
PO1	■											
PO2		■										
PO3			■									
PO4				■								
PO5					■							
PO6						■						
PO7							■					
PO8								■				
PO9									■			
PO10										■		
PO11											■	
PO12												■

THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI – 625 015

DEPARTMENT OF COMPUTER APPLICATIONS

SCHEDULING OF COURSES

Semester	Theory / Theory cum Practical / Practical								Credit
	1	2	3	4	5	6	7	8	
I(26)	22CA110 Mathematical Foundations of Computer Science (FC- 3:1)	22CA120 Data Structures and Applications (PCC-3:1)	22CA130 Database Management Systems (PCC-3:1)	22CA140 Software Engineering (PCC-3:1)	22CA150 Problem Solving using Computers (PCC-3:1)	22CA170 RDBMS Lab (PCC Lab-0:2)	22CA180 Data Structure using C Lab (PCC Lab-0:2)	22CA190 Professional Communication (EEC-1:1)	26
II(25)	22CA210 Design and Analysis of Algorithms (PCC-3:1)	22CA220 Object Oriented Programming (PCC-3:1)	22CA230 Operating Systems (PCC-3:1)	22CA240 Web Technology (PCC-3:1)	22CAXX1 Elective – I (PE-3:0)	22CA270 Object Oriented Programming Lab (PCC Lab-0:2)	22CA280 Web Technology Lab (PCC Lab-0:2)	22CA290 Software Engineering Lab (PCC Lab 0:2)	25
III(23)	22CA310 Computational Statistics (FC-3:1)	22CA320 Computer Networks (PCC-3:1)	22CAXX2 Elective – II (PE-3:0)	22CAXX3 Elective – III (PE-3:0)	22CAXX4 Elective – IV (PE-3:0)	22CA370 Mobile Application Development Lab (PCC Lab 0:2)	22CA380 Computational Statistics Lab (FC Lab 0:2)	22CA390 Mini Project (EEC-0:2)	23
IV(12)	22CA410 Project work (EEC-0:12)								12
Total Credits									86

BOS meeting approved: 01-06-2022

Approved in 63rd Academic Council meeting on 25-06-2022

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015

Master of Computer Applications (M.C.A) Degree Program (2 Years)

COURSES OF STUDY

(For the candidates admitted from 2022-2023 onwards)

FIRST SEMESTER

Course code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
22CA110	Mathematical Foundations of Computer Science	FC	3	1	-	4
22CA120	Data Structures and Applications	PC	3	1	-	4
22CA130	Database Management Systems	PC	3	1	-	4
22CA140	Software Engineering	PC	3	1	-	4
22CA150	Problem Solving using Computers	PC	3	1	-	4
PRACTICAL						
22CA170	RDBMS Lab	PC	-	-	2	2
22CA180	Data Structure using C Lab	PC	-	-	2	2
22CA190	Professional Communication	EC	-	1	1	2
Total			**15**	**6**	**5**	**26**

SECOND SEMESTER

Course code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
THEORY						
22CA210	Design and Analysis of Algorithms	PC	3	1	-	4
22CA220	Object Oriented Programming	PC	3	1	-	4
22CA230	Operating Systems	PC	3	1	-	4
22CA240	Web Technology	PC	3	1	-	4
22CAXX1	Elective - I	PE	3	-	-	3
PRACTICAL						
22CA270	Object Oriented Programming Lab	PC	-	-	2	2
22CA280	Web Technology Lab	PC	-	-	2	2
22CA290	Software Engineering Lab	PC	-	-	2	2
Total			**15**	**4**	**8**	**25**

THIRD SEMESTER

Course code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
22CA310	Computational Statistics	FC	3	1	-	4
22CA320	Computer Networks	PC	3	1	-	4
22CAXX2	Elective – II	PE	3	-	-	3
22CAXX3	Elective – III	PE	3	-	-	3
22CAXX4	Elective – IV	PE	3	-	-	3
PRACTICAL						
22CA370	Mobile Application Development Lab	PC	-	-	2	2
22CA380	Computational Statistics Lab	FC	-	-	2	2
22CA390	Mini Project	EC	-	-	2	2
Total			**15**	**2**	**6**	**23**

FOURTH SEMESTER

Course code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
PRACTICAL						
22CA410	Project	PC	-	-	24	12
Total					**24**	**12**

FC : Foundation Courses
PC : Programme Core
PE : Programme Elective
EEC : Employability Enhancement Courses

L : Lecture
T : Tutorial
P : Practical

Note:
1 Hour Lecture/week is equivalent to 1 credit

1 Hour Tutorial/week is equivalent to 1 credit

2 Hour Practical/week is equivalent to 1 credit

Total credits to be earned for the award of degree: 86

THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI – 625 015

Master of Computer Applications (M.C.A) Degree Program

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2022-2023 onwards)

FIRST SEMESTER

S.No.	Sub. Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
THEORY								
1	22CA110	Mathematical Foundations of Computer Science	3	50	50	100	25	50
2	22CA120	Data Structures and Applications	3	50	50	100	25	50
3	22CA130	Database Management Systems	3	50	50	100	25	50
4	22CA140	Software Engineering	3	50	50	100	25	50
5	22CA150	Problem Solving using Computers	3	50	50	100	25	50
PRACTICAL								
6	22CA170	RDBMS Lab	3	50	50	100	25	50
7	22CA180	Data Structure using C Lab	3	50	50	100	25	50
8	22CA190	Professional Communication	3	50	50	100	25	50

SECOND SEMESTER

S.No.	Sub. Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
THEORY								
1	22CA210	Design and Analysis of Algorithms	3	50	50	100	25	50
2	22CA220	Object Oriented Programming	3	50	50	100	25	50
3	22CA230	Operating Systems	3	50	50	100	25	50
4	22CA240	Web Technology	3	50	50	100	25	50
5	22CAXX1	Elective - I	3	50	50	100	25	50
PRACTICAL								
6	22CA270	Object Oriented Programming Lab	3	50	50	100	25	50
7	22CA280	Web Technology Lab	3	50	50	100	25	50
8	22CA290	Software Engineering Lab	3	50	50	100	25	50

THIRD SEMESTER

S.No.	Sub. Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
THEORY								
1	22CA310	Probability and Statistics	3	50	50	100	25	50
2	22CA320	Computer Networks	3	50	50	100	25	50
3	22CAXX2	Elective – II	3	50	50	100	25	50
4	22CAXX3	Elective – III	3	50	50	100	25	50
5	22CAXX4	Elective – IV	3	50	50	100	25	50
PRACTICAL								
6	22CA370	Mobile Application Development Lab	3	50	50	100	25	50
7	22CA380	Computational Statistics Lab	3	50	50	100	25	50
8	22CA390	Mini Project	3	50	50	100	25	50

FOURTH SEMESTER

S.No.	Sub. code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
PRACTICAL								
1	22CA410	Project	3	150	150	300	75	150

* Continuous Assessment (CA) evaluation pattern will differ from subject to subject and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100/300 and subsequently be reduced to 50/150 marks for the award of terminal examination marks

LIST OF ELECTIVE COURSES OFFERED
FOR THE M.C.A DEGREE PROGRAMME

Sub. Code	Sub. Name	Category	No. of Hours / Week			Credits
			L	T	P	
22CAPA0	Big Data Analytics	PE	3	-	-	3
22CAPB0	Social Networking and Web mining	PE	3	-	-	3
22CAPC0	Machine Learning	PE	3	-	-	3
22CAPD0	Cloud Computing	PE	3	-	-	3
22CAPE0	Internet of Things	PE	3	-	-	3
22CAPF0	Information Security	PE	3	-	-	3

MCA CURRICULUM 2022-2023 ONWARDS

CHOICE BASED CREDIT SYSTEM

Credit Distribution:

S.No.	Category of courses	Credits	Percentage of Credits to Total Credits
1	Foundation Courses	10	11.62%
2	Professional Core- Theory	34	39.53%
3	Professional Core - Practical	14	16.27%
4	Professional Electives	12	13.95%
5	Employability Enhancement Courses	16	18.6%
	Total Credits	**86**	**100%**

Foundation courses (FC):

Course code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
22CA110	Mathematical Foundations of Computer Science	FC	3	1	-	4
22CA310	Computational Statistics	FC	3	1	-	4
22CA380	Computational Statistics Lab	FC	-	-	2	2

Professional Core (PC):

Course code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
22CA120	Data Structures and Applications	PC	3	1	-	4
22CA130	Database Management Systems	PC	3	1	-	4
22CA140	Software Engineering	PC	3	1	-	4
22CA150	Problem Solving using Computers	PC	3	1	-	4
22CA170	RDBMS Lab	PC	-	-	2	2
22CA180	Data Structure using C Lab	PC	-	-	2	2
22CA210	Design and Analysis of Algorithms	PC	3	1	-	4
22CA220	Object Oriented Programming	PC	3	1	-	4
22CA230	Operating Systems	PC	3	1	-	4
22CA240	Web Technology	PC	3	1	-	4
22CA270	Object Oriented Programming Lab	PC	-	-	2	2
22CA280	Web Technology Lab	PC	-	-	2	2
22CA290	Software Engineering Lab	PC	-	-	2	2
22CA320	Computer Networks	PC	3	1	-	4
22CA370	Mobile Application Development Lab	PC	-	-	2	2

Professional Electives (PE):

Course code	Name of the Course	Category	No. of Hours / Week			Credits
			L	T	P	
22CAPA0	Big Data Analytics	PE	3	-	-	3
22CAPB0	Social Networking and Web mining	PE	3	-	-	3
22CAPC0	Machine Learning	PE	3	-	-	3
22CAPD0	Cloud Computing	PE	3	-	-	3
22CAPE0	Internet of Things	PE	3	-	-	3
22CAPF0	Information Security	PE	3	-	-	3

Employability Enhancement Courses (EEC):

Course code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
22CA190	Professional Communication	EEC	-	1	1	2
22CA390	Mini Project	EEC	-	-	2	2
22CA410	Project	EEC	-	-	24	12

22CA110	Mathematical Foundations of Computer Science	CATEGORY	L	T	P	CREDIT
		FC	3	1	0	4

Preamble

A Computer Application student needs to have some basic mathematical tools and techniques to understand various designing concepts, storage methods, concepts in digital principles, managing databases etc. The main objective of this course is to introduce the basic terminology used in advanced courses in Computer application. This emphasizes the development of rigorous logical thinking for solving different kinds of problems that occur in computer applications.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO Number	Course Outcome Statement	
CO1	Convert the verbal statement into symbolic statement	Apply
CO2	Check the validity of the arguments.	Apply
CO3	Understand graph models and their properties.	Understand
CO4	Apply graph models to solve science and engineering problems.	Apply
CO5	Apply trees structures to solve science and engineering problems	Apply
CO6	Apply properties of integers to solve cryptographic problem.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	-	-			-	-	-	-		-
CO2	S	M	L	-			M	M	M	M		M
CO3	M	L	-	-			-	-	-	-		-
CO4	S	M	L	-			M	M	M	M		M
CO5	S	M	L	-			M	M	M	M		M
CO6	S	M	L	-			M	M	M	M		M

S- Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	10	10	10	-
Understand	30	30	30	30
Apply	60	60	60	70
Analyze				
Evaluate				
Create				

Sample Questions for Course Outcome Assessment

Course Outcome 1(CO1):

1. You cannot edit a protected Wikipedia entry unless you are an administrator. Express your answer in terms of e:"You can edit a protected Wikipedia entry" and a: "You are an administrator."
2. Translate the statement ∀x(C(x) ∨∃y(C(y) ∧F (x, y))) into English, where C(x) is "x has a computer," F (x, y) is "x and y are friends," and the domain for both x and y consists of all students in your school.
3. Let p, q, and r be the propositions p : You get an A on the final exam. q : You do every exercise in this book. r : You get an A in this class. Write these propositions using p, q, and r and logical connectives(including negations)

Course Outcome 2(CO2):

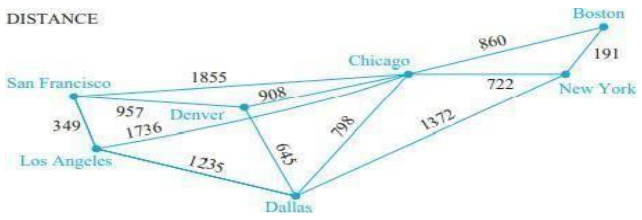
1. Determine whether each of the compound propositions (p∨¬q) ∧ (q∨¬r)∧ (r ∨¬p),(p∨q ∨r)∧(¬p ∨¬q∨¬r), and(p ∨¬q)∧ (q ∨¬r)∧ (r∨¬p)∧(p ∨q ∨r)∧(¬p ∨¬q ∨¬r)is satisfiable.
2. Show that the premises "A student in this class has not read the book," and "Everyone in this class passed the first exam" imply the conclusion "Someone who passed the first exam has not read the book."
3. Is the following argument valid? If you do every problem in this book, then you will learn discrete mathematics. You learned discrete mathematics. Therefore, you did every problem in this book.

Course Outcome 3(CO3):

1. Can a simple graph exist with 15 vertices each of degree five?
2. Find an adjacency matrix of a complete graph on n vertices
3. How many non isomorphic simple graphs are there with six vertices and four edges?

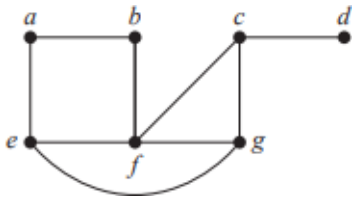
Course Outcome 4(CO4):

1. Show that a simple graph G with n vertices is connected if it has more than (n−1)(n−2)/2edges.
2. Show that Kn has a Hamilton circuit whenevern≥3.
3. Find a shortest path (in mileage) between each of the following pairs of cities in the airline system shown in Figure 1. a) New York and Los Angeles b) Boston and San Francisco c) Miami and Denver d) Miami and Los Angeles



Course Outcome 5(CO5):

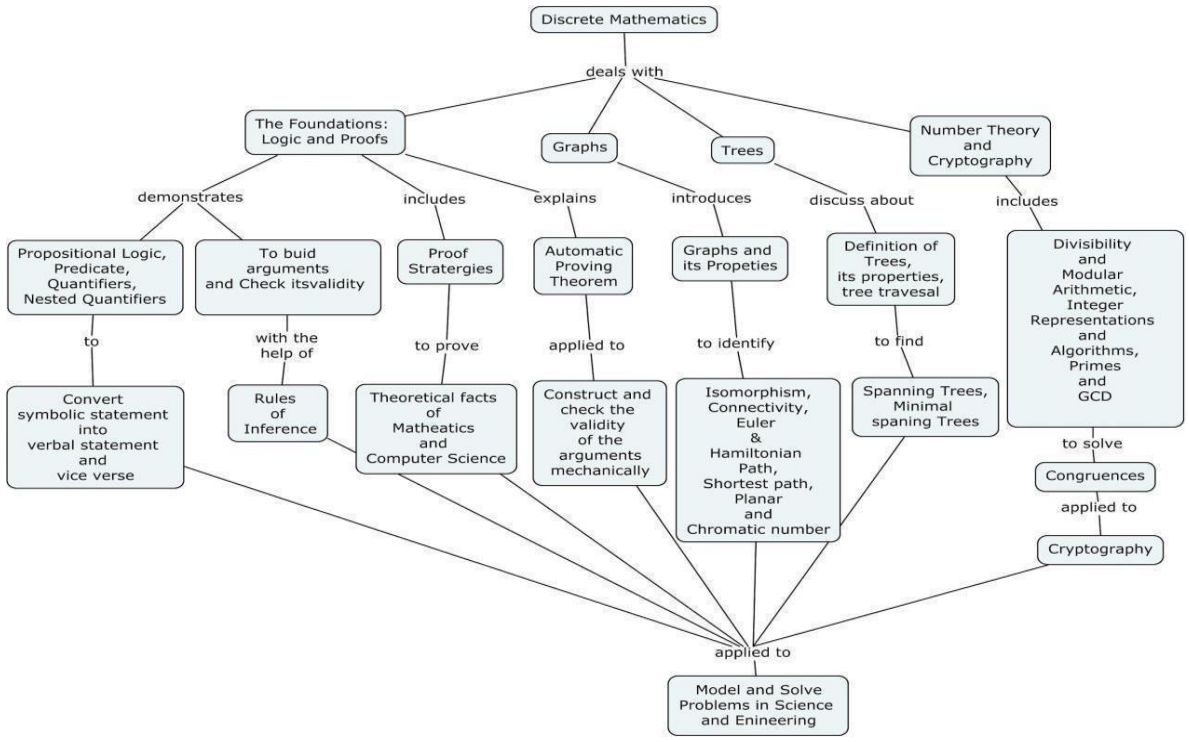
1. Form a binary search tree for the words mathematics, physics, geography, zoology, meteorology, geology, psychology, and chemistry (using alphabetical order).
2. Suppose that the address of the vertex v in the ordered rooted tree T is 3.4.5.2.4. a) At what level is v? b)What is the address of the parent of v? c)What is the least number of siblings v can have? d)What is the smallest possible number of vertices in T if v has this address? e) Find the other addresses that must occur.
3. Find a spanning tree of the simple graph G



Course Outcome 6(CO6):

1. There are certain things whose number is unknown. When divided by 3, the remainder is 2; when divided by 5, the remainder is 3; and when divided by 7, the remainder is 2. What will be the number of things?
2. Find all solutions, if any, to the system of congruences $x \equiv 5 \pmod 6$, $x \equiv 3 \pmod{10}$, and $x \equiv 8 \pmod{15}$.
3. Encrypt the message STOP using the RSA cryptosystem with key (2537, 13). Note that $2537 = 43 \cdot 59$, $p = 43$ and $q = 59$ are primes, and $\gcd(e, (p-1)(q-1)) = \gcd(13, 42 \cdot 58) = 1$

Concept Map



Syllabus

MODULE I: THE FOUNDATIONS: LOGIC AND PROOFS: Propositional Logic, Applications of Propositional, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy, Automatic Proving Theorem

MODULE II: GRAPHS: Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar, Graph Coloring.

MODULE III: TREES: Introduction to Trees, Applications of Trees, Tree Traversal, Spanning Trees, Minimum Spanning Trees.

MODULE IV: NUMBER THEORY AND CRYPTOGRAPHY: Divisibility and Modular Arithmetic, Integer Representations and Algorithms, Primes and Greatest Common Divisors, Solving Congruences, Applications of Congruences, Cryptography.

Learning Resources

1. Kenneth H. Rosen, "Discrete mathematics and its applications", 8th edition, McGrawHill International Editions 2019.
   Module I – Section: 1.1to 1.8
   Module II – Section: 10.1 to 10.8
   Module III – Section: 11.1 to 11.5
   Module IV – Section: 4.1 to 4.6
2. An Introduction to the Theory of Numbers 5ed-Niven, Zuckerman Montgomery(2008)
3. Applied Combinatorics – Alan Tucker, Sixth Edition.(2012)
4. Trembly and Manohar, "Discrete mathematical structures with applications to Computer Science", Tata McGrawHill, 2001
   Module I – Section 1.4.4(Automatic theorem proof only)
5. https://d3gt.com- D3 Graph Theory – Interactive Graph theory Tutorials.
6. http://www.research.ibm.com/haifa/dept/svt/papers/Mathematical_Logic.pdf

Course Contents and Learning Schedule

ModuleNo.	Topic	No. of Lectures
1	**THE FOUNDATIONS: LOGIC AND PROOFS**	
1.1	Propositional Logic	2
1.2	Applications of Propositional	1
	Tutorial	1
1.3	Propositional Equivalences	1
1.4	Predicates and Quantifiers	1
1.5	Nested Quantifiers	1
	Tutorial	1
1.6	Rules of Inference	1
1.7	Introduction to Proofs	1
1.8	Proof Methods and Strategy	1
	Tutorial	1

1.9	Automatic Proving Theorem	2
	Tutorial	1
2	GRAPHS	15
2.1	Graphs and Graph Models	1
2.2	Graph Terminology and Special Types of Graphs	1
2.3	Representing Graphs	1
	Tutorial	1
2.4	Graph Isomorphism	1
2.5	Connectivity	1
2.6	Euler and Hamilton Paths	1
	Tutorial	1
2.7	Shortest-Path Problems	1
2.8	Planar	1
2.9	Graph Coloring	1
	Tutorial	1
3	**TREES**	
3.1	Introduction to Trees	1
3.2	Applications of Trees	2
	Tutorial	1
3.3	Tree Traversal	2
3.4	Spanning Trees	1
	Tutorial	1
3.5	Minimum Spanning Trees	1
4	**NUMBER THEORY AND CRYPTOGRAPHY**	
4.1	Divisibility and Modular Arithmetic	1
4.2	Integer Representations and Algorithms	2
	Tutorial	1
4.3	Primes and Greatest Common Divisors	1
4.4	Solving Congruences	2
	Tutorial	1
4.5	Applications of Congruences	1
4.6	Cryptography	2
	Tutorial	1
	TOTAL	**48**

Course Designers

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22CA120	DATA STRUCTURES AND APPLICATIONS	CATEGORY	L	T	P	CREDIT
		PC	3	1	0	4

Preamble

This course will cover various data structures and their operations for manipulating them. Students will learn how to organize the data so that, the data can be accessed and updated efficiently using computer programs. This course illustrates the applications of data structures.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Apply the concepts of stack and queue for suitable applications in tradeoff with time and space complexity.	Apply
CO2	Illustrate the operations like insertion, deletion, traversing on the non linear tree data structure	Apply
CO3	Choose appropriate binary and multiway search tree for performing Searching operations, with an understanding of the trade-off between the time and space complexity.	Apply
CO4	Manipulate disjoint sets by performing union, iterative find-set operations	Apply
CO5	Demonstrate the concepts of advanced data structures including heap in various applications	Apply
CO6	Show the avoidance of collisions in the hash tables using collision resolution techniques including open and closed hashing techniques.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M									
CO2	S	S	M									
CO3.	S	S	M									
CO4.	S	S	M				L					
CO5.	S	S	M				L					
CO6.	L	S	M				L					

S-Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	10	10	10	10
Understand	30	30	10	10
Apply	60	60	80	80
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1(CO1):

1. Suppose a circular queue of capacity (n –1) elements is implemented with an array of n elements. Assume that the insertion and deletion operation are carried out using REAR and FRONT as array index variables, respectively. Initially, REAR=FRONT=0. Give the conditions to detect queue full and queue empty?
2. Given a 5 element stack S (from top to bottom:2,4,6,8,10), and an empty queue Q, remove the elements one-by-one from S and insert them into Q, then remove them one- by-one from Q and re-insert them into S. List the elements in S (from top to bottom).
3. Given an array and a singly linked list. Which of these data structures uses more memory space to store the same number of elements? Justify your answer.

Course Outcome 2(CO2):

1. Perform the AVL algorithm for non AVL trees. In each case, count the number of updated links required by the AVL rotation. Given a simple expression tree, consisting of basic binary operators i.e., +,-,*and / and some integers, write an algorithm to evaluate the expression tree.
2. Suppose inorder and preorder traversal of a binary tree: Inorder D, B, H, E, A, I, F, J, C, G Preorder A,B,D,E,H,C,F,I,J,G
3. Construct binary tree. Show the step by step process with suitable algorithm. Given a red-black tree with n elements, how fast can you sort them using the tree?

Course Outcome 3(CO3)

1. Given a B-Tree with H=5, M=10 and L=10, what is the Maximum and Minimum number of values that can be contained in the leafs of the B-Tree. Remember, all internal nodes and leafs must be atleast half full.
2. Given a red-black tree and a key. Check the given key exist or not without recursion.
3. Create a tree for these to words S={ab,ba,ca,caa,caaa,baaa} over the alphabet Σ={a,b,c}.

Course Outcome 4(CO4)

1. Given a Boolean 2D matrix, find the number of islands using disjoint set.
2. Write pseudocode for make-set, find-set, union using singly linked lists and the weighted union rule. Each object x, has:
    a) Field repr[x] pointing to the representative of the set containing x,

b) Field last[x]pointing to the last object in the list containing x,

c) field size[x] giving the size of the list containing x.Size[x] and Last[x] are correct only when x is representative

3. Suppose you have an implementation of union that is “by-size” and an implementation of find that does not use path compression. Give the parent map (or array)that results from the following sequence: union(1,2), union(3,4), union(3,5), union(1,7),union(3, 12), union(0,9), union(8,10), union(8,9), union(7,4), union(2,9) where the unions are: a)bysize b)by height c)by size, but now with path compression

Course Outcome 5(CO5)

1. For a binary heap stored in an array, the root is stored in position1,the parent of node i is stored in position floor(i/2), the left child is in position 2i, and the right child is in position 2i+1. What about a d-heap stored in an array? In what positions are the children and parent of node is stored? [Hint: to start, assume that the root is at position 0.Then

modify your results to work with the root at position1]

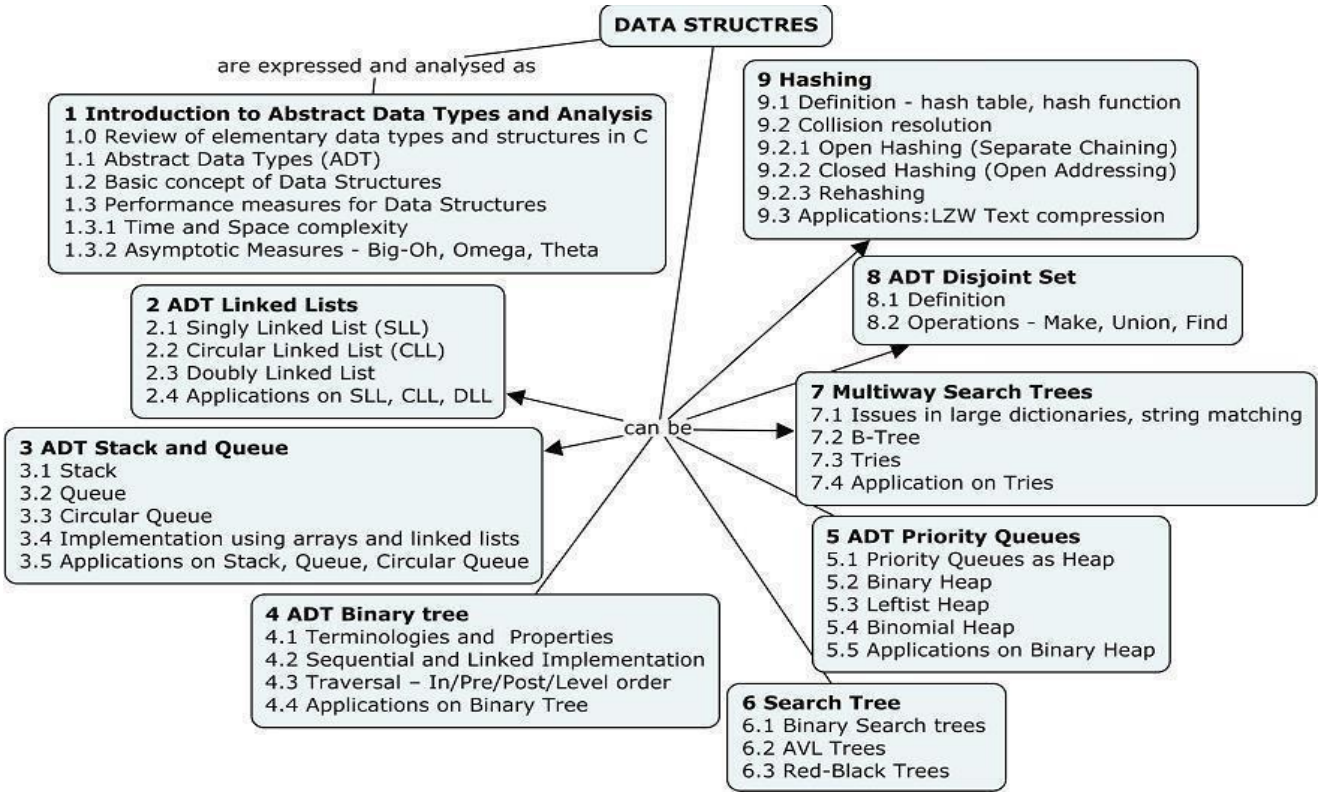
2. Show the result of inserting keys 1 to15 inorder (i.e.1 first, then 2 second, then 3 third, etc.) into an initially empty left ist heap. Use the left ist heap insert (i.e. merge) algorithm a teach step. Show each step for this process.

3. Prove or disprove: A perfectly balanced tree forms if keys 1to2k−1 are inserted inorder (again this means1 first, then 2etc) in to an initially empty left ist heap. K is a positive integer.

Course Outcome 6(CO6):

1. Given input {4371, 1323, 6173, 4199, 4344, 9679, 1989} and a hash function h(x) = x(mod()10), show the resulting
   a. Separate chaining hash table
   b. Hash table using linear probing, quadratic probing
2. Consider implementing a hash table for an application in which we will build an initial hash table by inserting a substantial collection of records. After this, we expect that the number of insertions and the number of deletions performed to be roughly the same, although there may be long runs of consecutive insertions or consecutive deletions. Furthermore, the table will use a probe strategy to resolve any collisions that occur during insertion, and therefore we will "tombstone" cells from which a record has been deleted. If we implement the hash table described above,then when we search for a record, we cannot conclude the record is not in the table until we have found an empty cell in the table, not just a tombstone. (We will ensure that the table never reaches the state that there are no empty cells.) Explain carefully why the search cannot stop when a tombstone is encountered.
3. Let m=17,h1(x)=(k+15)%m,h2(x)=(4k+11)%m,andh3(x)=(7k+2)%m. Insert the keys 23, 7, 50, and 91 into the bit vector, and show the resulting vectors content. Then, find a key that is a false positive; that is, find a key that appears to have been inserted, but wasn’t.

Concept Map



Syllabus

Introduction to Abstract Data Types and Analysis: Review of elementary data types and structures in C – Abstract Data Types (ADT) – Basic concept of Data Structures – Performance measures for Data Structures – Time and Space Complexity Asymptotic Measures
- Big - Oh, Omega, Theta. **Linked Lists:** Singly Linked List(SLL) – Definition and Operations (Create, Insert, Delete, Search, Reverse) - Circular Linked List (CLL) – Definition and Operations (Create, Insert, Delete, Search) - Doubly Linked List – Definition and Operations (Create,Insert,Delete,Search)-Applications on Lists- SLL: Representing univariate polynomial and adding two univariate polynomial - CLL: Josephus Problem - DLL: Checking Palindrome, Quick Sort. **Stack and Queue:**Stack – Definition and Operations (Create, Push,Pop),Queue-Definition and Operations(Create,Enqueue,Dequeue),CircularQueue-Definition and Operations (Create,Enqueue,Dequeue), Implementation using arrays and linked lists Applications - Stack: Arithmetic Expression Evaluation - Queue: First Come First Serve(FCFS) Scheduling - Circular Queue: -Round Robin Scheduling. **Binary tree:** Terminologies and Properties- Sequential and Linked Implementation – Traversal – Inorder, Preorder, Postorder, Levelorder - Application
- Huffman coding and expression trees. **Priority Queues:** Priority Queues as Heap, Heap Implementation, Binary Heap - Definition and Operations (Create, Insert, Delete),Leftist Heap - Definition and Operations (Create, Insert, Delete), Binomial Heap – Definition and Operations(Create,Insert,Delete), Applications on Binary Heap: Heap Sort, use of winner trees in merge sort as an external sorting algorithm. **Search Tree:** Binary Search trees – Definition, Properties and Operations (Create, Insert, Delete, Search),AVL Trees –

Definition, Importance of Balancing, Properties and Operations (Create,Insert,Delete, Search), Red-Black Trees–Definition, compare with AVL, Properties and Operations (Create, Insert, Delete, Search). **Multiway Search Trees:** Issues inlargedictionaries, string matching, B-Tree–Definition, Properties and Operations (Create,Insert,Delete,Search), Tries-Definition and Operations(Create,Insert,Delete, Search), Application on Tries: Pattern Searching. **Disjoint Set:** Definition and Operations (Make, Union, Find). **Hashing:** Definition – hash table, hash function, Collision resolution and overflow handling techniques, Open Hashing(Separate Chaining), Closed Hashing(Open Addressing)–Linear, Quadratic, Double, Rehashing, Applications – LZW Text compression algorithm.

Learning Resources

1. MarkAllenWeiss, "Data Structures and Algorithm Analysis in C++",Pearson,2007
2. Adam Drozdek, "Data structures and Algorithms in C++", Cengage Learning; 4thEdition,2012.
3. Y.Langsam, M.J.Augenstein and A.N.Tanenbaum, "Data Structure Using Cand C++", Pearson Education, 2nd Edition,2015.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1	**Introduction to Abstract Data Types and Analysis**	
1.0	Review of elementary data types and structures in C	1
1.1	Abstract Data Types(ADT)- Basic concept of Data Structures	1
1.3	Performance measures for Data Structures: Time and Space complexity – Asymptotic Measures: Big-Oh, Omega, Theta	2
2	**Linked Lists**	
2.1	Singly Linked List(SLL)–Definition and Operations (Create, Insert, Delete, Search, Reverse)	2
2.2	Circular Linked List(CLL)–Definition and Operations (Create, Insert, Delete, Search)	2
2.3	Doubly Linked List – Definition and Operations	1
	(Create, Insert, Delete, Search)	
2.4	Applications on Lists	1
2.4.1	SLL: Representing univariate polynomial and adding two univariate polynomial	1
2.4.2	CLL: Josephus Problem	1
2.4.3	DLL: Checking Palindrome, Quick Sort	1
3	**Stack and Queue**	
3.1	Stack,Queue,CircularQueue–DefinitionandOperations(Create,Insert,Delete)	2
3.2	Implementation using arrays and linked lists	1
3.3	Applications	1
3.3.1	Stack: Arithmetic Expression Evaluation	2
3.3.2	Queue : First Come First Serve (FCFS) Scheduling	1
3.3.3	Circular Queue:– Round Robin Scheduling	1
4	**Binary tree**	

4.1	Terminologies and Properties-Sequential and Linked Implementation	2
4.2	Traversal – Inorder, Preorder, Postorder, Levelorder	1
4.3	Application-Huffman coding and expression trees	1
5	**Priority Queue**	
5.1	Priority Queue as Heap, Heap Implementation	1
5.2	Binary Heap-Definition and Operations (Create, Insert, Delete)	1
5.3	Left ist Heap-Definition and Operations (Create,Insert,Delete)	1
5.4	Binomial Heap-Definition and Operations (Create,Insert,Delete)	1
5.5	Applications on Binary Heap: Heap Sort, use of winner trees in merge sort as an external sorting algorithm	1
6	**Search Tree**	
6.1	Binary Search trees – Definition, Properties and Operations(Create,Insert,Delete,Search)	2
6.2	AVL Trees-Definition, Importance of Balancing, Properties and Operations (Create, Insert, Delete,Search)	1
6.3	Red-Black Trees – Definition, Compare with AVL ,Properties and Operations (Create, Insert, Delete,Search)	1
7	**Multiway Search Trees**	
7.1	Issues in large dictionaries, string matching	1
7.2	B-Tree-Definition, Properties and Operations(Create,Insert,Delete,Search)	1
7.3	Tries-Definition and Operations (Create,Insert,Delete,Search)	1
7.4	Application on Tries: Pattern Searching	1
8	**Disjoint Set**	
8.1	Definition and Operations(Make, Union, Find)	1
9	Hashing	
9.1	Definition-hash table, hash function	1
9.2	Collision resolution and overflow handling techniques	1
9.2.1	Open Hashing(Separate Chaining)	1
9.2.2	Closed Hashing (Open Addressing) – Linear, Quadratic, Double	1
9.2.3	Rehashing	1
9.3	Applications-LZWT ext compression algorithm.	1
	Total No of Hours	45

Course Designers:

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22CA130	Database Management Systems	CATEGORY	L	T	P	CREDIT
		PC	3	1	0	4

Preamble

This course aims at facilitating the student to understand the various concepts and functionalities of Database Management Systems, the method and model to store data and how to manipulate them through query languages, the effective designing of relational database and how the system manages the concurrent usage of data in multi user environment.

Prerequisite

None

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Develop Entity Relationship(ER) and Relational Models for a given application	Apply
CO2	Build and manipulate relational database using Structured Query Language and relational languages.	Apply
CO3	Develop a normalized database for a given application by incorporating various constraints like integrity and value constraints.	Apply
CO4	Construct data structures like indexes and hash tables for the fast retrieval of data	Apply
CO5	Illustrate different transaction and concurrency control mechanismsto preserve data consistency in a multi-user environment.	Apply
CO6	Explain the basic requirements for Backup and recovery	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	M	M	L	-	-	-	-	-	-	-
CO2	M	M	S	M	L	-	-	-	-	-	-	-
CO3	S	S	S	-	-	-	-	-	-	-	-	-
CO4	S	S	L	M	S	-	-	-	-	-	-	-
CO5	M	S	S	M	-	-	-	-	-	-	-	-
CO6	L	M	M	M	L							

S-Strong; M-Medium; L-Low

Assessment Pattern

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	20
Understand	20	20	40	30
Apply	60	60	40	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What are mapping cardinalities? State their uses with examples.
2. Define weak entity set with an example.
3. Explain the concepts of generalization – specialization in E-R Model with suitableexamples.
4. For the following employee database

   employee(employee-name, street, city)
   works(employee-name, company-name,
   salary)company(company-name, city)
   manages(employee-name, manager-name)

   Draw the ER diagram with all possible components and cardinalities.
5. Illustrate the concept of aggregation with suitable example.

Course Outcome 2 (CO2):

1. What do you mean by data integrity?
2. Recall the use of CHECK constraint.
3. How will you drop a table whose primary key is referenced by a foreign key in anothertable? Give two possible ways to accomplish this task.
4. Consider the following schema used by the Campus Book

   Store:B OOK(bookno, bookname, booktype, price)
   PUBLISHER(pname, address, phone)
   STOCK(bookno, pname, quantity)

   a) Create the tables with appropriate constraints.
   b) Alter the table PUBLISHER and change the attribute „address" to composite attribute.
   c) Drop the constraint in PUBLISHER table.

5. Considering the schema structure given below

   CUSTOMER(custno, custname, city, phone)

   ITEM (Itemno, Itemname, Itemprice,

   QtyOnhand)INVOICE (Invno , Invdate ,

   Custno)

   INVITEM (Invno , Itemno , Qty)

   For each of the following queries, give an expression in relational algebra and SQL.

   a) Find customers from „Chennai „.

   b) Display all item name along with the quantity sold.

   c) Find the customers who are not from „Madurai‟ (use set operator)

Course Outcome 3 (CO3) :

1. Outline the desirable properties of decomposition.
2. Using the functional dependencies given A->BC , CD->E, B->D, E->A Compute B+.
3. When a relation is said to be in 1NF? Give an example.
4. Design a database for the Banking environment by following the various design phasesincluding normalization.
5. For the following employee database

   employee(employee-name, Address)

   company(company-name, Address,

   setof(Phones))Address(street,city,pincode)

   works(employee-name, company-name, salary)

   Construct the appropriate tables by considering

   normalization.

Course Outcome 4 (CO4) :

1. List the advantages of dynamic hashing when compared to static hashing.
2. Stable storage can‟t be implemented. Explain why.
3. Consider the following account relation and construct a bitmap index on the attributes branch_name and balance, dividing balance values into 4 ranges – < 250, 250 ..<500, 500..<750 and >750.

Account_No	Branch_Name	Balance
A-217	Madurai	200
A-219	Chennai	600
A-117	Coimbatore	350
A-207	Madurai	800
A-317	Chennai	700

4. Construct a B+ tree for the following set of key values { 2,3,5,7,11,17,19,23,29,31 }
5. Suppose that we are using extendable hashing on a file that contains records with the

following search key values 2,3,5,7,11,17,19,23,29,31. Show the extendable hash structure for this file, if the hash function is h(x)=x mod 8 and buckets can hold 3 records.

Course Outcome 5 (CO5) :

1. In what way can you implement atomicity in transactions? Explain.
2. Define concurrency control.
3. What do you mean by Serializability?
4. When will deadlock occur in concurrent transactions?
5. Consider the following ordering Schedule - S of transactions:

   T3: W(X); T2: R(X); T3: commit; T1: W(Y); T1: commit; T2: R(Y); T2: W(Z); T2: commit;T4: R(X); T4: R(Y); T4:W(Z); T4: commit.

   a) Draw the precedence graph for S.
   b) Is S conflict-serializable according to the precedence graph? Justify.
   c) Identify the transactions that are view equivalent and justify your answer.

Course Outcome 6 (CO6) :

Backup and recovery(CO6)

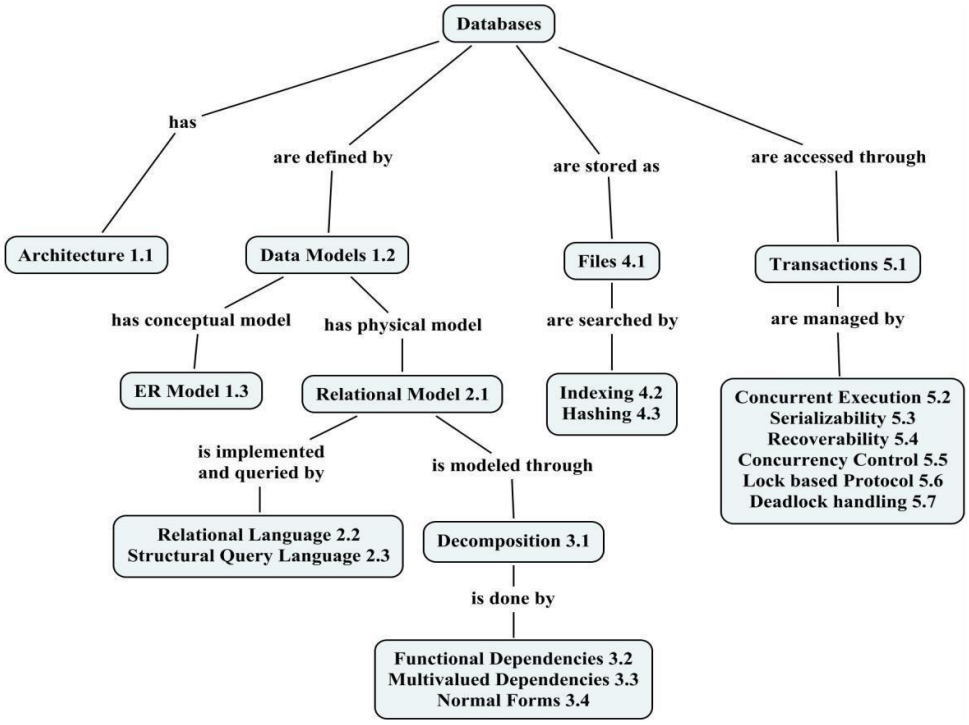
1. Consider the following transactions

T1: read(A);
read(B);
if A=0 then
B:=B+1; write(B)
	T2: read(B);
	read(A);
	if B=0 then
	A:=A+1; write(A)

Add lock and unlock instructions to the above transactions and show that they observe two-phase locking protocol.

2. Compute the closure of the following set F of functional dependencies for relation schema R= (A,B,C,D,E).
A->BC, CD->E, B->D, E->A
List the candidate keys for R.

Concept Map



Syllabus

Introduction to database: Purpose of database system, System Architecture, Data Models - ER data model. **Relational Databases**: Relational Model, Mapping ER model to Relational Model, Relational language, Structured Query Language - DDL, DML and TCL. **Database design**: Decomposition, Functional Dependencies, Multivalved Dependencies, and Normal forms. **Data Storage**: File Structure - Indexing, Ordered Index, Bitmap index, index files, Hashing - Static and dynamic hashing. **Transaction and Concurrency control** - Transaction concepts, Concurrent Execution, Serializability, Recoverability, Concurrency Control, Lock based protocol, Deadlock handling.

Reference Books

1. Henry F. Korth, Abraham Silberchatz, S.Sudarshan, Database System Concepts, McGraw-Hill-2020
2. Ramez Elmasri, Shamkant B. Navathe - Fundamentals of Database Systems –Addison Wesley Higher Education – 2018
3. Raghu Ramakrishnan, Johannes Gehrke- Database Management Systems - ThirdEdition-McGraw-Hill-2014
4. C.J.Date, Longman, Dr.S.Swamynathan, Introduction to Database Systems, Pearson Education -2010
5. Hoffer, Prescott & McFadden-Modern Database Management – Eighth Edition-Prentice Hall-2010
6. Kifer, Bernstein & Lewis Database Systems: An Application Oriented Approach, Compete Version – Second Edition – Addison Wesley Higher Education -2010

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1	**Introduction to database (4)**	
1.1	Purpose of database system, System Architecture	1
1.2	Data Models – ER Model	3
2	**Relational Databases (10)**	
2.1	Relational Model, Mapping ER model to Relational Model	2
2.2	Relational language – Relational Algebra	2
2.3.1	Structured Query Language – DDL	2
2.3.2	Structured Query Language – DML	4
2.3.3	Structured Query Language – TCL	2
3	**Database design (7)**	
3.1	Decomposition	1
3.2	Functional Dependencies	2
3.2	Multivalved Dependencies	2
3.4	Normal forms	2
4	**Data Storage (7)**	
4.1	File Structure	1
4.2	Indexing, Ordered Index, Bitmap index, index files	3
4.3	Static and dynamic hashing	3
5	**Transaction and Concurrency control (8)**	
5.1	Transaction concepts	2
5.2	Concurrent Execution	1
5.3	Serializability	2
5.4	Recoverability	2
5.5	Concurrency Control	2
5.6	Lock based protocol	2
5.7	Deadlock handling	1
	Total	**42**

Course Designers:

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22CA140	Software Engineering	CATEGORY	L	T	P	CREDIT
		PC	3	1	0	4

Preamble

This course presents methods, tools and procedures that enable to control the process of software development and provide the student with a foundation for building quality software in a productive manner. The course highlights the application of systematic, disciplined, quantifiable approach to the development, operation and maintenance of software. The course also enables the students to acquire analytical, critical, technical writing, team building and managerial skills through team project activities by using agile practices

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Compare traditional and agile software process models	Understand
CO2	Identify user stories, Story map, functional and non-functional requirements for any given problem	Apply
CO3	Prepare design documents with standards for the given requirements	Apply
CO4	Develop test cases using appropriate testing techniques for an application	Apply
CO5	Illustrate the use of version controlling and tracking Mechanisms	Apply
CO6	Demonstrate DEVOPS life cycle processes	Understand

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	L					L					
CO2	S	M										
CO3	M		M	M			S	S				
CO4	L		L		S			L				
CO5	M	S		S	L							
CO6		S		M	L		M	S				

S-Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	20
Understand	40	20	20	30
Apply	40	60	60	50
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1(CO1):

1. Identify the needs for software engineering.
2. Differentiate the various processing models highlighting their advantages and disadvantages.
3. As a Project Manager, you have been contracted to build the software for weather monitoring system. Choose a process model that best fits your project and justify your answer comparing with other process models. Explain your choice of process model in detail.
4. Using the example of safe home security function, justify how does Agile process model can be implemented in this project. Write advantages and disadvantages
5. Explain the roles and responsibilities of software project manager.

Course Outcome 2(CO2):

1. Identify user stories and draw story map for Railway reservation system.
2. Explain the requirements analysis process.
3. Differentiate the requirements analysis process between various process models
4. Signing off contract is a major task in requirements analysis. Justify your answer for this foragile process model.
5. Identify functional requirements for Online shopping software
6. Identify functional and non-functional requirements for the given case study.

Course Outcome 3(CO3)

1. Draw DFD for the given case study (online shopping software)
2. Select use case diagram for the given case study (online shopping software)
3. Draw class and sequential diagram for the given case study (online shopping software)
4. Construct activity diagram for the given case study (Library Management System)
5. Draw use case diagram for Hospital management.

Course Outcome 4 (CO4)

1. Explain different testing techniques
2. Explain cause-effect testing technique with suitable example
3. Design the black-box test suite for software that computes the square root of an inputinteger which can assume values in the range of 0 to 5000.
4. Identify test cases for Prime Number generation program using the cyclomatic complexity
5. Draw program dependence graph and write test cases for the given problem.

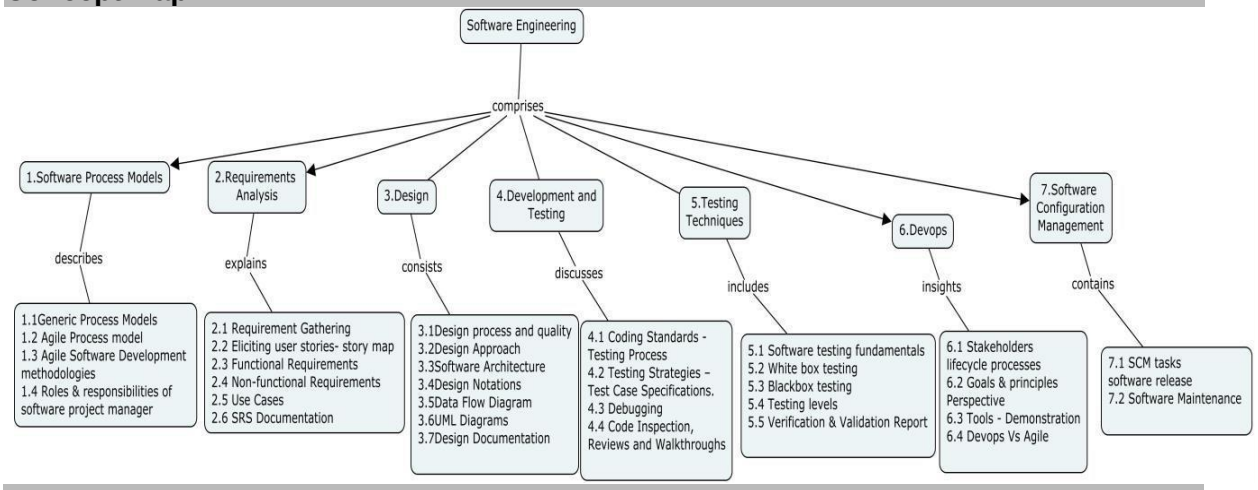
Course Outcome 5(CO5)

1. List SCM tasks.
2. Explain version controlling and tracking
3. Identify the characteristics of software maintenance.
4. Define software release plan.
5. Discuss about software reviews

Course Outcome 6(CO6):

1. List Devops stakeholders.
2. Identify Devops goals and principles.
3. Explain Devops life cycle processes
4. Compare Devops and Agile process models
5. Describe the advantages of using Devops

Concept Map



Syllabus

Software Process Models: Generic Process Models Vs Agile Process model. Agile Software Development methodologies -Extreme Programming (XP), Adaptive Software Development (ASD) - Dynamic Systems Development Method (DSDM) – Scrum – Crystal – Feature Driven Development (FDD) - Roles and responsibilities of software project manager
Requirements Analysis: Requirement Gathering – Eliciting user stories- story map - Functional Requirements - Non-functional Requirements. Use Cases – SRS Documentation
Design: Design process and quality - Design concepts – design guidelines – Design Approach - Structured approach – Object-oriented approach. Software Architecture- Data design – Architectural styles and patterns - User Interface Design. Design Notations – Data Flow Diagram – Context Diagram - UML Diagrams – Class Diagram - Sequential Diagram – User Interface Design - Design Documentation. Exploration of Design tools
Development and Testing: – Coding Standards –Testing Process – Testing Strategies – Test Case Specifications. Debugging - Code Inspection, Reviews and Walkthroughs
Testing techniques: – Software testing fundamentals – Black box and white box testing - White box testing - Basis path testing- Control structure testing – Program Dependence Graph. Black box testing –Equivalence Partitioning – Boundary Value Analysis – Cause effect graph Testing levels – Unit testing – Integration testing - System testing -Modular testing – Regression testing –User acceptance testing – Verification & Validation Report. Testing tools.
Devops: Stakeholders – Lifecycle processes – Goals & principles –Perspective –Tools - Demonstration of Devops. DevopsVs Agile.
Software Configuration Management: SCM tasks- version control- tracking- software release. Software Maintenance – characteristics, controlling factors, maintenance tasks

Learning Resources

1. Fundamentals of Software Engineering, (5thEdition) RajibMall, Prentice-Hall of India
2018.
2. IanSomerville, Software Engineering,10thEdition, Addison Wesley,2017
3. RogerPressman, Software Engineering: A Practitioners Approach, (8thEdition), McGrawHill, 2015.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Hours
1	**Software Process Models**	
1.1	Generic Process Models	1
1.2	Agile Process model	1
1.3	Agile Software Development methodologies	
1.3.1	Extreme Programming (XP)	1
1.3.2	Adaptive Software Development (ASD)	
1.3.3	Dynamic Systems Development Method (DSDM)	1
1.3.4	Scrum	2
1.3.5	Crystal	
1.3.6	Feature Driven Development (FDD)	
1.4	Roles and responsibilities of software project manager	1
2	**Requirements Analysis**	
2.1	Requirement Gathering	1
2.2	Eliciting user stories- story map	1
2.3	Functional Requirements	1
2.4	Non-functional Requirements	1
2.5	Use Cases	1
2.6	SRS Documentation	1
3	**Design**	
3.1	Design process and quality - Design concepts – Design guidelines	1
3.2	Design Approach - Structured approach – Object-oriented approach.	1
3.3	Software Architecture - Data design –Architectural styles and Patterns	1
3.4	Design Notations	1
3.5	Data Flow Diagram – Context Diagram	2
3.6	UML Diagrams – Class Diagram - Sequential Diagram – User Interface Design	2
3.7	Design Documentation	1
4	**Development and Testing**	
4.1	Coding Standards –Testing Process -	1
4.2	Testing Strategies – Test Case Specifications.	2
4.3	Debugging	1

4.4	Code Inspection, Reviews and Walkthroughs	1
5	**Testing techniques**	
5.1	Software testing fundamentals	1
5.2	White box testing	1
5.2.1	Basis path testing	1
5.2.2	Control structure testing	1
5.2.3	Program Dependence Graph	1
5.3	Black box testing	1
5.3.1	Equivalence Partitioning	1
5.3.2	Boundary Value Analysis	1
5.3.3	Cause effect graph	1
5.4	Testing levels – Unit testing – Integration testing - System testing -Modular testing – Regression testing –User acceptance testing	1
5.5	Verification & Validation Report	1
5.6	Testing tools	1
6	**Devops**	
6.1	Stakeholders – lifecycle processes	1
6.2	Goals & principles – Perspective	1
6.3	Tools - Demonstration	1
6.4	DevopsVs Agile	1
7	**Software Configuration Management**	
7.1	SCM tasks- version control- tracking- software release.	1
7.2	Software Maintenance – characteristics, controlling factors, maintenance tasks	1
	Total No. of Hours	45

Course Designers:

1. P.Sharmila psaca@tce.edu

22CA150	Problem Solving Using Computers	CATEGORY	L	T	P	CREDIT
		PC	2	0	2	4

Preamble

This course is intended for the candidate who desires to learn problem-solving techniques and the design of computer solutions in a precise manner. The course emphasizes problem-solving methodologies, algorithm designs and developments and computer-programming skills.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO1	Explain an algorithmic solution for the given requirements using problem decomposition and step-wise refinement.	Understand
CO2	Construct algorithms for solving engineering problems using appropriate repetition and selection constructs.	Apply
CO3	Demonstrate fundamental programming knowledge by designing structured programs and algorithms with the help of fundamental Data structures.	Apply
CO4	Solve searching, sorting and string manipulation problems using iteration or modularization as applicable.	Apply
CO5	Describe methods for text processing and pattern searching.	Understand
CO6	Develop programs based on the algorithms devised for solving problems.	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	L									L
CO2	S	S	M		L	L		L	L			L
CO3	M	M	L		L							L
CO4	S	S	M		L	L		L	L			L
CO5	M	M	L									L
CO6	S	S	M		S	L		L	L			L

S-Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	20
Understand	50	40	40	40
Apply	30	40	40	40
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1(CO1):

1. Draw the flow chart to find the biggest of 3 numbers(Understand)
2. Explain the pseudo code to get three marks of a student and find the average of 3 marks and display it.(Understand)

Course Outcome 2(CO2):

1. Write a pseudocode to generate Fibonacci series upto n terms.
2. Develop an algorithm that will read two integer numbers and an integer code from user.

   The value of the integer code should be 1, 2 or 3. The table below specifies the process to be taken based on the integer code. The program displays the computed result to the screen

Integer code	Tasks/Actions to be taken
1	Compute the sum of the two numbers
2	Compute the difference of the two numbers (first number-second number)
3	Compute the product of the two numbers
4	Display error

Course Outcome 3(CO3):

1. Discuss the logic of algorithm that will get an array of 10 character letters, count the number of vowels in the array. A letter, such as a, e, i, o, and u in the English alphabet represents a vowel. The algorithm is then to display the number of vowels in the array.
2. Give an algorithm that gets the maximum and minimum value in a dictionary.

Course Outcome 4(CO4):

1. Develop an algorithm to compare two strings.
2. Given an array arr = {4, 6, 72, 81, 91} and key = 81; How many iterations are done until the element is found in Binary Search?
3. Develop an algorithm with swap_case function that works like this: i/p:Hello,o/p:hELLO

Course Outcome 5(CO5):

1. What is text processing?

2. Explain the algorithm for linear pattern searching.

Course Outcome6 (CO6):

1. Write a program for binary search.

TestData: binary_search([1,2,3,5,8],6)
Output:
False

2. Write a program that accepts a string and calculate the number of digits and letters.

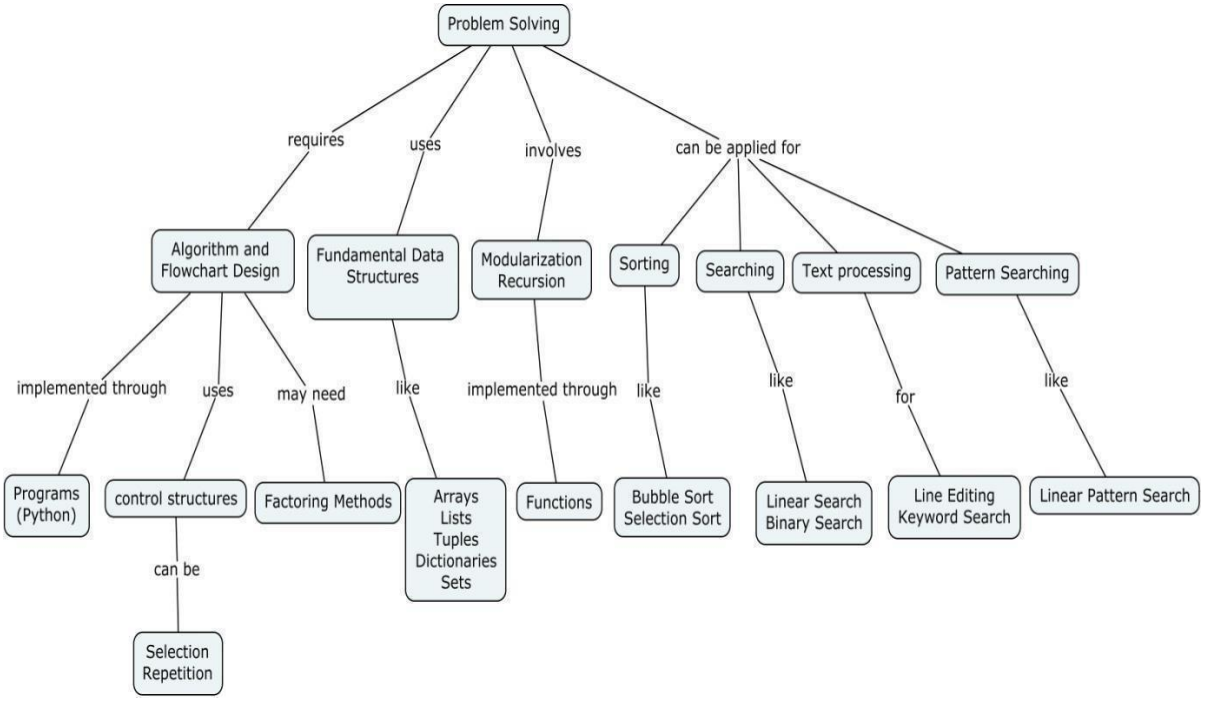
Sample Data : Version 5.6.2Output :
Letters 7
Digits 3

3. Write a program to remove an item from a set if it is present in the set.

Mini Project Details: (Teamsize:3)

- Problem identification.
- Problem Analysis and Modular design.
- Develop algorithm/pseudo code and draw the flowchart – module wise individually.
- Develop programs module level, test and debug individually.
- Integrate the modular programs and present the results in a team.
- Document the above process as are port.

Concept Map



Syllabus

Introduction to Computer Problem Solving: Problem Solving aspect, Topdown Design, Flowcharts, Developing an Algorithm**Efficiency of algorithms, Analysis of algorithms**, Problem solving using fundamental algorithms-Exchanging the values of two variables, Counting. Selection Control Structures, Repetition Control Structures**,** Algorithms Using Selection and Repetition - Summation of a set of numbers, Reversing Digits of an Integer.

Factoring Methods-Finding Square root of a number, smallest divisor of an integer, Greatest common divisor of two integers, Generating Prime numbers, Implementation of fundamental algorithms and factoring methods.
Array Techniques: Array order reversal, Array Counting, Finding maximum and the minimum value in a set, Modularization and recursion. Collection data types–Tuples, Lists, Sets, and Dictionaries, Implementation of array techniques and Collection data types.
Sorting and Searching: Bubble Sort, Selection Sort, Linear Search, Binary Search, Implementation of sorting and searching.
Text Processing and Pattern Searching: Text line editing, keyword searching, and linear pattern searching, and Implementation of Text Processing and pattern searching.

Learning Resources

1. John V.Guttag, " Introduction to Computation and Programming Using Python: With Application to Understanding Data", Prentice-Hall International publishers, Second Edition, 2017.
2. Reema Thareja, "Python Programming using problem solving Approach", Oxford University, Higher Education Oxford University Press, First edition, 2017.
3. E.Balagurusamy, "Introduction to Computing and Problem Solving using Python", Mcgraw Higher Ed, First Edition, 2016.
4. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Updated for Python 3, Shroff/O, Reilly Publishers, Second Edition,2016.
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt.Ltd., First Edition, 2016.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1	**Introduction to Computer Problem Solving**	
1.1	Problem Solving aspect, Topdown Design	1
1.2	Flowcharts	1
1.3	Developing an Algorithm	1
1.4	Efficiency of algorithms, Analysis of algorithms	2
1.5	Problem Solving using Fundamental Algorithms - Exchanging the values of two variables, Counting	2
2	**Control Structures and Factoring Methods**	
2.1	Selection Control Structures, Repetition Control Structures	3
2.2	Summation of a set of numbers	2
2.3	Reversing Digits of an Integer	2
2.4	Factoring Methods: Finding Square root of a number, smallest divisor of an integer	2

2.5	Greatest common divisor of two integers, Generating Prime numbers.	3
2.6	Implementation of fundamental algorithms and factoring methods	3
3	**Array Techniques**	
3.1	Array order reversal, Array Counting, Finding maximum and the minimum value in a set.	2
3.2	Modularization and recursion	2
3.3	Collection datatypes –Tuples, Lists, Sets, and Dictionaries.	2
3.4	Implementation of array techniques and Collection Data types.	2
4	**Sorting and Searching**	
4.1	Bubble Sort, Selection Sort	2
4.2	Linear Search, Binary Search	2
4.3	Implementation of sorting and searching.	2
5	**Text Processing and Pattern Searching**	
5.1	Text line editing	1
5.2	Keyword searching, and linear pattern searching	1
5.3	Implementation of text processing	2
5.4	Implementation of pattern searching	1
	Total No. of Hours	**30**

Module No.	**Topic**	No. of Practical Hours
1	**Introduction to Computer Problem Solving**	
1.1	Problem Solving aspect, Top down Design	2
1.2	Flowcharts	
1.3	Developing an Algorithm	
1.4	Efficiency of algorithms, Analysis of algorithms	
1.5	Problem Solving using Fundamental Algorithms – Exchanging the values of two variables, Counting	
2	**Control Structures and Factoring Methods**	
2.1	Selection Control Structures, Repetition Control Structures	2
2.2	Summation of a set of numbers	
2.3	Reversing Digits of an Integer	
2.4	Factoring Methods: Finding Square root of a number, Smallest divisor of an integer	2
2.5	Greatest common divisor of two integers, Generating Prime numbers.	
2.6	Implementation of fundamental algorithms and factoring methods	
3	**Array Techniques**	

3.1	Array order reversal, Array Counting, Finding maximum and the minimum value in a set.	2
3.2	Modularization and recursion	
3.3	Collection datatypes –Tuples, Lists, Sets, and Dictionaries.	2
3.4	Implementation of array techniques and Collection datatypes.	
4	**Sorting and Searching**	
4.1	Bubble Sort, Selection Sort	4
4.2	Linear Search, Binary Search	
4.3	Implementation of sorting and searching.	
5	**Text Processing and Pattern Searching**	
5.1	Text line editing	2
5.2	Keyword searching, and linear pattern searching	
5.3	Implementation of text processing	2
5.4	Implementation of pattern searching	
	Total No. of Hours	**18**

Course Designers:

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2. P.Sharmila psaca@tce.edu

22CA170	RDBMS Laboratory	CATEGORY	L	T	P	CREDIT
		PC	0	0	2	2

Preamble

This course aims at giving adequate exposure to students on the Database design and E-R modelling. The course also facilitates students with hands on training on SQL and programming language extension to SQL within the RDBMS environment.

Prerequisite

22CA130 Database Management Systems

Course Outcomes

On the successful completion of the course students will be able to

CO1	Model Entity Relationship with E-R diagrams	Apply
CO2	Design database schema considering normalization and relationships within database.	Apply
CO3	Write SQL queries to user specifications.	Apply
CO4	Develop triggers, procedures, user defined functions and design accurate and PLSQL programs in Oracle and DB2.	Apply
CO5	Use the database from a front end application.	Apply
CO6	Prepare technical report on the observations of the experiments	Apply

S-Strong; M-Medium; L-Low

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	-	S	L	L	-	-	-	-	-
CO2	S	S	S	-	S	L	L	-	-	-	-	-
CO3	S	S	S	-	S	L	L	-	-	-	-	-
CO4	S	S	S	-	S	L	L	-	-	-	-	-
CO5	S	S	S	-	S	L	L	-	-	-	-	-
CO6	L	-	-	-	M	M	L	-	S	-	-	-

List of Experiments

1. Basic SQL – DDL & DML, Views, Group operations, aggregate operations, System operations in Oracle
2. Intermediate SQL–Joins, Subqueries, DCL operations
3. Advanced SQL–Nested tables, V-arrays
4. ER Modeling
5. Database Design and Normalization

6. Stored procedures and using them in a client application
7. Triggers and their front end application
8. DBA mechanisms – Installation, Backup and recovery operations, Batch processing
9. **Mini Project**

The course instructor shall provide real time problems / specifications to the students for mini project. The project shall be completed before the commencement of 2nd semester and a report shall be submitted.

Sample Specifications

Design a database for student mark entry system. Provide provisions for different queries, procedures and triggers.

Sample Queries:

1. List the name of students under one particular staff.
2. Find the students who are below 50 marks in all subjects.

Procedure:

Write the procedure for calculating total marks (internal+ external) for a particular student.

Trigger:

Raise the trigger for entering the internal mark more than 30.

Marks: Algorithm = 10 E-R Diagram = 15. Table Design=15 Queries = 20. Procedure=15. Trigger=15. Viva =10.

Note: Experiments 1 to 8 are to be carried out in a single application domain preferably in Oracle/DB2.

Course Designer:

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22CA180	Data Structure Using C Laboratory	CATEGORY	L	T	P	CREDIT
		PC	0	0	2	2

Preamble

With a dynamic learn by doing focus, this laboratory course encourages students to explore data structures by implementing them, a process through which students discover how data structures work and their applicability for the problems. This course challenges students to exercise their creativity in both programming and analysis.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO1	Construct and Implement the stack and queue functionality for suitable applications.	Apply
CO2	Implement the operations in linked list data structure for suitable applications	Apply
CO3	Implement appropriate binary and multi way search tree for performing searching operations, with an understanding of the trade-off between the time and space complexity.	Apply
CO4	Manipulate disjoint sets by performing union, iterative find-set operations	Apply
CO5	Implement heap tree for various applications	Apply
CO6	Show the avoidance of collisions in the hash tables using collision resolution techniques including open and closed hashing techniques.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1 2
CO1	S	M	L		L				M	L		
CO2	S	M	L		L				M	L		
CO3	S	M	L		L				M	L		
CO4	S	M	L		L				M	L		
CO5	S	M	L		L				M	L		
CO6	S	M	L		L				M	L		

S-Strong; M-Medium; L-Low

List of Experiments

1. Circular Queue and its application using arrays and/or linked list
2. Singly Linked List and its application
3. Circular Linked List and its application

4. Doubly Linked List and its application
5. Binary Search Tree operations and Traversals
6. AVL Tree operations and Traversals
7. Disjoint Set
8. Binary Heap operations and their application
9. Implementation of B Tree
10. Open and Closed Hashing

Learning Resources

1. La Rocca, M, “Advanced Algorithms and Data Structures”, United states: Manning, 2021.
2. Y.Langsam, M.J. Augenstein and A.N. Tanenbaum, “Data Structure Using C and C++”, Pearson Education, 2nd Edition,2015.
3. MarkAllenWeiss,“Data Structures and Algorithm Analysis in C++”, Pearson,2007
4. Adam Drozdek, “Data structures and Algorithms in C++”, Cengage Learning; 4th edition, 2012.

Course Designers:

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22CA190	Professional Communication	CATEGORY	L	T	P	CREDIT
		EEC	0	1	1	2

Preamble

This course provides opportunities to students to develop and demonstrate basic communication skills in technical, professional and social contexts effectively.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Listen to and respond confidently to neutral and native speakers in presentations, dialogues, and other situations on scientific, general context, and ETS samples.	Understand
CO2	Present ideas on a variety of technical topics, both individually and in groups, in a clear and confident manner.	Apply
CO3	Participate in talks and discussions on a variety of technical and non-Technical topics to express the thoughts and opinions.	Apply
CO4	Read and comprehend texts and passages to answer verbal aptitude Questions related to placement and higher studies.	Understand
CO5	Write with clarity, accuracy, intelligibility, and precision for journals and Business correspondences.	Apply
CO6	Enable students to demonstrate employability skills to make them industry-ready.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M		S		S	
CO2							M		S		S	
CO3							M		S		S	
CO4							M		S		S	
CO5							M		S		S	
CO6							M		S		S	

S-Strong; M-Medium; L-Low

Assessment Pattern

Internal

No Common Continuous Assessment Test (CAT) will be conducted.

Students' performance will be continuously assessed in various classroom activities on Listening, Speaking, Reading, and Writingfor50 marks as detailed below

- Listening Test - 10
- Speaking Test-Technical Presentation(10),(Movie/Book- Review)&GD(5) - 15
- Reading(Reading Comprehension(5) and Verbal Reasoning(5) - 10
- Written Test–General Aptitude Test - 15

(The test will be conducted for 30 marks and reduced to 15)

External (Practical)

Listening Test	- 20
Group Discussion	- 20
Personal Interview/Situational Conversation	- 20
Reading(Reading Comprehension and Reasoning)	- 10
General Aptitude Test	- 20
Resume Submission	- 10

List of Experiments

Sl.No.	Topic	No.ofHours	
		Tutorial	Practical
1	Characteristics of Technical Writing	2	
2	Development of Employability Skills	2	
3	Vocabulary Development	2	
4	Sentence Completion	1	
5	Error Spotting	1	
6	Interpretation of Verbal Analogy	1	
7	Interpretation of Reading(Comprehension-Conception)	1	
8	Interpretation of Reading(Comprehension-Reasoning)	1	
9	Practice for writing E-mails/Forums	1	
10	PPT Preparation/Demonstration of Technical Presentation		2
11	Preparation of Resume		1
12	Preparation for Job Interviews		2
13	Demonstration of Group Discussion Skills		2
14	Developing Listening Skill(Comprehension)		2

15	Practice for Short Speeches/Situational Conversation		1
16	Review: English Movies/Novels		2
	Total Hours	12	12
*(Any two English movies and two novels shall be discussed based on students' interest and relevance)			

Learning Resources

Reference Books:

1. Cappel, Annette and Sharp, Wendy, Cambridge English: Objective First, 4thEd.,CUP,
2. NewDelhi,2013.
3. Cusack,Barry.Improve Your IELTS Listening and Speaking Skills(WithCD)
4. Paperback,Mcmillan,2007.
5. Bates, Susan TOEFLiBT Exam Paperback-Oxford,2012.
6. Hart, GuyBrook .Cambridge English Business Benchmark: 2Ed.,CUP2014

Websites:

1. https://ielts-up.com(IELTS-LSRW-PracticeTests)
2. www.cambridgeenglish.org(BEC-LSRW)
3. www.etsglobal.org(TOEICPreparation)
4. www.examenglish.com(OnlineExams for international ESL Exams)
5. www.testpreppractice.net (GRE Tests -Vocabulary /Analogy / Sentence Completion /Reading)
6. https://www.freshersworld.com(PlacementPapers)

Course Designers:

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22CA210	Design and Analysis of Algorithms	CATEGORY	L	T	P	CREDIT
		PC	3	1	0	4

Preamble

Algorithm design and analysis provide the theoretical backbone of computer science. On completion of this course students will be able to: Determine the asymptotic time complexity of algorithms, Write rigorous correctness proofs for algorithms, Use different paradigms of problem solving to illustrate efficient ways of solving a given problem.

Prerequisite

22CA120 Data Structures and Applications
22CA170 Data Structures Lab

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Determine the running times of algorithms using asymptotic analysis and explain the significance of NP - completeness	Understand
CO2	Describe the divide - and-conquer paradigm and solve recurrences describing the performance of divide-and-conquer algorithms.	Apply
CO3	Construct problems graph based algorithms to solve engineering	Apply
CO4	Apply design principles for developing solutions using greedy algorithm approaches.	Apply
CO5	Analyse the algorithms and design techniques of dynamic programming to solve real world problems and mathematically evaluate the quality of the solutions.	Apply
CO6	Construct algorithms using branch and bound to solve any given problem.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1 2
CO1	S	S	M		M							
CO2	S	S	M		M							
CO3	S	S	M		M		L					
CO4	S	S	L		M		L					
CO5	S	S	L		M							
CO6	S	S	L		S	M						

S-Strong; M-Medium; L-Low

Assessment Pattern

Cognitive Levels	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	10	20
Understand	40	40	30	30
Apply	40	40	60	50
Analyse	-	-		-
Evaluate	-	-	-	-
Create	-	-	-	-

Course Level Assessment Questions

Course Outcome1(CO1):

1. Consider the searching problem: given an array A[1…n] and a value v output an Index I such that v = A[i] or the special value ф if v does not appear in A. If the array J is sorted, we can perform a binary search: compare P with the midpoint of the array and repeat the search on one half of array, eliminating the other half from further consideration.
   (a) Construct a pseudocode for binary search as a recursive procedure.
   (b) Rewrite your binary search procedure in an iterative style.
   (c) Formally state pre and post conditions for your iterative procedure. Deduce a loop invariant, and illustrate that your procedure is correct.

2. Demonstrate that Bubble Sort works by proving that
   a. It terminates.
   b. It sorts the set of numbers provided as an input.

   Deduce a loop-invariant to prove the correctness of the selection sort algorithm
   LetX1,.....,Xn be{0,1} – valued random variables such that Xi=0 with probability 1 −pi
   And Xi=1 with probability pi. Given probabilities p1,.....,pn, show how to compute
   Probabilities of events PiXi=m for all m∈[0,n], using a divide-and-conquer approach.
   Analyze the running time of your algorithm.
3. Let X be an NP – Complete problem. Consider a decision problem Z∈NP such that $X \leq_T^P$ Z. Then defend that Z is also NP-Complete.

Course Outcome 2(CO2):

1. Although merge sort runs in Θ(n log2 n) worst-case time and insertion sort runs in Θ(n2)worst-case time, the constant factors in insertion sort make it faster for small n. Thus, it makes sense to use insertion sort within merge sort when sub-problems become sufficiently small. Consider a modification to merge sort in which n/k sub-lists of length k are sorted using insertion sort and then merged using the standard merging mechanism, where k is a value to be determined.
   a) Show that the n/k sub-lists, each of length k, can be sorted by insertion sort in Θ(nk)worst-case time.
   b) Show that the sub-lists can be merged in Θ(nlog2(n/k)worst-case time.
2. The following code – fragment implements Horner's rule for evaluating a polynomial
   $(x)=\sum^{n}{}_{k=0}\, a_k x^k$

   y=0

   for i = n down to 0 y=ai+x*y

   a) In terms of Θ notation, calculate the running time of this code fragment for

Horner'srule

b) Construct a pseudo-code to implement the naïve polynomial- evaluation algorithm that computes each term of the polynomial from scratch. Calculate the running time of this algorithm. Compare it to the Horner's rule.

Course Outcome 3(CO3)

1. Show that a depth first search of an undirected graph G can be used to identify the connected components of G and that the depth first forest contains as many trees as

   G has connected components. More precisely, show how to modify depth-first-search so that each vertex v is assigned an integer label cc[v] between1and k, where k is the number of connected components of G such that cc[u] =cc[v] if and only if u and v are in the same connected component.
2. We are given a directed graph G = (V, E) on which each edge (u,v) $\in$E has an associated value r(u,v), which is a real number in the range 0 $\leq$r(u,v)$\leq$1 that represents the reliability of a communication channel from vertex u to vertex v. We interpret r(u,v) as the probability that the channel from u to v will not fail, and we assume that these probabilities are independent. Construct an efficient algorithm to find the most reliable path between two given vertices.
3. Determine an algorithm to detect cycles in a directed graph G(V,E)in O(|V|+|E|)time.

Course Outcome 4(CO4):

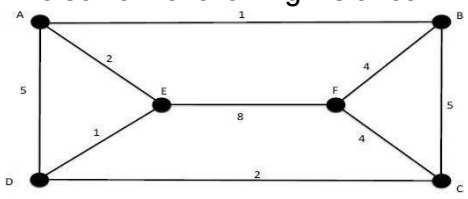
1. Defend that the greedy algorithm that solves the scheduling problem with the goal of minimizing the time spent by the customers in a system is optimal, if it adopts the following greedy strategy: "A teach step add to the end of the schedule the customer requiring the least service time among those who remain"
2. Suppose that you have a median (S) algorithm, which finds the median element in the sequence Sin O(n) time. Using this median(S) algorithm, construct a simple O(n)-linear time algorithm that solves the selection problem Select(S,k).
3. Suppose instead of running Dijkstra algorithm till the priority queue Q becomes empty, were unit as long as |Q| > 1. This change will cause the „while" loop in Dijkstra's algorithm to execute |V| - 1times instead of |V| times. Analyze whether the proposed algorithm is correct.

Course Outcome 5(CO5):

1. Write the pseudo code to find the optimal parenthesization of a matrix-chain product. Using the algorithm, find the optimal parenthesization of a matrix-chain product whose sequence of dimensions is (5,10,3,12,5)
2. Suppose we wish to find a shortest path from vertex I to vertex j. Let A I be the vertices adjacent from vertex i. Which of the vertices in Ai should be the second vertex on the path? There is no way to make a decision at this time and guarantee that future decisions leading to an optimal sequence can be made. If on the other hand we wish to find a shortest path from vertex I to all other vertices in G, then at each step, a correct decision can be made.
3. Deduce that backtracking algorithm solves the 2-SAT problem in polynomial time.

Course Outcome 6(CO6):

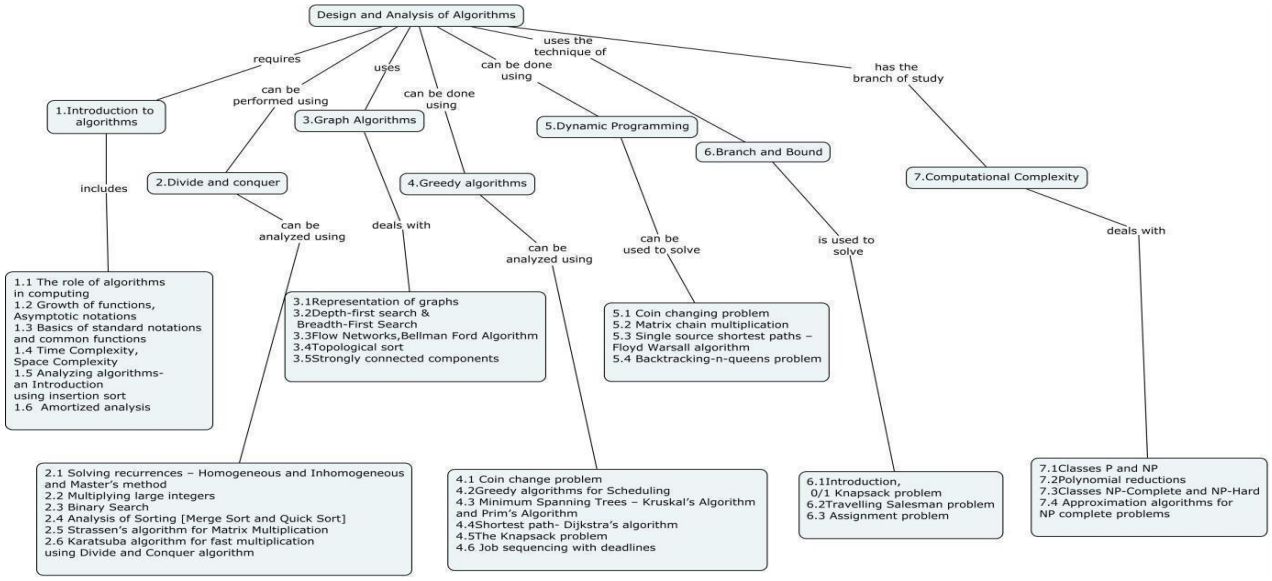
1. Apply the Branch and Bound Method (using the MST-based bounding scheme) seen in class for the TSP to solve the following instance.



2. Consider three jobs to be assigned to three machines. The cost for each combination is shown in the table below. Determine the minimal job – machine combinations

Job	Machine			
	1	2	3	Ai
1	5	7	9	1
2	14	10	12	1
3	15	13	16	1
bj	1	1	1	

Concept Map



Syllabus

Introduction to algorithms: The role of algorithms in computing, Growth of functions, Asymptotic notations, Basics of standard notations and common functions ,Time Complexity, Space Complexity ,Analyzing algorithms- an Introduction using insertion sort- Amortized analysis. **Divide and Conquer**: Solving recurrences – Homogeneous and Inhomogeneous, Master's method, Binary Search, Analysis of Sorting [Merge Sort, Quick Sort], Strassen's algorithm for Matrix Multiplication, Karatsuba algorithm for fast multiplication using Divide and Conquer algorithm. **Graph Algorithms**: Representation of graphs, Depth-first search & Breadth-First Search, Flow Networks, Bellman Ford Algorithm, Topological sort, strongly connected components. **Greedy Algorithms**: Coin change problem, Minimum Spanning Trees Kruskal's Algorithm and Prim's Algorithm, Shortest path-Dijkstra's algorithm, The Knapsack problem Job

sequencing with deadlines. **Dynamic Programming**: Coin changing problem, Matrix chain multiplication, Single source shortest paths – Floyd Warshall algorithm, Backtracking-n-queens problem. **Branch and Bound –** Introduction **-** 0/1 Knapsack problem**,** Travelling Salesman problem, Assignment problem. **Computational Complexity**: Classes P and NP, Polynomial reductions, Classes NP-Complete and NP - Hard, Approximation algorithms for NP complete problems.

Learning Resources

1. Charles E. Leiserson, Thomas H. Cormen, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, Third edition, PHI, 2015.
2. Gilles Brassard and Paul Bratley – Fundamentals of Algorithmics,PHI,2009
3. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, Second Edition, Universities Press, 2015
4. Steven S. Skiena, The Algorithm Design Manual, Second Edition, Springer, 2010.

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1.	**Introduction to Algorithms**	
1.1	The role of algorithms in computing	1
1.2	Growth of functions, Asymptotic notations	
1.3	Basics of standard notations and common functions	3
1.4	Time Complexity, Space Complexity	
1.5	Analyzing algorithms – an Introduction using insertion sort	2
1.6	Amortized analysis	
2.	**Divide and Conquer**	
2.1	Solving recurrences - Homogeneous and Inhomogeneous, Master's method	1
2.2	Multiplying large integers	1
2.3	Binary Search	1
2.4	Analysis of Sorting [Merge Sort and Quick Sort]	2
2.5	Strassen's algorithm for Matrix Multiplication	1
2.6	Karatsuba algorithm for fast multiplication using Divide And Conquer algorithm	2
3	**Graph Algorithms**	
3.1	Representation of graphs	1
3.2	Depth-first search & Breadth-First Search	2
3.3	Flow Networks, Bellman Ford Algorithm	2
3.4	Topological sort	2
3.5	Strongly connected components	1
4	**Greedy Algorithms**	
4.1	Coin change problem	2
4.2	Greedy algorithms for Scheduling	1
4.3	Minimum Spanning Trees – Kruskal's Algorithm and Prim's Algorithm	2
4.4	Shortest path – Dijkstra's algorithm	2
4.5	The Knapsack problem	2
4.6	Job sequencing with deadlines	

5	**Dynamic programming**	
5.1	Coin changing problem	1
5.2	Matrix chain multiplication	2
5.3	Single source shortest paths-Floyd Warsall algorithm	1
5.4	Backtracking-n-queens problem	1
6	**Branch and Bound**	
6.1	Introduction, 0/1 Knapsack problem	1
6.2	Travelling Salesman problem	2
6.3	Assignment problem	2
7	**Computational Complexity**	
7.1	Classes P and NP	2
7.2	Polynomial reductions	
7.3	Classes NP – Complete and NP-Hard	2
7.4	Approximation algorithms for NP complete problems.	
	Total No of Hours	**45**

Course Designers:

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22CA220	Object Oriented Programming	CATEGORY	L	T	P	CREDIT
		PC	3	1	0	4

Preamble

This course is intended for enabling students to learn Object Oriented Programming concepts and develop solutions for the real world problem. The syllabus emphasizes on OOP concepts, package, interfaces, exception handling, threads, collection, events and swing.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course students will be able to

CO1	Make use of programming concepts like Control structures, looping statements, typecasting and I/O file operations etc.	Understand
CO2	Construct object – oriented programs for the given scenario using object Oriented concepts like abstraction, encapsulation, polymorphism and inheritance.	Apply
CO3	Apply package, interface and exception handling mechanism for the given problem.	Apply
CO4	Implement multi thread concepts for the real world scenario.	Apply
CO5	Make use of Collections and Logging to solve the given problem.	Apply
CO6	Develop object-oriented applications for the given scenario that uses events through swing.	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L		L			L				M
CO2	S	M	L		L			L				M
CO3	S	M	L		L			L				M
CO4	S	M	L		M			L				M
CO5	S	M	L		M			L				S
CO6	S	M	L		M			L				S

S-Strong; M-Medium; L-Low

Assessment Pattern: Cognitive Domain

Cognitive Levels	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	20
Understand	30	30	20	20
Apply	50	50	60	60
Analyze	0	0	0	-
Evaluate	0	0	0	-
Create	0	0	0	-

Course Level Assessment Questions

Course Outcome 1(CO1)

1. Explain about the benefits of Object oriented Programming.
2. Write a Java program to create 2 two-dimensional arrays which hold numbers. Write a method
   which takes the arrays as arguments to perform matrix multiplication.
3. Write a Java Program to Copy the file contents from one to another.
4. Write a Java Program to generate the Armstrong no within the predefined range.

Course Outcome 2(CO2)

1. Write a java program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contain only the method printArea() that prints the area of the given shape.
2. Write a Java Program to implement multilevel inheritance for the following classes: Project, Task and Module. Assume the data members and methods used.
3. Illustrate compile time and runtime polymorphism for employee management system using a java program.
4. Produce a Java program for finding volume of different geometric shapes - cylinder, Rectangle and cube. Apply encapsulation to get and set the values of the attributes and apply compile time polymorphism to find the volume of shapes. (Hint: Volume of cylinder: 3.14 *r^2*h, rectangle = l*b*h, Cube= a^3)

Course Outcome 3(CO3)

1. Illustrate the following exceptions with a sample program and handle it using try with multiple catch.
   - Number Format Exception
   - Array Index Out of Bounds Exception
   - Arithmetic Exception
2. Discuss the ways of implementing interface with example program.
3. Differentiate checked exception from unchecked exception.
   Write a Java program to create a package which has classes and methods to read Student Admission details.

Course Outcome 4(CO4):

1. Write a Java Program to print the numbers 1 to 50 alternatively by Threads (Use Multithreading).
2. Write a java program to illustrate synchronization concept in threading.
3. Demonstrate inter-thread communication between ticket booking and cancellation in “Bus Reservation System”. Assume appropriate members and member

functions

4. Apply multithread programming concept to demonstrate how threads are running with different priority value. Take any real time application to illustrate the above.

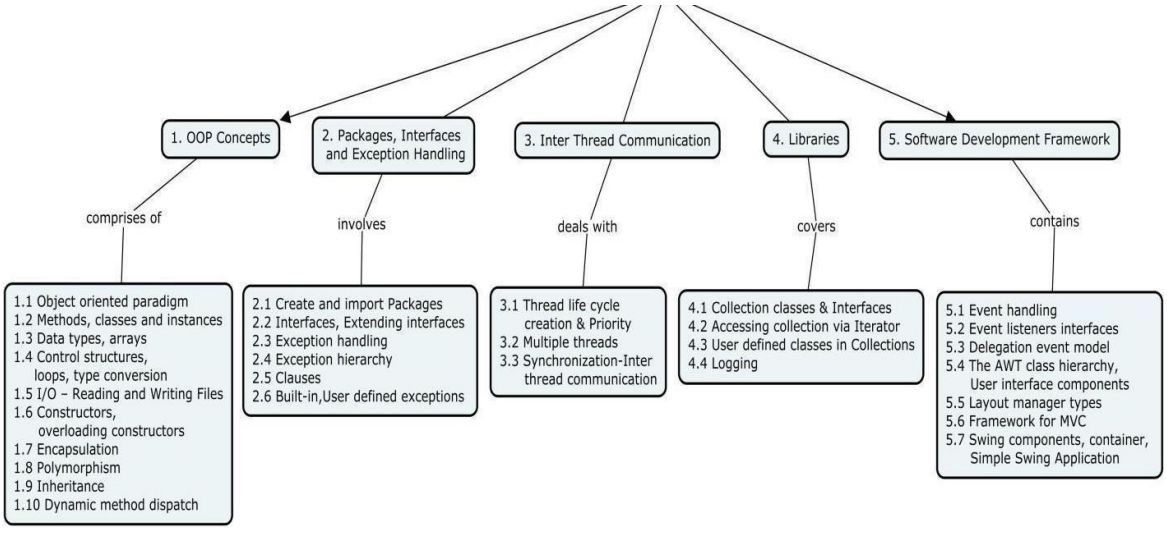
Course Outcome 5(CO5)

1. Identify the suitable collection for storing the student name (inclusive of duplicates) in the random order. Perform the following operations.
   a. Display the student name without duplicate
   b. Arrange the name in ascending order
   c. Count the number of students with duplicate
   d. Remove the student whose index is at 5
2. Identify any three levels of logs for electrical billing application. Write a program to generate it and store it in a file.
3. List out any four built – in classes in "collections framework".
4. List any four handlers that uses to handle log information.
5. Create any 3 collections for different types of books. Find the name of the book based on the given id. Generate the bill for the purchased books.

Course Outcome 6(CO6)

1. Design and develop an application for bill calculation of a book shop using swing with events.
2. Write an applet to perform the 4 basic arithmetic operations as buttons in a form accepting two integers in textboxes and display their result.
3. List out any four Listener Interfaces in Event Handling.
4. Recall the syntax of different layouts in swing handling.
5. Write a java program that simulates a traffic signal. The program lets the user select one of three lights: red, yellow, or green with radio buttons. On selecting a button, an appropriate message with "stop" or "ready" or "go" should appear above the buttons in a selected color. Initially there is no message shown.

Concept Map



Syllabus

Object Oriented Programming Concepts: object-oriented paradigm, methods, classes and instances, datatypes, arrays, control structures, looping statements, type conversion and casting, I/O – Reading and Writing Files, Constructors, overloading constructors, encapsulation, polymorphism, inheritance, Dynamic Method Dispatch

Packages, Interfaces and Exception Handling: Create and import packages - Interfaces, extending interfaces- Exception handling, exception hierarchy, Clauses, built in exceptions and user defined exceptions

Inter Thread Communication: Thread lifecycle, creation & priority-Multiple threads, Synchronization - Inter thread communication

Libraries: Collection classes & Interfaces - Accessing collection via an iterator - User defined classes in Collections – Logging

Software Development Framework: Event Handling: Events, Event sources, Event classes, Event Listeners Interfaces (Action Listener, Adjustment Listener Focus Listener, Item Listener, Key Listener, Mouse Listener, Text Listener), Delegation event model: handling mouse and keyboard events. The AWT class hierarchy, user interface components - Labels, button, scrollbars, text components, checkbox, checkbox groups, choices, lists, layout manager types
-boarder, grid, flow and card.

Swing: Framework for MVC, components, containers and Simple Swing Application.

Learning Resources

- Paul Deitel and HarveyDeitel, “Java How to Program (Early Objects)”, Pearson, Eleventh Edition ,2017.
- Herbert Schildt, “Java: The Complete Reference”, McGraw - Hill. Ninth Edition, 2014.
- E.Balagurusamy, “Programming with Java”, McGraw-Hill, Fifth Edition, 2014.
- K
- athy Sierra, “Head First Java ”, Shroff publications,Secondedition,2005.
- Cay S.Horstmann and Gary Cornell, “Core Java, Volume I-Fundamentals”, Prentice Hall, Ninth Edition, 2013.
- Cay S.Horstmann and Gary Cornell, “Core Java, Volume II-Advanced Features: 2”, Prentice Hall, Eleventh Edition, 2018.

Course Contents and Lecture Schedule

Module No	Topic	No. of Lecture Hours
1		
1.1	Object oriented paradigm – Introduction	2
1.2	Methods, classes and instances	
1.3	Datatypes, arrays	1
1.4	Control structures, looping statements, type conversion	2
1.5	I/O-Reading and Writing Files	1
1.6	Constructors, overloading constructors	2
1.7	Encapsulation	1
1.8	Polymorphism	2
1.9	Inheritance	2
1.10	Dynamic Method Dispatch	1
2		

2.1	Create and Import packages	1
2.2	Interfaces, Extending interfaces	2
2.3	Exception handling	2
2.4	Exception hierarchy	
2.5	Clauses	1
2.6	Built-in and User defined exceptions	1
3		
3.1	Thread life cycle, creation & priority	2
3.2	Multiple threads	2
3.3	Synchronization - Inter thread communication	2
4		
4.1	Collection classes & interfaces	2
4.2	Accessing collection via an Iterator	1
4.3	User defined classes in Collections	1
4.4	Logging	2
5		
5.1	Event handling: Events, Event sources, Event classes	2
5.2	Event listeners interfaces (actionlistener, adjustment listener focus listener, item listener, key listener, mouse listener, text listener)	2
5.3	Delegation event model: handling mouse and keyboard events	2
5.4	The AWT class hierarchy, user interface components- labels, button,scrollbars,textcomponents,checkbox,checkboxgroups,choices, lists	2
5.6	Layout manager types-boarder, grid, flow and card.	2
	Framework for MVC	1
5.7	Swing components, container, Simple Swing Application	2
	Total No of Hours	45

Course Designer

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P. Sharmila psaca@tce.edu

22CA230	Operating Systems	CATEGORY	L	T	P	CREDIT
		PC	3	1	0	4

Preamble

Computers use an Operating System (OS) to manage and provide access to system resources, and to provide a relatively simple interface to those resources. The Operating System is a large and complex software system, but it is typically organized around a set of time - tested, well-defined concepts and structures. The main objective of this course is to provide core knowledge of Operating Systems features, functions and techniques. This course provides a clear description of the basic principles and concepts of operating systems.

Prerequisites

Nil

Course Outcomes

On successful completion of the course, the students will be able to

CO1	Describe the components of the operating systems and basics of process and threads	Understand
CO2	Construct solutions for problems related to process scheduling in a multi-programmed operating system	Apply
CO3	Construct solutions for problems related to Process synchronization and deadlock handling in a multi-programmed operating system	Apply
CO4	Develop appropriate solutions for memory management considering challenges due to multi-programming and virtual memory.	Apply
CO5	Construct solutions for problems related to File allocation and managing the free space on secondary storage system	Apply
CO6	Interpret the mechanisms adopted for disk scheduling and swap space management.	Apply

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	L		L							
CO2	L	M	M	L	M							
CO3	L	M	M	L	L							
CO4	S	S	S	L	S							
CO5	S	S	S	L	S							
CO6	L	S	M		M							

S-Strong; M-Medium; L-Low

Assessment Pattern

Blooms Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	20
Understand	50	30	30	30
Apply	30	50	50	50
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1(CO1):

1. State the purpose of system calls?
2. What are the functions of the memory management component of the OS?
3. Define Process, Threads
4. What is the significance of Multithreading?

Course Outcome 2(CO2):

1. Assume you have the following jobs to execute with one processor, with the jobs arriving in the order listed here:

i	T(pi)
0	80
1	20
2	10
3	20
4	50

   a. Suppose a system uses FCFS scheduling. Create a Gantt chart illustrating the execution of these processes?
   b. State the turnaroundtimeforprocessp3?
   c. List the average wait time for the processes?
2. What do you mean by degree of Multiprogramming?
3. Can a process be demoted from the running to ready state? Justify your answer.
4. How is the process scheduling realized in Linux operating systems?

Course Outcome 3(CO3):

1. Consider the following snapshot of a system. There is no current outstanding queued unsatisfied requests. Available

R1	R2	R3	R4
2	1	0	0

	Current Allocation				Maximum demand			
Process	R	R	R	R	R	R	R	R
P0	0	0	1	2	0	0	1	2
P1	2	0	0	0	2	7	5	0
P2	0	0	3	4	6	6	5	6
P3	2	3	5	4	4	3	5	6
P4	0	3	3	2	0	6	5	2

   (i) Is the system in safe state? Why?
   (ii) Which process, if any, are or may be come deadlocked?
   (iii) If a request from P3 arrives for (0,1,0,0) can that request be safely granted

immediately? In what state (deadlocked, safe, unsafe) would immediately granting that whole request leave the system?
2. Differentiate deadlock prevention and deadlock avoidance
3. List the necessary condition for the characterization of deadlock.
4. Comment on the deadlock handling mechanism adopted by Windows OS

Course Outcome 4(CO4):

1. Consider the following page reference string 7,0,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,2.
   How many page faults would occur in the case?
   a. LRU
   b. FIFO
   c. Optimal algorithms
   assuming three, five or six frames. Note that initially all frames are empty.
2. Assume that we have a paging system with page table stored in memory
   a. If a memory reference takes 200 nanoseconds how long does a paged memory reference take?
   b. If we add associative registers and 75% of all page table references are found in the associative registers, what is the effective memory reference time? Assume that finding a page table entry in the associative registers takes zero time, if the entry is there.
3. Compare the external and internal fragmentation.
4. State the significance of memory management component in a mobile OS

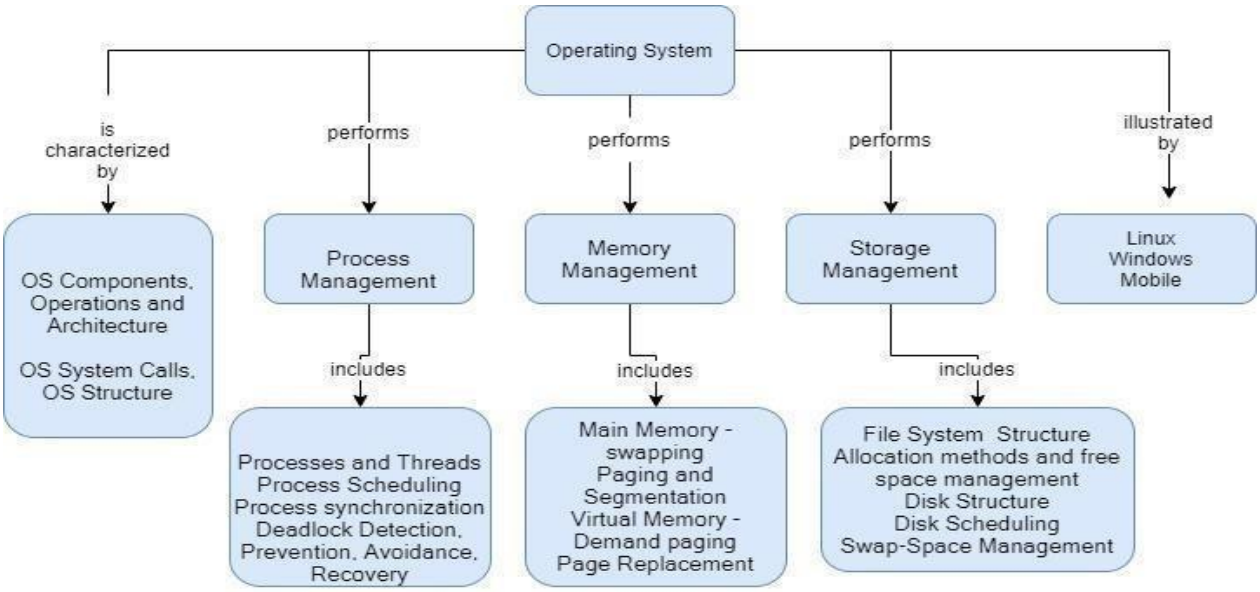
Course Outcome 5(CO5):

1. Define file system.
2. Compare the different methods for allocating the files in the disk
3. What is the significance of free space management on the disk by OS?

Course Outcome 6(CO6):

1. Put the following disk scheduling policies in the order that will result in minimum amount of head movement.
   a. FCFS
   b. Circular scan
   c. Elevator algorithm
2. Suppose that a disk drive has 5000 cylinders, numbered from 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order is 86,1470,913,1774,948,1509,1022,1750,130. Starting from the current headposition, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the disk scheduling algorithms.
   a. FCFS
   b. SSTF
   c. SCAN
   d. LOOK
   e. C-SCAN
   f. C-LOOK.
3. Define Latency and seek time.

Course Level Assessment Questions



Syllabus

Introduction: OS components - OS Architecture - OS Operations - System calls. **Process Management:** Process – Process states – PCB – Context switching. Threads – benefits of Threads –Multithreading concept. Process Scheduling – Types of Scheduler – Scheduling Criteria –Scheduling Algorithms - Pre-emptive and Non Pre-emptive, Process synchronization - solution to critical Section problem- Semaphores, Deadlock Detection, Deadlock Prevention, Deadlock Avoidance, Deadlock Recovery. **Memory Management :**Logical and Physical Addresses-Contiguous and Non Contiguous Memory allocation – Fixed and variable partition-Internal and External fragmentation and Compaction- Paging – Segmentation-Demand paging- Page Replacement algorithms. **Storage Management:** File System structure, Allocation methods, free space management, Disk Structure, Disk Scheduling, Swap-Space Management. **Case Studies:** Linux, Windows, Mobile Operating System.

Reference books & web Resources

1. Abraham Silberschatz, Greg Gagne, Peter B. Galvin, “Operating System Concepts”, 10th edition, Wiley, 2018.
2. William Stallings, “Operating systems Internal and Design Principles”, 9th edition, Pearson Education, Global edition, 2017.
3. Andrew Tanenbaum, “Modern Operating Systems”, 4th Edition, Pearson Education, Global edition, 2014.
4. H M Deital, P J Deital and D R Choffnes, “Operating Systems”, Third Edition, Pearson Education, (2004), Reprint 2012.
5. Jason Canon, ”Shell Scripting: How to Automate Command Line Tasks Using Bash Scripting and Shell Programming”, Linux Training Academy, 2015
6. Christine Bresnahan Richard Blum,” Linux Command Line and Shell Scripting Bible”, Third Edition, 2015,Wiley.
7. http://nptel.ac.in/courses/Webcoursecontents/IIScBANG/Operating%20Systems/New_index1.html
8. https://www.shellscript.sh/first.html
9. http://www.freeos.com/guides/lsst/

Course Content and Lecture Schedule

Module No.	Topic	No.of Hours
1	**Operating System Introduction & Structure**	**(5)**
1.1	OS Components, OS Operations and OS Architecture	3
1.2	OS System Calls, OS Structure	2
2	**Process Management**	**(13)**
2.1	Processes and Threads	2
2.2	Process Scheduling	4
2.3	Process synchronization	3
2.4	Deadlock Detection, Prevention, Avoidance, Recovery	4
3	**Memory Management**	**(11)**
3.1	Main Memory – swapping	2
3.2	Paging and Segmentation	4
3.3	Virtual Memory – Demand paging	2
3.4	Page Replacement	3
4	**Storage Management**	**(10)**
4.1	File System Structure	1
4.2	Allocation methods and free space management	3
4.3	Disk Structure	1
4.4	Disk Scheduling	4
4.5	Swap – Space Management	1
5	**Case Study**	**(9)**
5.1	Linux	3
5.2	Windows	3
5.3	Mobile OS	3
	Total No of Hours	45

Course Designer

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BOS meeting approved: 01-06-2022 Approved in 63rd Academic Council meeting on 25-06-2022

22CA240	Web Technology	CATEGORY	L	T	P	CREDIT
		PC	3	1	0	4

Preamble

The students will learn how to represent the structure and designs using HTML and XHTML and other related web technologies. The students gains understanding of how the internet application works and develop web programming skills. The course will establish a professional, client-based attitude towards web design.

Prerequisite

None

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Understand the working of internet with HTML and XHTML.	Understand
CO2	Understand the working principle of internet applications.	Understand
CO3	Construct HTML and XHTML documents	Apply
CO4	Develop client / server side programming for web application Development.	Apply
CO5	Describing the relationship between client/server objects used by SQL	Apply
CO6	Develop web pages with database connectivity.	Apply

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M									
CO2	M	M	M									
CO3	L	S	S									
CO4	L	S	S									
CO5	S	M	M									
CO6	S	M	M									

S- Strong; M-Medium; L-Low

Assessment Pattern

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	20
Understand	60	20	20	20
Apply	20	40	60	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Define IP Addressing
2. Define Computer Network.
3. List the types of Domain Name Space.

Course Outcome 2(CO2):

1. Sketch the Web Browser and Server Communication.
2. Write the Structure of HTML.
3. List out the version of HTML.

Course Outcome 3(CO3):

1. Draw the XHTML for Book Publisher along with List of Books.
2. Explain in detail about Servlet Database Connectivity with an example of Student database.
3. Write a servlet program to display the message by usingCookies.

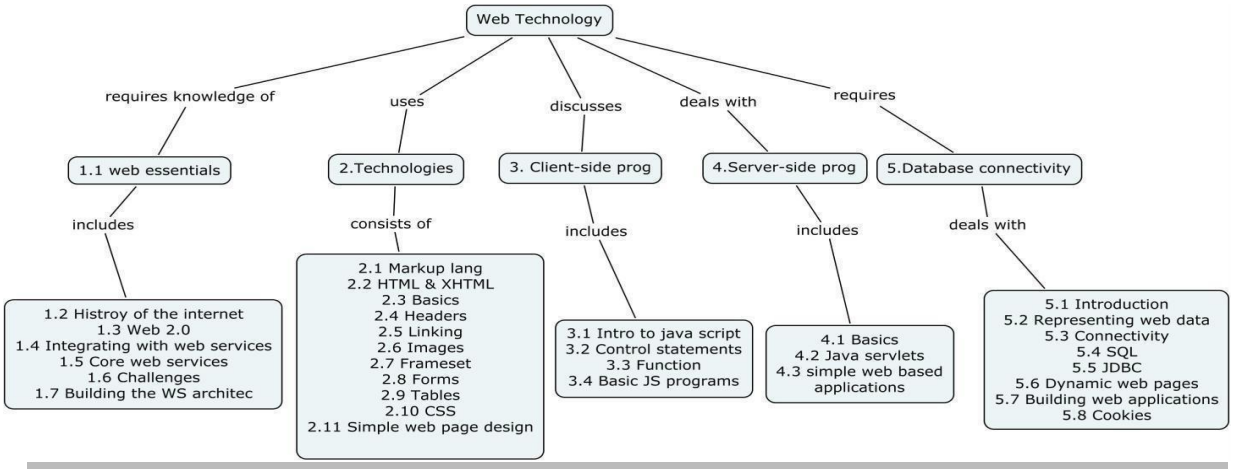
Course Outcome 4(CO4):

1. Write a JavaScript program to print the numbers from0to50 b. Write a JavaScript program to create table.
2. Explain in detail about Array with an example of Positive and negative numbers.
3. Write a JavaScript program to create user registration form.

Course Outcome 5(CO5):

1. Construct the book's HTML document using cascading style sheets.
2. Draw a picture describing the relationship between client/server objects used by SQL
3. Write a JavaScript program to create student registration form using database connectivity.

Concept Map



Syllabus

Introduction to Web- Web essentials – Basics of Internet –History of the Internet and World Wide Web - Web2.0 – Technology overview – integrating with web services –Motivation and Characteristics – uses - Basic operational model of web services - core web services – Known challenges in Web Services – Building the Web Services Architecture. **Technologies**-Markup languages – HTML & XHTML- Basics – Headers – Linking – Images – Frames –Frameset –Forms – Tables – CSS – simple web page designs. **Client-side Programming –** Introduction to Javascript – Control statements – Function – Basic Javascript programs.**Server-side programming** – Server side programming basics – java servlets – simple web based applications-Session-Sessiont racking.**Database Connectivity-**Introduction to Database-Representing Web data – database connectivity – SQL/MS – Access – Dynamic Web pages-Building Web applications – cookies.

Textbooks

1. Deitel and Deitel, "Internet and World Wide Web How to program", Prentice Hall of India, Fourth Edition,2014.
2. Gustavo Alonso, Fabio Casati, Harumi Kuno and Vijay Machiraju, "Web services" Springer International Edition, First edition,2019.

Course Contents and Lecture Schedule

No	Topic	No.of Lectures
1	**Introduction to Web**	
1.1	Web essentials and Basics of Internet	1
1.2	History of the Internet and World Wide Web	1
1.3	Web 2.0 – Technology overviews	1
1.4	Integrating with web services - Motivation and Characteristics – Basic operational model of web services - uses	2

1.5	Core web services	1
1.6	Challenges in Web Services	1
1.7	Building the Web Services Architecture	1
2	**Technologies**	
2.1	Markup languages	1
2.2	HTML&XHTML	1
2.3	Basics	2
2.4	Headers	1
2.5	Linking	1
2.6	Images	1
2.7	Frames-Framesets	2
2.8	Forms	2
2.9	Tables	2
	CSS-Cascading style sheets	2
2.11	Simple web page designs	1
	Client-side Programming	
3.1	Introduction to Java script	1
3.2	Control statements	2
3.3	Function	2
3.4	Basic Javascript programs	2
	Server-side programming	
4.1	Serverside programming basics	1
4.2	Java Servlets	2
4.3	Simple web based applications-Session	2
	Database Connectivity	
5.1	Introduction to Database, Representing of Web data	1
5.2	Database connectivity	2
5.3	SQL/MS-Acess	2
	Dynamic web pages, Building Web applications, Cookies	2
	Total	44

Course Designer

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22CA270	Object Oriented Programming Lab	CATEGORY	L	T	P	CREDIT
		PC	0	0	2	2

Preamble

This course provides knowledge and skills on object oriented concepts such as inheritance, polymorphism and also the concepts such as threading, packages, exceptions and collections. It also provides knowledge at analyze level on selecting java libraries to implement logging and swing for an application.

Prerequisite

Nil

Course Outcomes

On successful completion of the course, students will be able to

CO1	Apply Basic Programming concepts like type casting, control structures, looping statements, I/O Operations etc.	Apply
CO2	Apply object oriented concepts like abstraction, encapsulation, polymorphism and inheritance to solve the given problem.	Apply
CO3	Develop applications that use packages, interfaces, exceptions, and threads for the given requirements.	Apply
CO4	Implement Collections and logging to solve the given problem.	Apply
CO5	Examine suitable Application Programming Interfaces (APIs)to incorporate Swing concepts in the given application.	Apply
CO6	Develop applications for the given real time problems based on core and advance OOP concepts.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L		L			L	M	M		M
CO2	S	M	L		L			L	M	M		M
CO3	S	M	L		M			M	S	S		S
CO4	S	M	L		M			M	S	S		S
CO5	S	M	L		M			M	S	S		S
CO6	S	S	M	L	M			M	S	S		S

S-Strong, M-Medium, L- Low

List of Experiments

Ex.No	Experiment
1.	Develop Object Oriented Program for passing arguments to a method and returning value from a method
2.	Construct Object Oriented Program for method overloading and constructor overloading
3.	Develop Object Oriented Program for passing arrays and objects as arguments to method and returning objects from methods
4.	Demonstrate aggregation and composition using object oriented program
5.	Develop Object Oriented Program to demonstrate inheritance and overriding super class methods
6.	Develop Object Oriented Program to demonstrate abstract base classes abstract methods
7.	Construct Object Oriented Program to demonstrate File handling and Object Serialization
8.	Construct Object Oriented Program to demonstrate exception handling

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22CA280	Web Technologies Laboratory	CATEGORY	L	T	P	CREDIT
		PC	0	0	2	2

Preamble

With a dynamic learn-by-doing focus, the laboratory course encourages the students to explore the designing of web application by implementing the relevant and recent techniques. This course challenges the students to exercise their creativity in both programming and designing.

Prerequisite

- RDBMS Laboratory
- Object Oriented Programming Laboratory

Course Outcomes

On the successful completion of the course, students will be able to

CO1	Select suitable Technology as per the application requirements.	Apply
CO2	Develop application in different frameworks	Apply
CO3	Apply the recent techniques and features to Construct an internet application.	Apply
CO4	Host Web applications	Apply
CO5	Work effectively in a team through proper communication based on the given task	Apply
CO6	Develop applications for any IT problems using Web Technologies.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	M	S			M				
CO2	S	S	S	M	S			M				
CO3	S	S	S	M	S			M				
CO4	S	S	S	M	S			M				
CO5	S	S	S	L	S			M			S	
CO6	S	S	S	L	S			M				

S- Strong; M-Medium; L-Low

Lab experiments

I-Dynamic HTML- Develop a web application by having pages designed using

1. Cascading Style Sheets
2. Object Model and Collections
3. Event Model
4. Filters and Transitions

II-XML

1. Creating XML documents
2. XML style sheet
3. XML document object model
4. XML query language

III- Scripting Language- Enhance the web application with suitable client side validations and processing using javascript / vbscript

IV- ASP

1. Server side ActiveX components
2. File System objects
3. Session tracking

V- JSP

1. Request, response, session, application
2. AJAX/JSON/ AngularJS/JQuery

VI- PHP & MySQL and protect it by performing **SQL injection**

Mini Project – The lab exercises are to be carried out in a single application domain such as shopping cart, internet banking, online bidding, online cab booking and the site has to be hosted in a free host webserver.

Reference Books & web resources

1. HTML, CSS and JavaScript All in One, JulieMeloni, Sams Teach Yourself, Secondedition, 2014, Pearson.
2. PHP and MySQL Web Development, Luke Welling and Laura Thomson, 5th Edition, 2016, Addison Wesley.
3. Professional AngularJS, ValeriKarpov,DiegoNetto,Wrox,2015
4. Internet and WWW How to Program, Paul Deitel, Harvey Deitel, Abbey Deitel, 5th Edition, TataMcGraw Hill, 2011.
5. https://www.w3schools.com
6. www.oracle.com/technetwork/articles/javase/webappdev-142313.html

Course Designers:

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22CA290	Software Engineering Laboratory	CATEGORY	L	T	P	CREDIT
		PC	0	0	2	2

Preamble

This course focuses on providing hands-on experience in designing, developing and testing software systems. Consequently students take up a group project, working through a number of stages for the development of software.

Prerequisite

22CA140 Software Engineering

Course Outcomes

On the successful completion of the course students will be able to

CO1	Develop software requirements specification for given software	Apply
CO2	Perform Structured System Analysis and Structured Design for given requirement specification	Apply
CO3	Construct object oriented design diagrams based on requirement specification.	Apply
CO4	Produce efficient, reliable, robust and cost-effective software solutions.	Apply
CO5	Construct white-box and black-box test cases using various test generation methods	Apply
CO6	Use of appropriate CASE tools and program analysis tools for a given software	Apply

Mapping with programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L									
CO2	S	M	L									
CO3	S	M	L									
CO4	S	M	L									
CO5	S	M	L									
CO6	S	M	L									

S-Strong; M-Medium; L-Low

List of Experiments

Ex. No	List of Experiments
1.	Collect the requirements and Identify project scope, Objectives, deliverables
2.	Identify the individual Phases/ modules of the project
3.	Develop Class responsibility collaborator(CRC)Model
4.	Build a Prototype and develop modules of the project
5.	Prepare test plan, perform validation testing, coverage analysis, memory leaks, develop test case hierarchy, Site check and site monitor
6.	Track configuration items and document functional dependencies.
7.	Perform post execution analysis using dynamic program analysis tools

A possible set of applications may be the following:

a. E-Library System
b. Inventory System
c. Course Registration System
d. Quiz System
e. Student Marks Analyzing System
f. Reservation Systems for Airlines, Railways etc.
g. Stock Management System
h. Real-Time Scheduler
i. Simulator Software for Parallel Processing Operation

Learning Resources

1. IanSommerville, "Software Engineering", 10th Edition, John Wiley and sons, 2015.
2. Martin Flower, UML Distilled: A Brief Guide to the Standard Object Modeling Language", 2018
3. PankajJalote " Software Engineering: A Precise Approach", Wiley,2010.
4. Roger S.Pressman, "Software Engineering: A Practitioner's Approach". 7th Edition, McGrawHill,Education,2017.

"

Course Designers:

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22CA310	COMPUTATIONAL STATISTICS	CATEGORY	L	T	P	CREDIT
		FC	3	1	0	4

Preamble

The main objective of this course is to provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like disease modeling, climate prediction, computer networks and machine learning etc. Statistical methods are important tools which provide the engineers with both descriptive and analytical methods for dealing with the variability in observed data. It introduces students to cognitive learning in statistics and develops skills on analyzing the data by using different tests.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

.

CO Number	Course Outcome Statement	
CO1	Understand the concept of probability, random variables and their distributions.	Understand
CO2	Apply Baye's theorem and random variables to model and solve scientific, engineering problems.	Apply
CO3	Choose appropriate discrete or continuous distributions to model the problems in the field of science and engineering.	Apply
CO4	Apply the test of hypothesis for small and large samples to make decisions based on observed and experimental data.	Apply
CO5	Apply regression model to solve prediction problems.	Apply
CO6	Generate random numbers, random variates and test uniformity independence of random numbers.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	M	-	-	-	-	M	-	-	-
CO2	S	S	S	S	-	-	-	-	M	-	-	-
CO3	S	S	S	S	-	-	-	-	M	-	-	-
CO4	S	S	S	M	-	-	-	-	M	-	-	-
CO5	S	S	S	S	-	-	-	-	M	-	-	-
CO6	S	S	S	S	-	-	-	-	M	-	-	-

S- Strong; M-Medium; L-Low

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	10	10	10	-
Understand	30	30	30	30
Apply	60	60	60	70
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Understand the concept of probability, random variables and their distributions (CO1):

1. Time headway" in traffic flow is the elapsed time between the times that one car finishes passing a fixed point and the instant that the next car begins to pass that point. Let X= The headway between two randomly selected consecutive cars (sec). Suppose that in a different traffic environment, the distribution of time head way has the form

$$f(x) = \{ \frac{k}{x^4} \qquad x > 1 \}$$

0 Otherwise

a. Determine the value of k for which $f(x)$ is a legitimate pdf.
b. Obtain the cumulative distribution function.
c. Use the cdf from (b) to determine the probability that headway exceeds 2 second also, the probability that headway is between 2 and 3 sec.
d. Obtain the mean value of headway.

2. The probability that a regularly scheduled flight departs on time is $P(D) = 0.83$; the probability that it arrives on time is $P(A) = 0.82$; and the probability that it departs and arrives on time is $P(D \cap A) = 0.78$. Find the probability that a plane(a) arrives on time, given that it departed on time, and (b) departed on time, given that it has arrived on time.

3. An individual has 3 different email accounts. Most of her messages, in fact 70%,come into account #1, whereas 20% come into account #2 and the remaining 10%into account #3. Of the messages into account #1, only 1% are spam, whereas the corresponding percentages for accounts #2 and #3 are 2% and 5%, respectively. What is the probability that a randomly selected message is spam?

Apply Baye's theorem and random variables to model and solve scientific, engineering problems(CO2):

1. In a certain assembly plant, three machines, B1, B2, and B3, make 30%, 45%, and 25%, respectively, of the products. It is known from past experience that 2%, 3%, and 2% of the products made by each machine, respectively, are defective.
   Now, suppose that a finished product is randomly selected. What is the probability that it is defective? And if a product was chosen randomly and found to be defective, what is the probability that it was made by machine B1, B2, and B3 respectively?
2. The Reviews editor for a certain scientific journal decides whether the review for any particular book should be short (1 – 2pages), medium (3 – 4pages), or long (5 – 6pages). Data on recent reviews indicates that 60%ofthemare short, 30%are

   medium, and the other 10% are long. Reviews are submitted in either Word or LaTeX. For short reviews, 80% are in Word, whereas 50% of medium reviews are in Word and 30% of long reviews are in Word. Suppose a recent review is randomly selected.
   a. What is the probability that the selected review was submitted in Word format?
   b. If the selected review was submitted in Word format, what are the posterior probabilities of it being short, medium, or long?

Choose appropriate discrete or continuous distributions to model the problems in the field of science and engineering(CO3):

1. Consider babies born in the "normal" range of 37–43 weeks gestational age. Extensive data supports the assumption that for such babies born in the United States, birth weight is normally distributed with mean 3432 g and standard deviation482g.[The article "Are Babies Normal?"(The American Statistician, 1999: 298-302)
   a. What is the probability that the birth weight of a randomly selected baby of this type exceeds 4000g? Is between 3000 and 4000g?
   b. What is the probability that the birth weight of a randomly selected baby of this type is either less than 2000g or greater than 5000g?

c. What is the probability that the birth weight of a randomly selected baby of this type exceeds 7lb?
d. How would you characterize the most extreme .1% of all birth weights?

2. A particular type of tennis racket comes in a mid size version and an oversize version. Sixty percent of all customers at a certain store want the oversize version.
   a. Among ten randomly selected customers who want this type of racket, what is the probability that at least six want the oversize version?
   b. Among ten randomly selected customers, what is the probability that the number who want the oversize version is within 1 standard deviation of the mean value?
   c. The store currently has seven rackets of each version. What is the probability that all of the next ten customers who want this racket can get the version they want from current stock?

Apply the test of hypothesis for small and large samples to make decisions based on observed and experimental data (CO4):

1. The slant shear test is widely accepted for evaluating the bond of resinous repair materials to concrete; it utilizes cylinder specimens made of two identical halves bonded at 30°. The article "Testing the Bond Between Repair Materials and Concrete Substrate"(ACIMaterialsJ.,1996:553-558) reported that for 12 specimens prepared using wire-brushing, the sample mean shear strength (N/mm2) and sample standard deviation were 19.20 and 1.58, respectively, whereas for 12 specimens, the corresponding values were 23.13 and 4.01.
   a. Does the true average strength appear to be different for the two methods of surface preparation?
   b. State and test the relevant hypotheses using a significance level of .05. What are you assuming about the shear strength distributions?
2. Regardless of age, about 20% of American adults participate in fitness activities at least twice a week. However, these fitness activities change as the people get older, and occasionally participants become non participants as they age. In a local survey

of *n*=100 adults over 40 years old, a total of 15 people indicated that they participated in a fitness activity at least twice a week. Do these data indicate that the participation rate for adults over 40 years of age is significantly less than the 20%figure?

Apply regression model to solve prediction problems(CO5):

1. An article in the Tappi Journal(March,1986) presented data on green liquor Na2S concentration (in grams per liter) and paper machine production (in tons per day).The data (read from a graph)are shown as follows:

y	40	42	49	46	44	48	46	43	53	52	54	57	58
x	825	830	890	895	890	910	915	960	990	1010	1012	1030	1050

   a. Fit a simple linear regression model with y = green liquor Na2S concentration and x = production. Find an estimate of σ^2. Draw a scatter diagram of the data and the resulting least squares fitted model.
   b. Find the fitted value of y corresponding to x=910 and the associated residual.
   c. Find the mean green liquor Na2S concentration when the production rate is 950 tons per day.

2. The final test and exam averages for 20 randomly selected students taking a course in engineering statistics and a course in operations research follow. Assume that the final averages are jointly normally distributed.

Statistics	86	75	69	75	90	94	83	86	71	65	84	71	62
OR	80	81	75	81	92	95	80	81	76	72	85	72	65

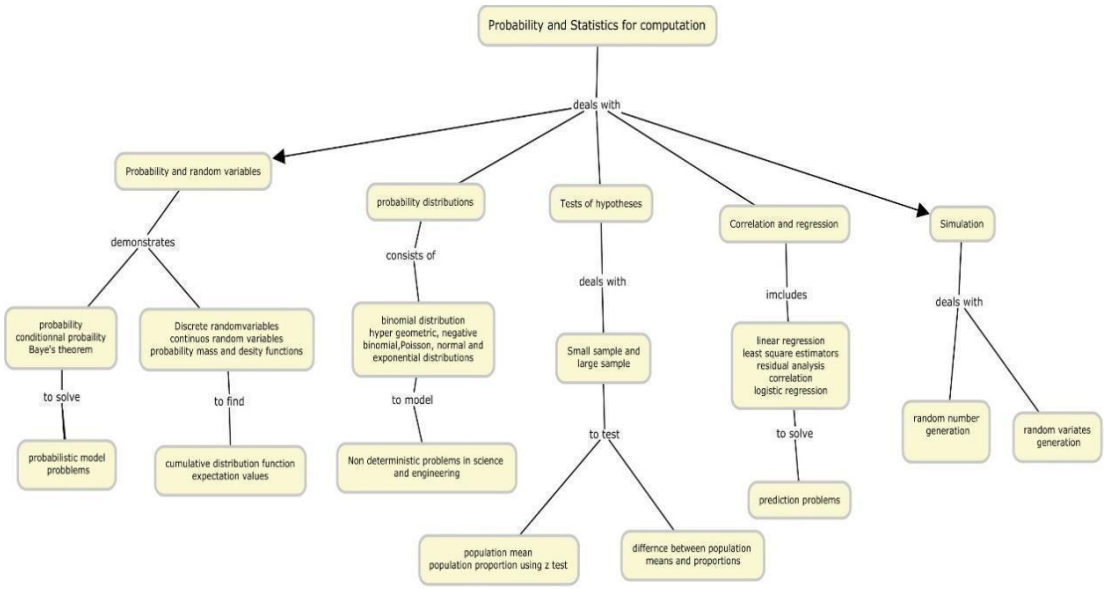
   a. Find the regression line relating the statistics final average to the OR final average. Graph the data.
   b. Estimate the correlation coefficient.

Generate random numbers, random variates and test uniformity independence of random numbers (CO6):

1. Find a combined generator combining three multiplicative generators, with m_1= 25,363, a_1= 257,2= 22,727, a_2= 246,m_3= 23,657 and a_3= 342. Generate 3 random numbers with the combined generator, using the initial seeds $X_{i,0}$=100,200,300, for the individual generators i=1,2,3.Also find its period.
2. Additive congruential method employs the following expression to generate random numbers: $X_{n+1} = (X_1+X_n) \pmod m$ Where X_1 to X_n are the seeds and X_{n+1} is the new random number. Assuming n= 5, X_1=20, X_2=82, X_3=42, X_4=76, X_5= 59, and m=100, generate 4 new random numbers.

3. (i) m=8, c= 5, X_0=6, a=33, what is the longest possible period? Verify.
   (ii) Test the uniformness and independence of the random numbers R_i generated in part(i).
   (iii) Generate Weibull random variate X_i with α= 2 and β= 1 for first three the random numbers R_i generated in part(i).

Concept Map



Syllabus

Probability and Random Variables Probability–conditionalprobability–Baye'stheorem–discreterandomvariables– probabilitymass function – continuous random variables – probability density functions – cumulative distribution function, expected values for discrete and continuous random variables.

Probability Distributions

The Binomial probability distribution – hyper geometric – negative Binomial distribution – the Poisson probability distribution – the normal distribution – the exponential distribution gamma distribution.

Tests of Hypotheses

Hypotheses and test procedures – tests concerning a population mean – tests concerning a population proportion – *z* tests and confidence intervals for a difference between two Population means – the two-sample *t* Test and confidence interval – inferences concerning a difference between population proportion–inferences concerning two populationvariances.

Correlation and Regression

Simple linear regression – Properties of the least square estimators – Residual analysis-Coefficient of determination-Correlation-Regression on transformed variables-Logistic regression.

Simulation

Random number generation – tests for random numbers – Kolmogorov test – test of auto correlation – exponential, uniform, Weibull random variate generators using inverse transform.

Reference Books

1. **Jay L. Devore**, "Probability and Statistics for Engineering and the Sciences" (English) 8th Edition, Cengage Learning India Pvt Ltd, New Delhi,2012.
   Module 1: Sections: 2.1, 2.2, 2.4, 3.1, 3.2, 3.3, 4.1, 4.2.
   Module 2: Sections: 3.4,3.5,3.6, 4.3,4.4
   Module 3: Sections:8.1,8.2,8.3,9.1,9.2,9.4,9.5
2. **Douglas C. Montgomery, George C. Runger**, "Applied statistics and probability for Engineers", Fifth Edition,Wiley,2018.
   Module 4: Sections: 11.2, 11.3, 11.7, 11.8, 11.9, 11.10.
3. **Jerry Banks, John S. CarsonII, Barry L. Nelson, David M. Nicol**, "Discrete-Event System Simulation", 5th edition, Pearson Education, New Delhi, 2013.
   Module 5: Chapter 7,8
4. **Ronald E. Walpole, Sharon L. Myers, Keying Ye,** "Probability & Statistics for Engineers & Scientists", 9th Edition, Pearson Education, New Delhi, 2012.
   MGF: Section 7.3
5. **Mendenhall William**, "Introduction to Probability and Statistics", 14th Edition, Duxbury Press, New Delhi, 2012.

Course Contents and Lecture Schedule

Module No.	Topic	No. Of Lectures
1	**Probability and Random Variables**	
1.1	Probability	1
1.2	Conditional probability and Baye's theorem	2
1.3	Tutorial	1
1.4	Discrete and continuous random variables and its distribution Functions	2
1.5	Cumulative distribution function and expectations of random variables	1
1.6	Tutorial	1
2	**Probability Distributions**	
2.1	The Binomial probability distribution	1
2.2	Hyper geometric distribution	1
2.3	Negative binomial distribution	1
2.4	Tutorial	1
2.5	Poisson probability distribution	1
2.6	The normal distribution	2
2.7	The exponential and gamma distribution	1
2.8	Tutorial	1
3	**Tests of Hypotheses**	
3.1	Hypotheses and test procedures	1
3.2	Tests concerning a population mean	2
3.3	Tutorial	1
3.4	Tests Concerning a population proportion	1

3.5	Z Tests and confidence intervals for a difference between two population means	2
3.6	Tutorial	1
3.7	The two-Sample t Test and confidence interval	1
3.8	inferences concerning a difference between population proportion	1
3.9	Tutorial	1
3.10	Inferences concerning two population variances	1
4	**Correlation and Regression**	
4.1	Simple linear regression	1
4.2	Properties of the least square estimators	1
4.3	Tutorial	1
4.4	Residual analysis	1
4.5	Coefficient of determination	1
4.6	Tutorial	1
4.7	Correlation	1
4.8	Regression on transformed variables	1
4.9	Tutorial	1
4.10	Logistic regression	1
5	**Simulation**	
5.1	Random numbers, linear congruential method	1
5.2	Random numbers period congruential method	1
5.3	Random numbers combined linear congruential generators	1
5.4	Tutorial	1
5.5	Kolmogorov test	1
5.6	Test of autocorrelation	1
5.7	Exponential random variate generators	1
5.8	Uniform and Weibull random variate generators	1
5.9	Tutorial	1
	Total	48

Course Contents and Learning Schedule

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22CA320	COMPUTER NETWORKS	CATEGORY	L	T	P	CREDIT
		FC	3	1	0	4

Preamble

The course aims to provide an understanding of computer networks architecture, various technologies available to build a network and protocols in use at different levels of network layers stack. An overview of global Internet, Internet applications and introduction to Network simulation is also provided.

Prerequisite

22CA120: Data Structures and Applications

Course Outcomes

On the successful completion of the course, students will be able to

.

CO Number	Course Outcome Statement	
CO1	Describe the building blocks of Computer Networks	Understand
CO2	Explain the functionalities and protocols of various layers in ISO/OSI Network model	Understand
CO3	Implement a suitable routing strategies for a given network	Apply
CO4	Use suitable transport/application layer protocol based on application requirements	Apply
CO5	Suggest appropriate access control, congestion control and congestion avoidance technique for a given traffic scenario	Apply
CO6	Examine performance analysis for a network using tools like NS2, wire shark	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	L	L	M							
CO2	L	M	L	L	M							
CO3	S	S	S	L	S			L				
CO4	S	S	S	L	S			L				
CO5	S	S	S	S	S			L				
CO6	S	S	S	S	S			L				

S- Strong; M-Medium; L-Low

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	20
Understand	40	40	40	40
Apply	40	40	40	40
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Describe the building blocks of Computer Networks (CO1):

1. Mention the physical devices operating at various layers of TCP/IP protocol Suite.
2. What is the difference between communication and transmission?
3. Discuss the differences in the functionalities of switches and routers.
4. Discuss the difference between hubs and bridges.

Explain the functionalities and protocols of various layers in ISO/OSI Network model (CO2):

1. Distinguish between LAN and WAN.
2. Describe various types of networks.
3. Explain the schemes prescribed in Ethernet for collision Detection.
4. Discuss the functionalities of all layers in Frame relay network.
5. Describe how ATM combines benefits of both circuit switching and packet switching.

Implement suitable routing strategies for a given network (CO3):

1. Write short notes on VoIP and discuss the suitable transport protocol for the same.
2. Differentiate Inter domain routing protocols and Intra domain routing protocols.
3. Compare various email protocols like SMTP, IMAP and POP and Outline when it is appropriate to use each.
4. Explain how TCP and IP complement each other's functionalities. And bring out the dependencies between the two.

Use suitable transport/application layer protocol based on application requirements (CO4):

1. Compare the functionalities of all layers in OSI architecture
2. Describe multi backbone internet structure
3. Explain how the Network layer and Transport layer complements each other's functionalities. And bring out the dependencies between the two

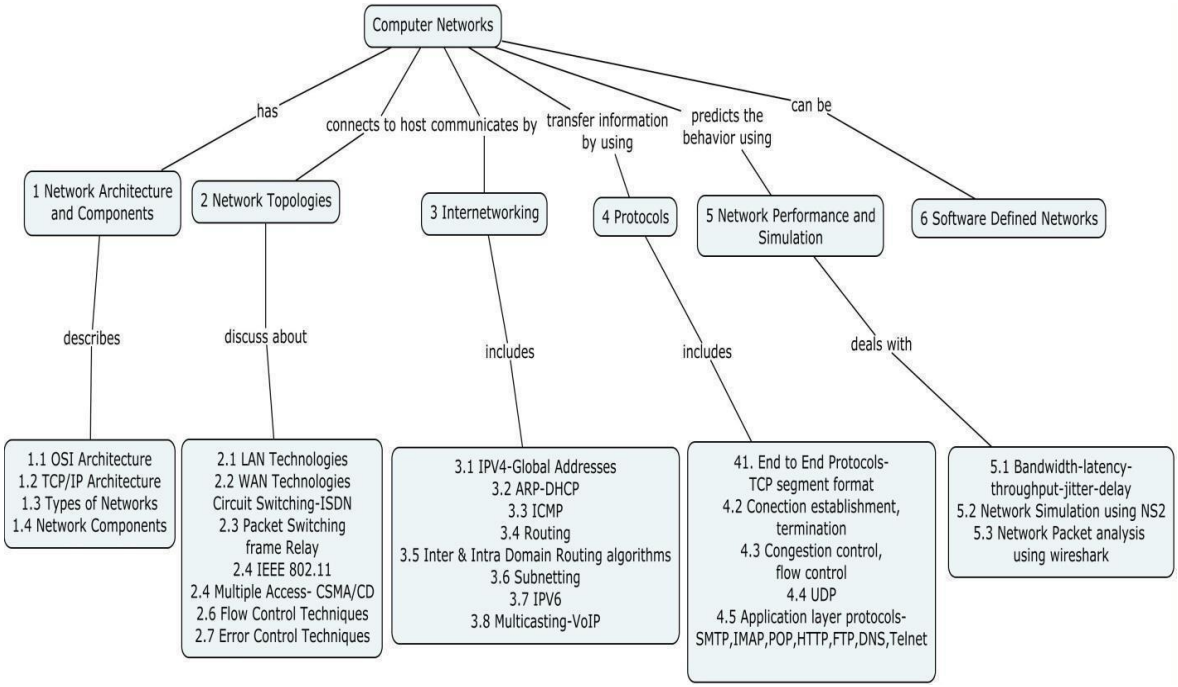
Suggest an appropriate access control, congestion control and congestion avoidance technique for a given traffic scenario (CO5):

1. Suppose a host wants to establish the reliability of a link by sending packets and measuring the percentage that is received; routers for example do this. Explain the difficulty doing this over TCP connection.
2. How do routers determine that an incoming IP packet is to be multicast?
3. How can a wireless node interfere with the communications of another node when the two nodes are separated by a distance greater than the transmission range of either node?

Examine performance analysis for a network using tools like NS2, Wireshark (CO6):

1. Analyze the resources needed to effectively apply micro simulation?
2. How should the project scope and physical limits be established to monitor the network?
3. What security risks are introduced by the use of Network Monitor?

Concept Map



Syllabus

Network Architecture and Components

ISO/OSI architecture – Functionalities of OSI Layers - TCP/IP architecture – Types of Networks (LAN, WAN, VPN, VLAN) – Network Components (NIC, Bridges, Switches, Routers, Hubs, Gateways)

Network Technologies to connect hosts

LAN Technologies (Ethernet, Token Ring) WAN Technologies (Circuit switching- ISDN , Packet Switching – Frame Relay - (IEEE802.11) – Multiple Access – CSMA/CD – Flow control techniques – Error control techniques.

Internetworking

IPv4 – Global Addresses – ARP – DHCP – ICMP – Routing – Intra domain Routing algorithms (RIP, OSPF) – Subnetting – Classless Addressing – Inter domain routing – Ipv6 – Multicasting – VoIP.

Protocol stack

End to End protocols [TCP (segment format, connection establishment & Termination, Congestion control, Flow Control), UDP] - Application layer protocols (SMTP, IMAP,POP, HTTP, FTP, DNS, Telnet).

Network Performance and simulation

Bandwidth – latency– Throughput - Jitter – Delay– Network simulation using NS2, WireShark.

Fundamentals of software defined networks

Reference Books

1. Behrouz A. Foruzan, “Data Communication and Networking”, Tata Mc Graw Hill, Fifth Edition, 2013
2. William Stallings, “Data and Computer Communications”, Pearson Education Ninth Edition 2013
3. Larry L. Peterson and Bruce S. Davie, “Computer Networks- A systems Approach”FifthEdition,MorganKaufmannPublishers,2011
4. Thomas D. Nadeau & Kengray, “Software defined Networks” ,O’reilly,2013
5. http://nptel.ac.in/video.php?subjectId=106105081
6. http://nptel.ac.in/courses/IIT-MADRAS/Computer_Networks/
7. Cisco network fundamentals- http://ptgmedia.pearsoncmg.com/images/9781587132087/samplepages/1587132087.pdf

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1	**Computer network architecture**	
1.1 1.2	ISO/OSI architecture Functionalities of OSI layers	2
1.3	TCP/IP architecture	1
1.4	Types of networks(LAN,WAN,VPN,VLAN)	1
1.5	Network components (NIC, Bridges, Switches, Routers, Hubs, Gateways)	1
2	**Network Technologies to connect hosts**	
2.1	LAN Technologies (Ethernet, Token Ring)	1
2.2	WAN Technologies-Circuit switching-ISDN	1
2.3	Packet Switching-Frame relay	1
2.4	IEEE802.11	3
2.5	Multiple access-CSMA/CD	1
2.6	Flow control techniques	2
2.7	Error control techniques	2
3	**Internetworking**	
3.1	IPv4-GlobalAddresses	1
3.2	ARP-DHCP	1
3.3	ICMP	1
3.4	Routing	1

Module No.	Topic	No. of Lectures
3.5	Intra domain routing algorithms(RIP,OSPF)	2
3.6	Subnetting – Classless addressing	1
3.7	Interdomainrouting-Ipv6	1
3.8	Multicasting-VOIP	1
4	**Protocol Stack**	
4.1	End to end protocols (TCP-segment format)	1
4.2	Connection establishment, Termination	2
4.3	Congestion control, Flowcontrol	2
4.4	UDP	1
4.5	Application layer protocols-SMTP,IMAP	1
4.6	POP,HTTP,FTP,DNS,TELNET	3
5	**Network Performance and Simulation**	
5.1	Bandwidth, Latency, Throughput, Jitter, Delay	1
5.2	NetworksimulationusingNS2	2
5.3	Wireshark	2
6	Fundamentals of Software Defined Networks	1
	Total Lectures	**42**

Course Designer

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22CA370	MOBILE APPLICATION DEVELOPMENT LABORATORY	CATEGORY	L	T	P	CREDIT
		PC	0	0	2	2

Preamble

This course provides knowledge and skill on recent technologies in Mobile Application Development frameworks such as Android and iOS.

Prerequisite

22CA220 Object Oriented Programming
22CA240 Web Technology

Course Outcomes

On the successful completion of the course, students will be able to

.

CO Number	Course Outcome Statement	
CO1	Apply the UI components and location based services for the given problem	Apply
CO2	Choose the suitable storage mechanisms such as shared preferences, files, SQLite database for the given requirements	Apply
CO3	Apply multimedia, graphics and animation Application Programming Interfaces (APIs) for the suitable problems	Apply
CO4	Produce applications with the support of Camera, Bluetooth, WiFi and Sensor	Apply
CO5	Examine the usage of XML parsing, JSON parsing, Web services, React Native, Material Design and RSS Feed Reader in application development	Apply
CO6	Develop a mobile application with appropriate API based on the societal or business requirements	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	L	L	L		L					
CO2	S	M	M	L	M							
CO3	M		M	L	L		S					
CO4	L		S	S	S			M				
CO5	M	S	S	S	S			M				
CO6		S	M	L	M		M	M				

S- Strong; M-Medium; L-Low

List of Experiments

1. Installation of Android studio and Development Of Hello World Application
2. Write an android code for generate a notification when the particular location reached. Write code to
   Design a Feedback form of an event and perform validation.
   Design two activities to with proper navigation mechanisms such as link, button, menu etc
3. Design an app to enter the Name of the book and ISBN number and click on Add Book. Write code to
   Design an app to click on Show Books to view the contents added so far.
   Design an app to search for a book from querying author details.
4. Design an app with music player.
   Design an app to play, stop, and pause a video,
   Design an animated app for demonstrating the working principle of an algorithm
5. Implement a camera enabled application for capturing video or image.
   Implement a Bluetooth enabled application for controlling a system.
   Design an app with WiFi support API for transmitting signals to a system
6. Outline a web service for providing a hall booking service in a company.
   Illustrate JSON parsing of a book store application.
   Experiment XML parsing for a bus reservation application.
7. Mini Project - Forma team of 2/3 persons
   Pick-up a societal, business problem.
   As per the design thinking process, develop a design
   Implement and test the problem
   Upload the basic version of the application in Play store.

Learning Resources

1. Dawn Griffiths, David Griffiths, “Head First Android Development”, Shroff /O'Reilly 2ndEdition, 2017.
2. RetoMeier,“ProfessionalAndroidApplicationDevelopment4”,Wrox,2012.
3. Emilio Rodriguez Martinez, ”React: Cross-Platform Application Development with React Native” Build4real-worldappswith React Native, Packt Publishing, March 13,2018.
4. Devin Abbott, Houssein Djirdeh, Anthony Accomazzo, Sophia Shoemaker, ”Fullstack React Native: Create beautiful mobile apps with JavaScript and React Native”, January11, 2019.
5. https://developer.android.com

Course Designer

1. P.Sharmila psaca@tce.edu

22CA380	COMPUTATIONAL STATISTICS LAB	CATEGORY	L	T	P	CREDIT
		FC	0	0	2	2

Preamble

This course provides a solid undergraduate foundation in both probability theory and mathematical statistics and at the same time provides an indication of the relevance and importance of the theory in solving practical problems in the real world.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

.

CO Number	Course Outcome Statement	
CO1	Understanding basic R operations	Understand
CO2	Manipulate data within R.	Apply
CO3	Create simple graphs and charts used in introductory statistics	Apply
CO4	Perform and interpret different distribution using R	Apply
CO5	Carry out hypothesis testing and calculate confidence intervals	Apply
CO6	Perform linear regression models for data analysis	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	S	M					M			
CO2	M	M	S	M					M			
CO3	S	S	S	S					S			
CO4	S	S	S	S					S			
CO5	S	S	S	S					S			
CO6	S	S	S	S					S			

S- Strong; M-Medium; L-Low

List of Experiments

I. Introduction to R Programming

a. Installing **R**

b. Installing and Loading Add-on Packages

c. Basic R Operations and Concepts

II. Getting Used to R

a. Viewing and Manipulating Data

b. Plotting Data

c. Reading in Your Own Data

III-Visualizing Data

Tables, chart sand plots. Visualizing Measures of Central Tendency, Variation, and Shape. Box plots, Paretodiagrams. How to find the mean median standard deviation and quantiles of a set of observations.

IV- Probability Distributions

Generate and Visualize Discrete and continuous distributions using the statistical environment. Demonstration of CDF and PDF uniform and normal, binomial Poisson distributions.

V- Perform Tests of Hypotheses

How to perform tests of hypotheses about the mean when the variance is known. How to compute the p-value. Explore the connection between the critical region,the test statistic, and the p-value

VI- Correlation

How to calculate the correlation between two variables. How to make scatter plots. Use the scatter plot to investigate the relationship between two variables

VII- Estimating a Linear Relationship

- **a.** A Statistical Model for a Linear Relationship
- **b.** Least Squares Estimates
- **c.** The R FunctionIm
- **d.** Scrutinizing the Residual

Reference Books & Web Resources

1. MariaDoloresUgarte,AnaF.Militino,AlanT.Arnholt"ProbabilityandStatisticswithR"2ndEditionon,CRCPress,2016.
2. P.Dalgaard."IntroductoryStatisticswithR",2ndEdition.(Springer 2008)
3. MichaelAkritas,"Probability&StatisticswithRforEngineersandScientists",2ndEditionon,CRCPress,2016.
4. G.JayKerns"IntroductiontoProbabilityandStatisticsUsingR",Firstedition,2010.
5. https://www.tutorialspoint.com/r/index.html

Course Designer

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2. Dr.P.Victor -pvmat@tce.edu
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22CAPA0	BIG DATA ANALYTICS	CATEGORY	L	T	P	CREDIT
		PE	3	0	0	3

Preamble

This course aims at facilitating the student to explore and understand the Big data platform, its architecture and its technology foundations. Work on hadoop platform. Perform mining and analysis on massive data using certain techniques. Also perform analysis through visualization techniques.

Prerequisite

22CA130 - Database Management Systems

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	
CO1	Explain the big data perspective and its real world requirement (CO1)	Understand
CO2	Illustrate the working principle of big data architecture and its technology foundations. (CO2)	Understand
CO3	Compare and contrast the nature of data in distributed file systems (CO3)	Understand
CO4	Utilize the hadoop platform to work on huge data. (CO4)	Apply
CO5	Make use of certain analytical techniques on big data. (CO5)	Apply
CO6	Determine the results of big data analysis using certain analytical techniques or tools. (CO6)	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2	S											
CO3	S											
CO4	S	M	M	L					L			
CO5	S	M	M	L	M				L			
CO6	S	S		L	M				L			

S- Strong; M-Medium; L-Low

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	30	20	20	10
Understand	30	30	30	30
Apply	40	50	50	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Define Big data.
2. What is the need for big data in business? List two examples.
3. How to manage big data?

Course Outcome 2 (CO2):

1. Explain the architecture of Big data with a neat sketch.
2. Define Virtualization.
3. Outline the role of cloud in big data.

Course Outcome 3 (CO3) :

1. Compare and contrast NoSQL with Relational databases.
2. Summarize the difference of data in warehouse and hadoop environment.
3. List the importance of warehouse in big data.

Course Outcome 4 (CO4) :

1. Make use of hadoop framework for explaining the role of it in big data analytics.
2. What do you mean by map reduce?
3. Utilizing an application explain the use of hadoop framework to maintain big data.

Course Outcome 5 (CO5) :

1. Compare and contrast sampling and filtering.
2. Define sentiment analysis.
3. What do you mean by stop words? Give examples.
4. Outline the interaction techniques.
5. Apply the association technique for the given data set to identifying frequent item sets.

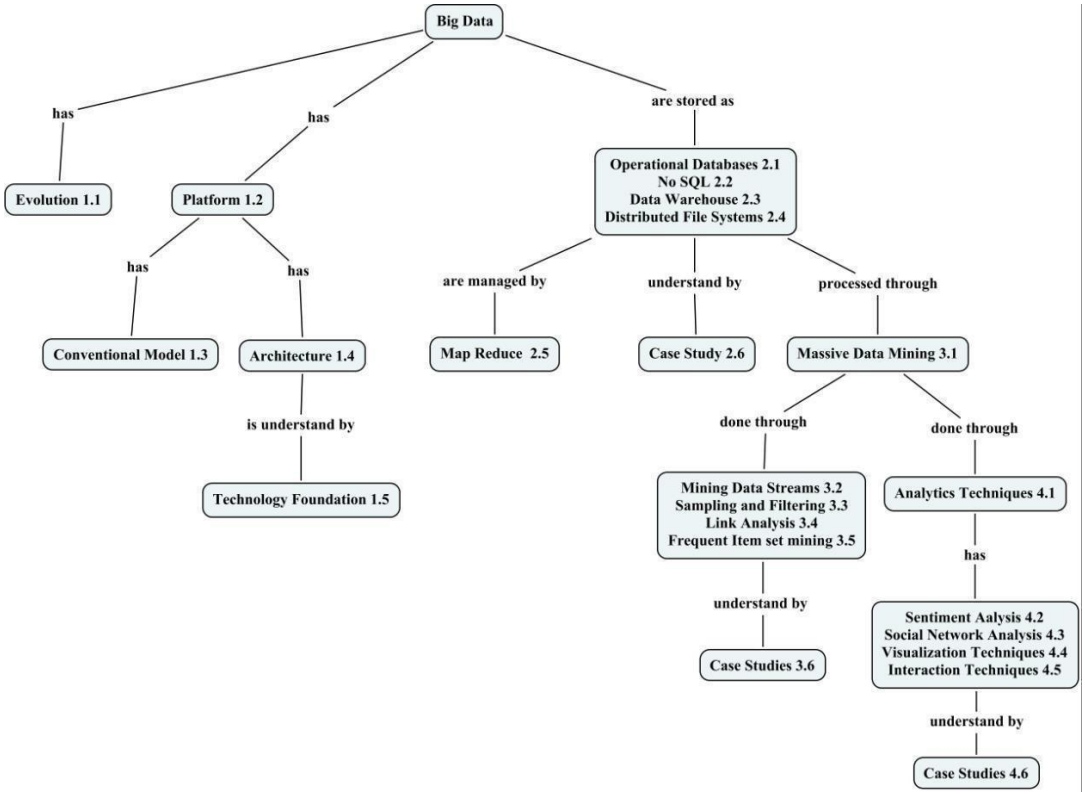
Course Outcome 6 (CO6) :

1. Big data analytics in real world applications – The results can be analyzed and evaluated using tools. (Assignment / Mini Project)

Syllabus

Big Data Introduction: Evolution of data management, Big data definition, Big data a business perspective, Introduction to Big Data Platform – Challenges of Conventional Systems, How to manage big data, Building a successful architecture, Technology foundations of big data. **Big Data Management**: Operational databases, NoSQL, Distributed file systems and its architecture; Data Warehouse vs Hadoop, Map reduce fundamentals, Case study: Hadoop, HDFS, MongoDB. **Massive Data Mining:** Mining data streams – Model, Sampling, Filtering, and Counting Distinct Elements in a Stream, Link Analysis, and Frequent Itemset mining from data stream, Case Studies - Real World Analysis, Stock Market Predictions. **Analytics on big Data:** Defining big data analytics, Analytics techniques – Sentiment analysis, Social Network analysis, Understanding text data analytics, Visualizations - Visual data analysis techniques, Interaction techniques, Case study: Big data analytics in Health care systems.

Concept Map



Course Contents and Lecture Schedule

Module No.	TOPIC	No. of Lectures
1	**Big data introduction(6)**	
1.1	Evolution of data management	1
1.2	Introduction to Big Data Platform	1
1.3	Challenges of Conventional Systems	1
1.4	Building a successful big data architecture	2
1.5	Technology foundations of big data	1
2	**Big Data Management(13)**	
2.1	Operational databases	1
2.2	NoSQL – MongoDB	2
2.3	Data in Warehouse	1
2.4	Data in Distributed File Systems–Hadoop, HDFS architectures	4
2.5	Map reduce fundamentals	3
2.6	Case study: Applications on Big Data Using Pig and Hive	2

3	**Massive Data Mining(10)**	
3.1	Massive data mining -introduction	1
3.2	Mining data streams	2
3.3	Sampling, Filtering, and Counting Distinct Elements in a Stream	1
3.4	Link Analysis	2
3.5	Frequent Item set mining from data stream	2
3.6	Case Studies-Real world analysis-Stock Market Predictions	2
4	**Analytics on big Data(7)**	
4.1	Big data analytic definition and techniques	1
4.2	Sentiment Analysis	1
4.3	Social network analysis	1
4.4	Visual data analysis	1
4.5	Interaction techniques	1
4.6	Case study: Big data analytics in Healthcare systems	2
	Total	**36**

Reference Books

1. Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman, “Big Data for Dummies”, Wiley Brand, 2013.
2. Paul Zikopoulos, Chris Eaton, ”Understanding Big Data: Analytics for Enterprise ClassHadoopandStreamingData”,McGraw-HillOsborneMedia,2011.
3. Anand Rajaraman, Jeffrey D. Ullman, “Mining of Massive Datasets”, Cambridge University Press New York, 2011.

Course Designer

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22CAPB0	SOCIAL NETWORKING AND WEBMINING	CATEGORY	L	T	P	CREDIT
		PE	3	0	0	3

Preamble

To learn knowledge representation using ontology and Understand the concept of semantic web and related applications.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	
CO1	Explain semantic web related applications.	Understand
CO2	Explain key concepts and measures in network analysis	Understand
CO3	Classify the Blogs and online communities	Apply
CO4	Demonstrate knowledge using ontology.	Apply
CO5	Discuss social network features with Semantic Web applications	Apply
CO6	Evaluate web-based social network extraction	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	L									
CO2	M	L	S									
CO3	M	L		S								
CO4	L	L										
CO5	L	L	M	S								
CO6	S	M										

S- Strong; M-Medium; L-Low

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	20
Understand	40	20	20	20
Apply	40	60	60	50
Analyze	0	0	0	0
Evaluate	0	0	0	0

Course Level Assessment Questions

Explain semantic web related applications. (CO1):

1. What do you mean by Semantic Web?
2. Show the limitations of the current web.
3. Explain in detail about the Development of the Semantic Web.
4. Outline the emergence of the social web.
5. What is Web 3.0?

Explain key concepts and measures in network analysis (CO2):

1. What is Network Analysis?
2. Discuss in detail about the Development of Social Network Analysis.
3. Differentiate global and Macro structure of social networks.
4. Show the key concepts in social network Analysis.
5. How will you measure a social network?

Classify the Blogs and online communities (CO3):

1. Define Blog.
2. Illustrate different online communities with example.
3. In what way Features of blogs can be used for social network extraction. Analyze.
4. How Features in web pages can be used for social network extraction?
5. Explain Jaccard-coefficient.

Demonstrate knowledge using ontology. (CO4):

1. Ontology based Knowledge representation. Discuss in detail.
2. Show the special characteristics of Ontology.
3. Draw a neat diagram of ontological structures.
4. Define RDF.
5. Explain RDF and the notion of semantics with example.
6. What is OWL?
7. How do you represent State-of-the-art in network data? Give a flow graph.
8. Exhibit the different Classes and properties of the FOAF ontology.

Discuss social network features with Semantic Web applications (CO5):

1. What are the criteria's to be met for Semantic Web applications with respect to the Challenge?
2. Draw the generic architecture of Semantic Web applications with a neat sketch.
3. Explain Sesame in detail.
4. Name the two main components of Elmo. Describe it.
5. Exhibit some features of Flink.
6. Draw a neat diagram of Flink architecture and explain it.

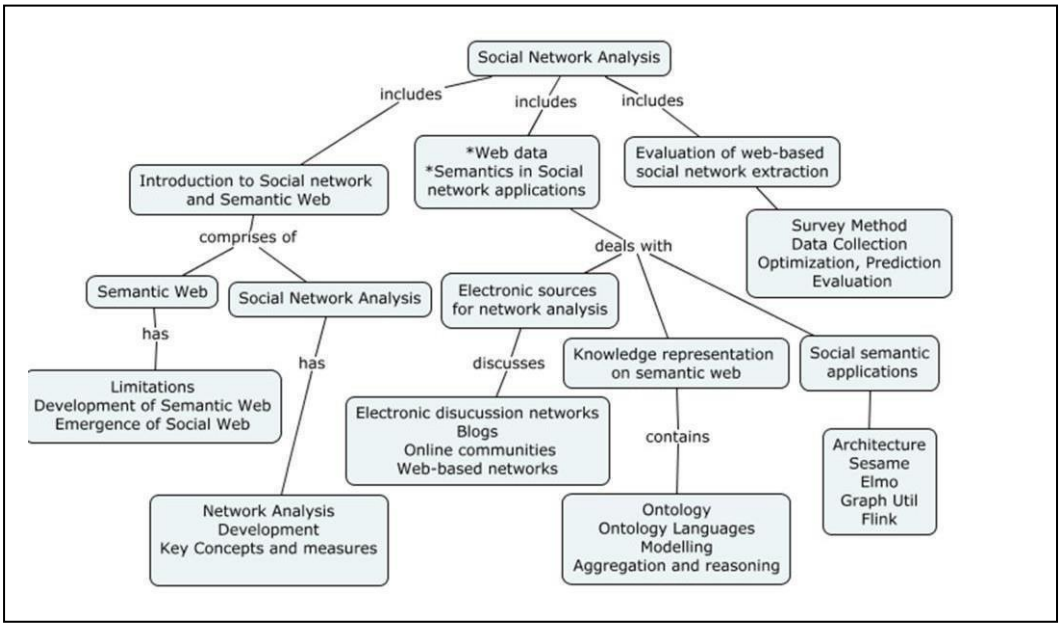
Evaluate web-based social network extraction (CO6):

1. Analyze the various steps in conducting case study of web based social network extraction.
2. Evaluate the survey method used for data extraction.
3. How will you optimize and predict the goodness of fit in network extraction

Syllabus

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. **Knowledge representation on the Semantic web:** Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language. **Modeling 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. **Social-semantic applications:** Generic Architecture- Sesame- Elmo – Graph util, Flink-Open academia. **Social network extraction:** Survey method- electronic data extraction- Data collection- Optimization- prediction- Evaluation.

Concept Map



Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1	**Introduction to Semantic Web**:	
1.1	Limitations of current Web	2
1.2	Development of Semantic Web	2
1.3	Emergence of the Social Web	1
2	**Social Network analysis:**	
2.1	Development of Social Network Analysis	1
2.2	Key concepts and measures in network analysis	2
3	**Electronic sources for network analysis:**	
3.1	Electronic discussion networks	1
3.2	Blogs and online communities	2
3.3	Web-based networks	1
4	**Knowledge representation on the Semantic web:**	
4.1	Ontology and their role in the Semantic Web	1
4.2	Ontology-based knowledge	2
4.3	Representation	1
4.4	Ontology languages for the Semantic Web	1
4.5	Resource Description Framework	1
4.6	Web Ontology Language	1
5	**Modeling and aggregating social network data:**	
5.1	State-of-the-art in network data representation	1
5.2	Ontological representation of social individuals	2
5.3	Ontological representation of social relationships	2
5.4	Aggregating and reasoning with social network data	2

Module No.	Topic	No. of Lectures
6	**Social- semantic applications:**	
6.1	Generic Architecture	1
6.2	Sesame-Elmo-Graph util	2
6.3	Flink – Open academia	1
7	**Social network extraction:**	
7.1	Survey method	1
7.2	Electronic data extraction	1
7.3	Data collection	1
7.4	Optimization	1
7.5	Semantic Web Tool demo and Exercise	2
	Total No. of Hours	36

Reference Books

1. Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.(Chapters1 to 7)
2. Guandong Xu, Yanchun Zhang and Lin Li, "Web Mining and Social Networking –Techniques and applications", First Edition Springer, 2011.
3. Dion Goh and Schubert Foo, "Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.
4. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling", IGI GlobalSnippet,2009.
5. John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web",Springer,2009.

Course Designer

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22CAPC0	MACHINE LEARNING	CATEGORY	L	T	P	CREDIT
		PE	3	0	0	3

Preamble

The course on machine learning provides an emphasis on data dimensionality reduction techniques, supervised, unsupervised and reinforcement learning models. It also facilitates the student by interpreting the real world problems by examining with appropriate machine learning tools.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	
CO1	Describe theory underlying machine learning concepts and techniques.	Understand
CO2	Apply suitable dimensionality reduction techniques to select the features from the given dataset.	Apply
CO3	Construct algorithms to learn linear and non-linear classification and Regression models.	Apply
CO4	Implement data clustering algorithms such as Hierarchical Clustering, Gaussian Mixture Models, Expected Maximization and Hidden Markov Model to cluster the given dataset and hence identity the outliers.	Apply
CO5	Apply reinforcement learning techniques for real life problems especially medical data set.	Apply
CO6	Apply the performance of various classifiers, regression models, clustering and reinforcement algorithms in terms of time and space complexity.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L										
CO2	S	M	L		M							
CO3	S	M	L		M							
CO4	S	M	L		M							
CO5	S	M	L		M							
CO6	S	S	M	L	S	M						

S- Strong; M-Medium; L-Low

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	30	20	20	20
Understand	20	20	20	20
Apply	50	60	60	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Describe different types of Learning Models.
2. Differentiate supervised, unsupervised and Reinforcement Learning.
3. Explain about PAC Framework.

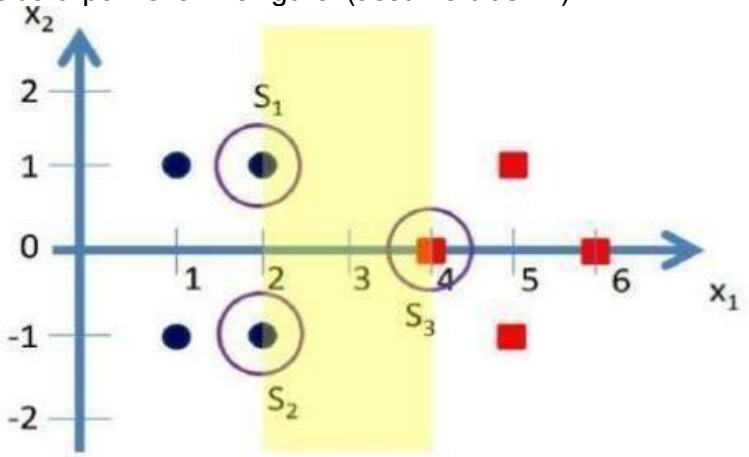
Course Outcome 2 (CO2):

1. Compute the Linear Discriminant projection for the following two dimensional dataset. Samples for class **ω1** : **X1**=(x1,x2)={(4,2),(2,4),(2,3),(3,6),(4,4)}Sample for class **ω2** : **X2**=(x1,x2)={(9,10),(6,8),(9,5),(8,7),(10,8)}
2. Determine the Principal Components for the given 3-Dimensional dataset.(1, 2,4), (2, 4,6), (3, 6,8) (4,8,10) (5,10,12) (6,12,14)
3. Apply Partial Least Squares in the following data and write the findings. Let us assume that dependent variables are J1 to J6, Explanatory variables are: Glucose, Fructose, Saccharose and Observation label is: Name of the Orange Juice.

Orange juice	Glucose	Fructose	Saccharose	J1	J2	J3	J4	J5	J6
pampryl amb.	25.32	27.36	36.45	2	1	2	4	2	2
tropicana amb.	17.33	20	44.15	2	3	3	4	3	4
fruvita fr.	23.65	25.65	52.12	3	3	4	4	2	5
joker amb.	32.42	34.54	22.92	2	2	2	2	2	3
tropicana fr.	22.7	25.32	45.8	4	4	3	4	3	3
pampryl fr.	27.16	29.48	38.94	3	1	1	2	2	3

Course Outcome 3 (CO3):

1. Apply SVM algorithm for the data-points and find dimension of hyper plane to classify the data-points for the figure. (assume bias =1)



2. Apply KNN classifier to classify the following Breast Cancer Dataset by considering 7 features in to account. Let diagnosis is the class label. Also compute the following
    a. Leave one cut cross validation error of 1NN
    b. 3 – folded cross validation error of 4NN

diagnosis	radius_ mean	texture_ mean	perimeter_ mean	area_ mean	smoothness_ mean	Concavity_ mean
M	17.99	10.38	122.8	1001	0.1184	0.3001
M	20.57	17.77	132.9	1326	0.08474	0.0869
M	19.69	21.25	130	1203	0.1096	0.1974
M	11.42	20.38	77.58	386.1	0.1425	0.2414
M	20.29	14.34	135.1	1297	0.1003	0.198
B	13.54	14.36	87.46	566.3	0.09779	0.06664
B	13.08	15.71	85.63	520	0.1075	0.04568
B	9.504	12.44	60.34	273.9	0.1024	0.02956

3. Apply Ridge and Lasso Regression in the „*Motor Trend* US magazine – mtcars" dataset and analyze their performance. The variable mpg - miles per gallon (or fuel efficiency) is the response variable.

Model	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
Mazda RX4	21	6	160	110	3.9	2.62	16.46	0	1	4	4
Mazda RX4 Wag	21	6	160	110	3.9	2.875	17.02	0	1	4	4
Datsun 710	22.8	4	108	93	3.85	2.32	18.61	1	1	4	1
Hornet 4 Drive	21.4	6	258	110	3.08	3.215	19.44	1	0	3	1
Hornet Sportabout	18.7	8	360	175	3.15	3.44	17.02	0	0	3	2
Valiant	18.1	6	225	105	2.76	3.46	20.22	1	0	3	1
Duster 360	14.3	8	360	245	3.21	3.57	15.84	0	0	3	4
Merc 240D	24.4	4	146.7	62	3.69	3.19	20	1	0	4	2

Course Outcome 4 (CO4):

1. Consider the following matrix and apply the hidden markov model. Class label is Climate A(hot,cold),Temperature is hidden node for climate- B(low,medium,high)

$$\Pi = [0.55, 0.45] \quad A = \begin{bmatrix} 0.1 & 0.9 \\ 0.4 & 0.6 \end{bmatrix} \quad B = \begin{bmatrix} 0.2 & 0.5 & 0.3 \\ 0.4 & 0.3 & 0.2 \end{bmatrix}$$

Find the probability of the 4 years sequence of [hot, cold, hot, hot] for[low, medium, high, medium]

2. Show the hierarchy of clustering created by the single-link clustering and complete-link clustering algorithms.

	P1	**P2**	**P3**	**P4**	**P5**	**P6**
P1	1.00	0.70	0.65	0.40	0.20	0.05
P2	0.70	1.00	0.95	0.70	0.50	0.35
P3	0.65	0.95	1.00	0.75	0.55	0.40
P4	0.40	0.70	0.75	1.00	0.80	0.65
P5	0.20	0.50	0.55	0.80	1.00	0.85
P6	0.05	0.35	0.40	0.65	0.85	1.00

1. Apply LOF (Local Outlier Factor) algorithm in the following dataset to detect the anomalydata.

user_id	**load_ video**	**pause_ video**	**play_ video**	**seek_ video**	**speed_change_ video**	**stop_ video**
0	2	1	4	1	0	1
1	6	14	14	0	0	1
2	1	0	0	0	0	0
3	2	2	2	0	0	1
4	1	3	22	18	0	0
5	4	1	5	9	0	1
6	1	5	9	6	1	1
7	2	1	18	16	0	0
8	3	7	9	2	0	1

Course Outcome 5 (CO5):

1. Apply temporal difference learning approach to the tic-tac-toe problem. Suppose that the probability of winning at a particular state is 0.6, the max probability value in the next set of states is 0.8, and based on our exploration policy, we choose a next state which has probability value 0.4. Should you backup the current state‟s probability value based on this choice of next state (i.e., move probability value 0.6 closer to 0.4) or not, given that the agent never stops exploring (i.e., the agent always makes an explanatory move some fraction of the time)? Justify your answer.

2. Suppose we want an RL agent to learn to play the game of golf. For training purposes, we make use of a golf simulator program. Assume that the original reward distribution gives a reward of +10 when the golf ball is hit into the hole

and -1 for all other transitions. To aid the agents learning process, we propose to give an additional reward of +3 whenever the ball is within a 1 metre radius of the hole. Is this additional reward a good idea or not? Justify.

3. Implement Q- Learning .and SARSA algorithm for developing the game called “cliff”. The cliff is a 2D world where a player (blue) has to reach the goal (green) by walking through the world while avoid to fall into the cliff (red).

Course Outcome 6 (CO6):

*CO6 will be assessed through Mini Project / Assignment

Group formation: Students are split into project groups with around 2 or 3 members in each group. A team can execute the project using appropriate Data dimension reduction and Learning algorithms. Students can use the software like R tool, Rapid Miner and python etc.

At the end of the semester, the team members have to present their project, submit their report and share their lessons learnt/best practices with other teams. Some of the activities may include: (but not limited to)

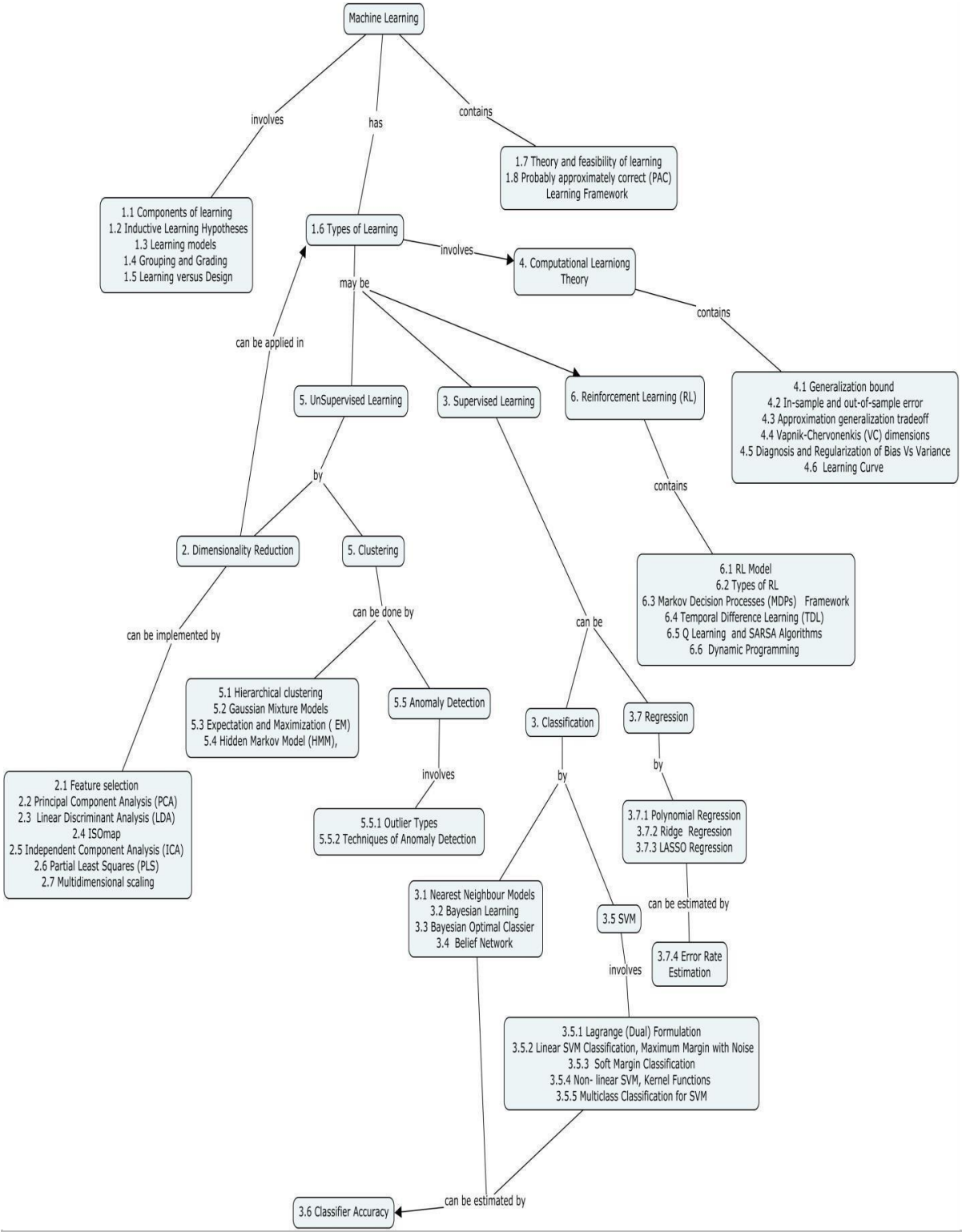
- Application identification and data set collection (Collect the real time dataset fromKaggle / UCI Repository / github etc)
- Design diagram or Data Modeling Diagram
- Applying Data dimensionality reduction algorithms
- Selecting relevant Learning algorithm to extract knowledge from the data set
- Execution of the algorithm
- Results and performance analysis
- Documentation

Some of the Mini-project titles may include: (but not limited to)

- Speech Recognition
- Automatic Recognition of Handwritten documents
- Healthcare Dataset
- Biological Data Analysis
- Intrusion Detection
- Internet of Things (IoT),
- Security Applications
- Financial Data Analysis
- Retail Industry
- Telecommunication Industry
- Education

CRM- Customer Relationship Management

Concept Map



Syllabus

Machine Learning : Components of learning – Inductive Learning Hypotheses- Learning models – geometric models, probabilistic models, logic models – Grouping and Grading – Learning versus Design – Types of learning – supervised , unsupervised , reinforcement – Theory and feasibility of learning - Probably approximately correct (PAC) Learning Framework

Dimensionality Reduction: Feature selection - Principal Component Analysis (PCA) - Linear Discriminant Analysis (LDA) – ISOmap - Independent Component Analysis (ICA) - Partial Least Squares (PLS) - Multidimensional scaling – Case Study

Supervised learning – Nearest Neighbour Models - Bayesian Learning - Bayesian Optimal Classier - Belief Network - SVM – Lagrange (Dual) Formulation, Linear SVM Classification, Maximum Margin with Noise, Soft Margin Classification, Non- linear SVM, Kernel Functions - Multiclass Classification for SVM - Classifier Accuracy Estimation - Case Study

Regression – Types - Polynomial Regression - Ridge and LASSO (Least Absolute Shrinkage and Selection Operator) Regression - Error Rate Estimation - Case Study

Computational Learning Theory: Generalization bound - In-sample and out-of-sample error - Approximation generalization tradeoff - Vapnik-Chervonenkis (VC) dimensions - Diagnosis and Regularization of Bias Vs Variance - Learning Curve - Case Study

UnSupervised Learning: Hierarchical clustering - Divisive and Agglomerative – Gaussian Mixture Models – Expectation Maximization (EM) algorithm – Hidden Markov Model (HMM), Anomaly Detection – Outlier Types, Techniques of Anomaly Detection - Case Study

Reinforcement Learning (RL): RL Model, Types of RL, Markov Decision Processes (MDPs) Framework, — Temporal Difference Learning (TDL) -Q Learning – SARSA (State-Action-Reward-State-Action) Algorithms – Dynamic Programming - Case Study

The following **use cases** will be applied during the discussion of the different Learning Models: Speech Recognition, Automatic Recognition of Handwritten documents, Healthcare Dataset, Biological Data Analysis, Intrusion Detection, Internet of Things (IoT), Security Applications. Gaming etc.

Learning Resources

- Tom M Mitchell, “Machine Learning”, McGraw-Hill, Indian Edition, 2017.
- Manaranjan Pradhan, U Dinesh Kumar, “Machine Learning using Python”, Wiley, First Edition, 2019.
- Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, “Learning from Data”, AML BookPublishers, First Edition, 2012.
- P. Flach, “Machine Learning: The art and science of algorithms that make sense ofdata”, Cambridge University Press, First Edition, 2012.
- K. P. Murphy, “Machine Learning: A probabilistic perspective”, MIT Press, First Edition,2012
- M. Mohri, A. Rostamizadeh, and A. Talwalkar, “Foundations of Machine Learning”, MITPress, First Edition, 2012.
- C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, First Edition, 2007.
- https://nptel.ac.in/courses/106105152/ - Introduction to Machine Learning by Prof. Sudeshna Sarkar, IIT Kharagpur
- https://www.coursera.org/learn/machine-learning - Machine Learning by Prof. Andrew Ng, Standford University

Course Contents and Lecture Schedule

Module No	Topic	No. of LectureHours	
1	**Machine Learning**		
1.1	Components of learning	1	
1.2	Inductive Learning Hypotheses		
1.3	Learning models – geometric models , probabilistic models, logic models	1	
1.4	Grouping and Grading	1	
1.5	Learning Versus Design		
1.6	Types of learning – supervised,unsupervised and reinforcement	1	
1.7	Theory and feasibility of learning		
1.8	Probably approximately correct (PAC)Learning Framework		
2	**Dimensionality Reduction**		
2.1	Feature selection	1	
2.2	Principal Component Analysis (PCA)	1	
2.3	Linear Discriminant Analysis (LDA)	1	
2.4	ISOmap	1	
2.5	Independent Component Analysis (ICA)		
2.6	Partial Least Squares (PLS)	1	
2.7	Multidimensional Scaling	1	
3	**Supervised Learning**		
3.1	Nearest Neighbour Models	1	
3.2	Bayesian Learning	1	
3.3	Bayesian Optimal Classier		
3.4	Belief Network	1	
3.5	**SVM**		
3.5.1	Lagrange (Dual) Formulation	1	
3.5.2	Linear SVM Classification ,MaximumMargin with Noise	1	
3.5.3	Non- linear SVM	1	
3.5.4	Kernel Functions		
3.5.5	Multiclass Classification for SVM	1	
3.6	Classifier Accuracy Estimation	1	
3.7	Regression		
3.7.1	Types, Polynomial Regression	1	
3.7.2	Ridge Regression	1	
3.7.3	LASSO (Least Absolute Shrinkage and Selection Operator) Regression		
3.7.4	Error Rate Estimation		
4	**Computational Learning Theory**		

4.1	Generalization bound	1	
4.2	In-sample and out-of-sample error		
4.3	Approximation generalization tradeoff	1	
4.4	Vapnik-Chervonenkis (VC) dimensions	1	
4.5	Diagnosis and Regularization of Bias Vs Variance	1	
4.6	Learning Curve		
5	UnSupervised Learning		
5.1	Hierarchical clustering--- Divisive and Agglomerative	1	
5.2	Gaussian Mixture Models	1	
5.3	Expectation - Maximization (EM) Algorithm	1	
5.4	Hidden Markov Model (HMM)	1	
5.5	Anomaly Detection		
5.5.1	Outlier Types	1	
5.5.2	Techniques of Anomaly Detection	1	
6	Reinforcement Learning (RL)		
6.1	RL Model	1	
6.2	Types of RL		
6.3	Markov Decision Processes (MDPs) Framework	1	
6.4	Temporal Difference Learning (TDL)	1	
6.5	Q Learning and SARSA (State-Action-Reward-State-Action) Algorithms	1	
6.6	Dynamic Programming	2	
	Total Lectures	**36**	

Course Designer

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22CAPD0	CLOUD COMPUTING	CATEGORY	L	T	P	CREDIT
		PE	3	0	0	3

Preamble

Cloud computing paradigm covers arrange of distributed computing, hosting and access solutions, including service- based computing. The objective of the course is to provide comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture and researching state – of – the – art in Cloud Computing fundamental issues, technologies, applications and implementations.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	
CO1	Describe the key technologies, architecture, strengths, limitations and applications of cloud computing	Understand
CO2	Explain the types and service models of cloud.	Understand
CO3	Describe the core issues such as security, privacy, and interoperability in cloud platform.	Apply
CO4	Apply suitable technologies, algorithms, and applications in the cloud computing driven systems	Apply
CO5	Provide appropriate cloud computing solutions for the given scenario	Apply
CO6	Analyze how applications are deployed in cloud	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2	M			L								
CO3	M											
CO4	S	M	L	S	S			M				
CO5	S	S	S	S	S			M				
CO6	M	S	M	s				L				

S- Strong; M-Medium; L-Low

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	20	10
Understand	50	30	30	30
Apply	30	50	50	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1(CO1):

1. Define Cloud computing, Enlist and explain essential characteristics of cloud computing.
2. What is self service provisioning?
3. Explain in brief, how cloud helps reducing capital expenditure?
4. What is the difference between process virtual machines, host VMMs and native VMMs?
5. What is the fundamental differences between the virtual machine as perceived by a traditional operating system processes and a system VM?

Course Outcome2(CO2):

1. Explain the services provided by the Amazon infrastructure cloud from a user perspective.
2. What is cloud computing? Enlist and explain three service models, and four deployment models of cloud computing.
3. Explain a user view of Google App Engine with suitable block schematic.

Course Outcome3(CO3)

1. Examine some of the common pitfalls that come with virtualization.
2. Show the reasons of Cloud Computing brings new threats
3. Classify secure execution environment and communication in cloud?
4. Show risks from multi-tenancy, with respect to various cloud environments.
5. Illustrate trusted cloud computing?

Course Outcome4(CO4)

1. Construct the SOAP and REST paradigms in the context of programmatic communication between applications deployed on different cloud providers, or between cloud applications and those deployed in-house.
2. Show conceptual representation of the Eucalyptus Cloud. Explain in brief the components within the Eucalyptus system.
3. Illustrate Nimbus? What is the main way to deploy Nimbus Infrastructure? What is the difference between cloud init.d and the Context Broker?
4. Show Open Nebula Cloud? Explain main components of Open Nebula.
5. Show Xen Cloud Platform(XCP) with suitable block diagram

Course Outcome5(CO5)

1. Construct the architecture of cloud file systems(GFS,HDFS).
2. Solve with suitable example, how a relational join could be executed in parallel using Map Reduce.
3. Show how Big tables are stored on a distributed file system such as GFS or HDFS.
4. Construct Map Reduce model with suitable examples

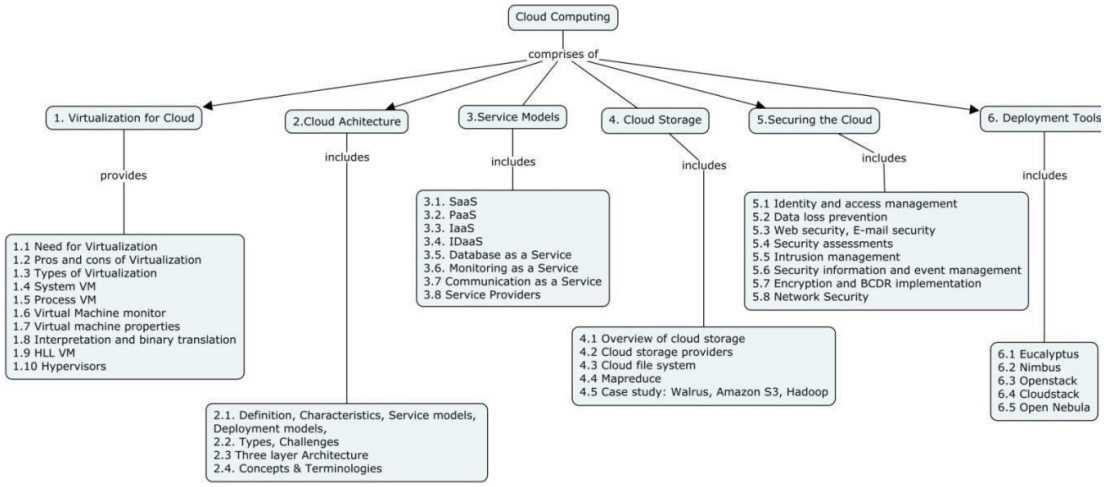
Course Outcome6(CO6):

1. Explaining how applications are deployed on IaaS, PaaS, private, public and hybrid clouds.
2. Classify the Deployment tools for Cloud Application.
3. Identify different models for deployment in cloud computing.

Syllabus

Virtualization for Cloud: Need for Virtualization, Pros and cons of Virtualization, Types of Virtualization, System VM, Process VM, Virtual Machine monitor, Virtual machine properties, Interpretation and binary translation, HLL VM, Hypervisors : Xen, KVM , VMWare, Virtual Box, Hyper-V. **Cloud Architecture:** Definition, Characteristics, Service models, Deployment models, Types, Challenges, Three-layer architecture, Concepts & Terminologies – Virtualization, Load balancing, Scalability and elasticity, Deployment, Replication, Monitoring, Software defined networking, Network function virtualization, Service level agreement, Billing. **Service Models:** SaaS – Multitenant, OpenSaaS, SOA. PaaS – IT Evolution, Benefits, Disadvantages. IaaS – Improving performance, System and storage redundancy, Cloud based NAS devices, Advantages, Server types. IdaaS – Single Sign-on, OpenID. Database as a Service, Monitoring as a Service, Communication as services. Service providers – Google, Amazon, Microsoft Azure, IBM, Sales force. **Cloud Storage:** Overview of cloud storage, cloud storage providers, Cloud file system, Mapreduce. Case study: Walrus, Amazon S3, Hadoop. **Securing the Cloud:** Identity and access management, Data loss prevention, Web security, E-mail security, Security assessments, Intrusion management, Security information and event management, Encryption and BCDR implementation, Network Security. **Deployment Tools:** Eucalyptus, Nimbus, Openstack, Cloudstack, Open Nebula.

Concept Map



Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1	**Virtualization for Cloud**	
1.1	Need for Virtualization	2
1.2	Pros and cons of Virtualization	

1.3	Types of Virtualization	2
1.4	System VM	
1.5	Process VM	2
1.6	Virtual Machine monitor	
1.7	Virtual machine properties,	
1.8	Interpretation and binary translation	2
1.9	HLLVM	2
1.10	Hypervisors: Xen, KVM , VM Ware, Virtual Box, Hyper-V.	2
2	**Cloud Architecture**	
2.1	Definition, Characteristics, Service models, Deployment models	2
2.2	Types, Challenges	2
2.3	Three-layer architecture	
2.4	Concepts & Terminologies-Virtualization, Load balancing, Scalability and elasticity, Deployment, Replication, Monitoring, Software defined networking, Network function virtualization, Service level agreement, Billing.	2
3	**Service Models**	
3.1	SaaS–Multitenant, OpenSaaS, SOA.	2
3.2	PaaS–IT Evolution, Benefits, Disadvantages.	2
3.3	IaaS – Improving performance, System and storage redundancy, Cloud based NAS devices, Advantages, Server types.	3
3.4	IDaaS– Single Sign-on, OpenID.	1
3.5	Database as a Service	1
3.6	Monitoring as a Service	1
3.7	Communication as services	1
3.8	Service providers - Google, Amazon, Microsoft Azure, IBM, Sales force.	2
4	**Cloud Storage**	
4.1	Overview of cloud storage	1
4.2	Cloud storage providers	1
4.3	Cloud file system	1

4.4	Map reduce.	2
4.5	Case study: Walrus, AmazonS3,Hadoop.	2
5	**Securing the Cloud**	
5.1	Identity and access management	1
5.2	Data loss prevention	
5.3	Web security, E-mail security	1
5.4	Security assessments	
5.5	Intrusion management	1
5.6	Security information and event management	
5.7	Encryption and BCDR implementation	2
5.8	Network Security.	
6	**Deployment Tools**	
6.1	Eucalyptus	1
6.2	Nimbus	
6.3	Openstack	1
6.4	Cloudstack	
6.5	Open Nebula	1
	Total No of Hours	36

Reference Books

1. JamesESmith, RaviNair,"VirtualMachines",MorganKaufmannPublishers,2006.
2. JohnRittinghouse&JamesRansome,"CloudComputing,Implementation,ManagementandStrategy", CRCPress, 2010.
3. T. Velte, A. Velte, R. Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill,2009.
4. CloudSecurityAlliance,"ProvidinggreaterclarityinSecurityasaService",2013.
5. RajkumarBuyya, Christian Vecchiola, S.ThamaraiSelvi, "Mastering cloud computing", MorganKaufman,2013.
6. Dr.KrisJamsa,"CloudComputing:SaaS,PaaS,IaaS,Virtualization,BusinessModels,Mobile,SecurityandMore",JonesandBartlettlearning, Firstedition, 2013.
7. ArshdeepBahga,VijayMadisetti,"CloudComputing:AHands-OnApproach",CreateSpaceIndependentPublishingPlatform, 1stedition, 2013.
8. MassimoCafaro(Editor),GiovanniAloisio(Editor),"Grids,CloudsandVirtualization"Springer;edition, 2011.
9. GautamShroff,"EnterpriseCloudComputingTechnologyArchitectureApplications",CambridgeUniversityPress;1edition, 2010.

Course Designer

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22CAPE0	INTERNET OF THINGS	CATEGORY	L	T	P	CREDIT
		PE	3	0	0	3

Preamble

This course aims at providing a basic understanding of Internet of Things. It aims at providing hands on training for building simple applications using appropriate sensors, microcontroller board and other components.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	
CO1	Describe Internet of Things and the protocols of IoT	Understand
CO2	Identify the various IoT components such as sensors, shields (Arduino, Raspberry Pi, Bluetooth, WiFi)	Understand
CO3	Program using Arduino studio and Rasperry Pi toolkits	Apply
CO4	Experiment various problems related with IoT using controllers and processors.	Apply
CO5	Explain the role of cloud and security in IoT	Apply
CO6	Demonstrate various applications of IoT integrating with Cloud and ensuring security	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	M		L		L							
CO2	S	M		L	M							
CO3	S	M		M	L							
CO4	S	M						L				
CO5	M	L	S					L				
CO6	S	S	M	L	M			L				

S- Strong; M-Medium; L-Low

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	30	20	20	20
Understand	40	40	40	40
Apply	30	40	40	40
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Discuss the Evolution of IoT.
2. List the some of the protocols involved in IoT.
3. Distinguish among Raspberry Pi,Arduino and Zigbee.
4. Describe the architecture of Cloud of Things.
5. Discuss the two pillars of IoT

Course Outcome 2 (CO2):

1. Illustrate the Arduino board with a diagram and name its components.
2. Illustrate the Rasperry Pi with a diagram and name its components.

Course Outcome 3(CO3):

1. Write a program to read the input from a switch port and copy it to a LED.
2. Write a program to glow an LED using Arduino

Course Outcome 4 (CO4):

1. Illustrate how a microcontroller can be connected to mobile device.
2. Show the connectivity of microcontroller with Bluetooth and USB.
3. Demonstrate the connectivity issues involved in IoT

Course Outcome 5 (CO5) :

1. Discuss the integration of IoT with Cloud
2. Describe the right components to build cloud based applications in IoT
3. List the security issues related to IoT

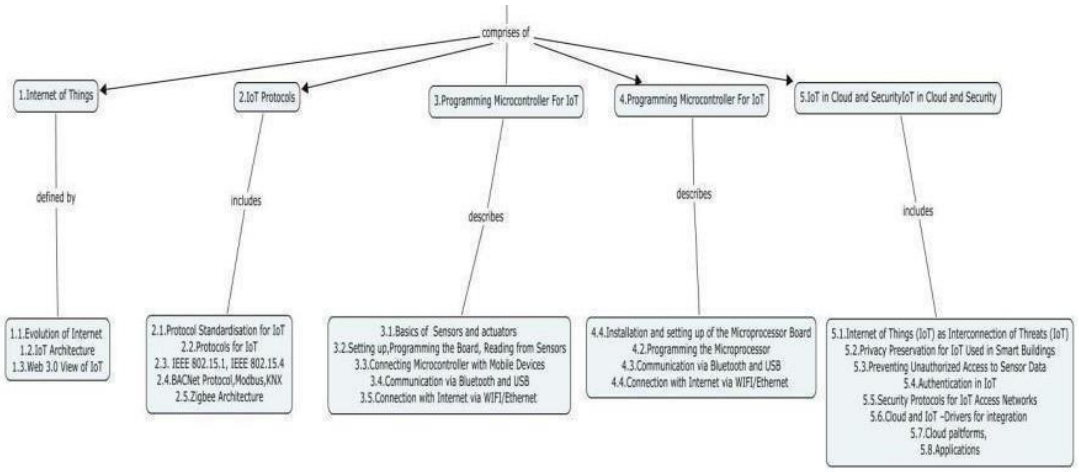
Course Outcome 6(CO6):
CO6 is assessed through Mini Project. Mini Project Details

1. Team formation (Team size: 5)
2. Problem identification on various IT, societal, business and environmental needs (Eg. IoT based Smart Bin Application, Home Automation etc.)
3. Identify and assemble the appropriate components needed to build the microcontroller board.
4. Test the board with sample input.

Syllabus

Internet of Things: Evolution of Internet, IoT Architecture, Web 3.0 View of IoT. **IoT Protocols:** Protocol Standardisation for IoT ,Protocols for IoT, IEEE 802.15.1, IEEE 802.15.4,BACNet Protocol, Modbus, KNX, Zigbee Architecture. **Programming Microcontroller For IoT:** Basics of microcontroller, Setting up, Programming the Board, Reading from Sensors, Connecting Microcontroller with Mobile Devices, Communication via Bluetooth and USB, Connection with Internet via WIFI/Ethernet. **Programming Microprocessor For IoT:** Installation and Setting up of the Microprocessor board, Programming the Microprocessor, Communication via Bluetooth and USB, Connection with Internet via WIFI/Ethernet. **IoT in Cloud and Security:** Internet of Things (IoT) as Interconnection of Threats (IoT), Privacy Preservation for IoT Used in Smart Buildings, Preventing Unauthorized Access to Sensor Data, Authentication in IoT, Security Protocols for IoT Access Networks, Cloud and IoT – Drivers for integration ,Cloud platforms, Applications

Concept Map



Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1	**Internet of Things**	
1.1	Evolution of Internet	1
1.2	IoT Architecture	
1.3	Web 3.0 View of IoT	1
2	**IoT Protocols**	
2.1	Protocol Standardisation for IoT	1
2.2	Protocols for IoT	2
2.3	IEEE 802.15.1, IEEE 802.15.4	1
2.4	BACNet Protocol, Modbus, KNX	1
2.5	Zigbee Architecture	1
3	**Programming Microcontroller For IoT**	
3.1	Basics of sensors and actuators	2
3.2	Setting up, Programming the Board, reading from Sensors	2
3.3	Connecting Microcontroller with Mobile Devices	2
3.4	Communication via Bluetooth and USB	2

3.5	Connection with Internet via WIFI/Ethernet	2
4	**Programming Microprocessor For IoT**	
4.1	Installation and Setting up of the Microprocessor board	2
4.2	Programming the Microprocessor	2
4.3	Communication via Bluetooth and USB	2
4.4	Connection with Internet via WIFI/Ethernet	2
5	IoT in Cloud and Security	
5.1	Internet of Things (IoT) as Interconnection of Threats (IoT)	1
5.2	Privacy Preservation for IoT Used in Smart Buildings	1
5.3	Preventing Unauthorized Access to Sensor Data	1
5.4	Authentication in IoT	1
5.5	Security Protocols for IoT Access Networks	1
5.6	Cloud and IoT –Drivers for integration	1
5.7	Cloud paltforms	1
5.8	Applications	1
	Total No Of Hours	36

Reference Books

1. Charalampos Doukas ¯ Building Internet of Things with theArduino, Create space, April 2012.
2. Fei Hu- Security and Privacy in Internet of Things (IoTs): Models,Algorithms and Implementation, CRC press ,2016
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles ¯Architecting the Internet of Things, Springer,2011
4. Donald Norris ¯The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black, Mc.Graw ill,2015.
5. Cuno Pfister ¯Getting Started with the Internet of Things, O'Reilly Media,Inc.,2011
   Honbo Zhou ¯The Internet of Things in the Cloud: A Middleware Perspective, CRC Press,2012
6. Olivier Hersent, David Boswarthick, Omar Elloumi, ¯The Internet of Things, Key applications and Protocols, Wiley, 2012
7. https://www.raspberrypi.org/
8. https://developer.ibm.com/iot/
9. http://www.microsoft.com/en-in/server-cloud/internet-of-things.aspx

Course Designer

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22CAPF0	INFORMATION SECURITY	CATEGORY	L	T	P	CREDIT
		PE	3	0	0	3

Preamble

The objective of the course on Information Security is to provide exposure on cryptography and secure communication protocols. This course develops a basic understanding of the algorithms used for data protection and few design choices behind these algorithms. The course emphasizes the understanding of previous attacks on the networks with the aim of preventing future attacks.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	Course Outcome Statement	
CO1	Perform Encryption/ Decryption of text using symmetric and asymmetric crypto algorithms to provide confidentiality	Apply
CO2	Compute hash and digital signature for the given message to provide integrity and non-repudiation.	Apply
CO3	Examine the strength of any cryptographic algorithm by crypt analysis.	Apply
CO4	Explain different types of authentication and key agreement protocols.	Understand
CO5	Use security protocols such as SSL, IP Sec etc., at different layers of TCP/IP stack to develop security solutions.	Apply
CO6	Identify security attacks and vulnerabilities in any information system and provide preventive measures and solutions in adherence with security standards.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	S	M	L									
CO2	S	M	L									
CO3	S	S	M	L								
CO4	M	L										
CO5	S	M	L									
CO6	S	S	M	L	M			S				

S- Strong; M-Medium; L-Low

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests			Terminal Examination
	1	2	3	
Remember	20	20	10	10
Understand	30	30	30	30
Apply	40	40	60	60
Analyze	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Alice Wishes to send the message (24, 26) to Bob using Elliptic curve encryption. If the Cryptosystem parameters are E67(2,3), G=(2,22) and the private key of Alice is 4 ,find the public key of Alice and the encrypted message if the random value is r=2. Show the steps by which Bob recovers the plaintext from the cipher text.
2. Encrypt the message "CS" using RSA algorithm with n= 18923 and e=79. Break the code by factorizing n and compute the deciphering key.
3. Consider a Diffie Hellman scheme with a common prime q=19 and a primitive root 13. (i) If User A has a public key 10, what is his private key? (ii) If User B has a private key 6, what is his public key? (iii) What is the shared secret key?

Course Outcome 2 (CO2):

1. Apply SHA-1 message digest to message M=THIAGARAJARCOLLEGE…. for one step. Make assumptions of initial buffer values in big endian form. F(t,b,c,d)=bc+b‟d. Draw the flow diagram for the scheme and then compute all other relevant parameters required for the calculation.
2. Generate the digital signature for a message with hash value h(m) =25 using Digital Signature Standard Scheme if p=709,q=59,d=14,r=4,e0=3. Verify the signature at the receiving end.
3. Differentiate strong and weak collision resistance with reference to hash functions.

Course Outcome 3(CO3)

1. Intercept the message „FBRTLWUGATEPHBNXSW‟ which was encoded using a Hill Cipher System with a 3 X 3 key matrix in a 26 letter alphabetic system. The last nine letters are the sender‟s signature "JAMESBOND". Find the enciphering matrix, deciphering matrix and read the message.
2. Can the following matrix be used as key in Hill cipher? Justify your answer. {1,2,3; 4,5,6; 7,8,9}
3. John is reading a mystery book involving cryptography. In one part of the book, the author gives a cipher text "CIW" and two paragraphs later the author tells the reader that this is a Caesar cipher and the plain test is "yes", In the next chapter the hero found a tablet in a cave with "XVIEWYWI" engraved on it. John immediately found the actual meaning of the cipher text, what type of attack did John launch here? What is the plain text?

Course Outcome 4 (CO4)

1. Compare and contrast biometric authentication vs. cryptographic authentication.
2. Explore the various ways of distribution of public keys.
3. Enlist the various parameters present in a digital certificate.

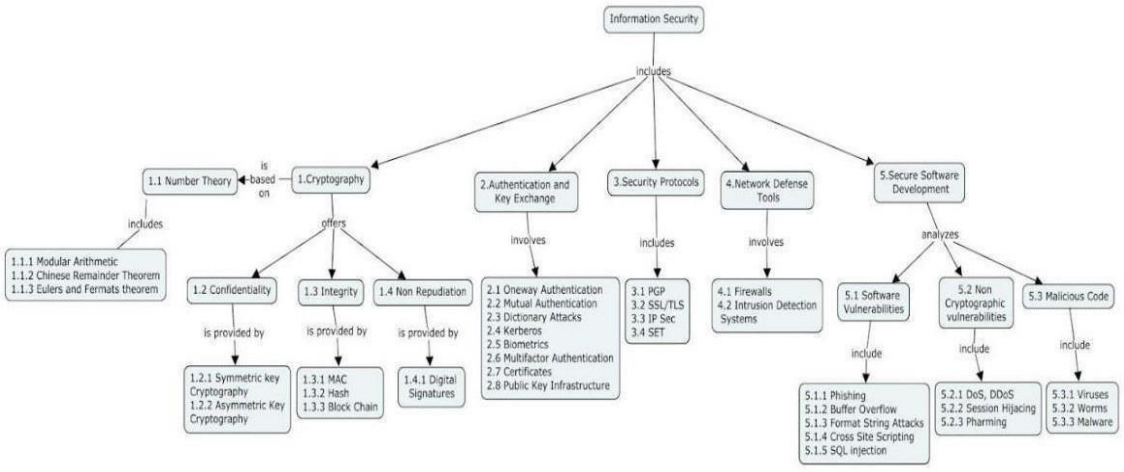
Course Outcome 5 (CO5)

1. An organization allows its employees a remote login facility through an IPsec based VPN. With the help of neat sketches, show different possible placements of VPN terminator with respect to organization firewalls. Discuss the pros and cons of each placement.
2. Compare the packet marking versus packet logging schemes for IP trace back in respect to the probability of success, cost, and ease of deployment and performance overheads.
3. How are the following supported in electronic passport? (i)Detection of fake passports, (ii) Detection of stolen passports, (iii) Prevention of passport skimming attacks, (iv) Prevention of eaves dropping on passport to reader communications.

Course Outcome 6(CO6):

1. Is it possible to design a protocol that accomplishes both authentication and session key exchange with only two messages and without timestamps? Consider each of the following two cases separately. The two parties share a long term secret. Both communicating parties have a public key – private key pair. Each party knows other‟s public key
2. Prepare a security analysis report on the threats and vulnerabilities involved in an online examination system.
3. Examine the feasibility of launching an offline dictionary attack on the electronic passport with the goal of obtaining certain fields in it such as the Date of Birth. Let S represent the concatenation of three fields –DOB, expiry date and passport number. Assuming each character is possible and equally likely, calculats the total number of possible values of S. Recalculate the total number of possible values of S under the following assumptions: (i) The holder of the passport being targeted is less than 80 years old. (ii) The passport validity period is 5 years. (iii) The passport number uses numeric characters only. (iv) About 1million passports have been issued in India and the passport numbers are aligned in sequence.

Concept Map



Syllabus

Basics of Information Security – Perspectives and Impact, Threats and vulnerabilities, Attacks, Security Services CIA Triad and Security Models, Internet Law and Cyber Crimes **Cryptography** - Mathematics for Cryptography – Number Theory - Modulo Arithmetic Euclidean and extended Euclidean Theorem - Chinese Remainder Theorem Euler and Fermat theorem , Symmetric Key Cryptosystems –Hill Cipher, Data Encryption Standard and Advanced Encryption Standard, Public Key Cryptography RSA , Elliptic Curve Cryptosystems , Integrity – Message Authentication Code and Hash, Block Chain Technology, Digital Signatures. **Authentication of Key Exchange** – One way Authentication- Mutual AuthenticationDictionary Attacks- Kerberos- Biometrics- Multifactor Authentication. Key management – Digital certificates- Public Key Infrastructure. **Security**

Protocols Security at Application Layer – PGP, Security at Transport Layer –SSL and TLS, Security at Network layer –IP Sec, Electronic Payments – SET Network Defense Tools -Firewalls, Intrusion Prevention and Detection Systems **Secure Software Development** -Software Vulnerabilities – Phishing, Buffer Overflows, Format String Attacks, Cross Site Scripting, SQL injection. **Non cryptographic Protocol Vulnerabilities** –DoS, DDoS, Session Hijacking and Pharming Attacks. Viruses, Worms and Malware Analysis- Case Studies

Course Contents and Lecture Schedule

Module No.	Topic	No. of Lectures
1	**Basics Of Information Security**	
1.1	Perspectives and Impact, Attacks, Threats and vulnerabilities	1
1.2	SecurityServices -CIA Triad and Security Models	
1.3	Internet Law and Cyber Crimes	1
2	**Cryptography**	
2.1	**Mathematics for Cryptography- Number Theory** Modulo Arithmetic - Euclidean and extended Euclidean Theorem	1
2.2	Chinese Remainder Theorem Euler and Fermat theorem	1
2.3	**Symmetric Key Cryptography** Hill Cipher	1
2.4	Data Encryption Standard	2
2.5	Advanced Encryption Standard	2
2.6	Public Key Cryptography RSA	2
2.7	Elliptic Curve Cryptosystems	2
2.8	Integrity Message Authentication Code and Hash	1
2.9	SHA -512	1

2.10	Block Chain Technology	1
2.11	Digital Signatures Digital Signature Standard	1
3	Authentication And Key Exchange	
3.1	One way Authentication Mutual Authentication	1
3.2	Dictionary Attacks	1
3.3	Kerberos	1
3.4	Biometrics	1
3.5	Multifactor Authentication.	1
3.6	Key management –Digital certificates	1
3.7	Public Key Infrastructure	1
4	Security Protocols	
4.1	Security at Application Layer – PGP	1
4.2	Security at Transport Layer –SSL and TLS	1
4.3	Security at Network layer –IP Sec	1
4.4	Electronic Payments – SET	1
5	Network Defense Tools	

5.1	Firewalls	1
5.2	Intrusion Prevention and Detection Systems	1
6	Secure Software Development	
6.1	Software Vulnerabilities, PhishingBuffer Overflows	1
6.2	Format String Attacks Cross Site Scripting SQL injection.	1
6.3	Non cryptographic Protocol VulnerabilitiesDoS, DDoS	1
6.4	Session Hijacking Pharming Attacks	1
6.5	Malicious Code Viruses, Worms and Malware Analysis - Case Studies	2
	Total No of Hours	36

Reference Books

1. Behrouz. A. Foruzan and Debdeep Mukhopadhyay, “Cryptography and Network Security”, Tata McGraw Hill , Third Edition, 2016.
2. William Stallings, “Cryptography and Network Security: Principles and Practice”, Prentice Hall,Seventh Edition, 2017.
3. Bernard L Menezes, and Ravinder Kumar “Cryptography, Network Security and Cyber Laws”, Cengage Learning India Pvt Limited, 2018.
4. Charlie Kaufman and Radia Perlman, Mike Speciner, “Network Security, Private Communication in Public World”, Prentice Hall India, Second Edition, 2002.
5. William Stallings, "Network Security Essentials: Applications and Standards", Prentice Hall, Sixth Edition, 2016.
6. Man Young Rhee, "Internet Security Cryptographic Principles, Algorithms and Protocols", Wiley, First Edition, 2003.
7. Douglas R. Stinson, “Cryptography Theory and Practice”, Third Edition, Chapman & Hall/CRC, 2006.
8. http://cse.iitkgp.ac.in/~debdeep/courses_iitkgp/Crypto/index.htm

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