SEMESTER V

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1.	PC	CI20501	Design and Analysis of Algorithms	3	0	0	3
2.	PC	CI20502	Artificial Intelligence	3	0	0	3
3.	PC	CI20503	Operating Systems	3	0	0	3
4.	PC	CI20504	Database Management Systems	3	0	0	3
5.	PC	CI20505	Sensors and Devices	3	0	0	3
6.	PE	CI2015*	Professional Elective Course I	3	0	0	3
Practical							
7.	PC	CI20506	Operating Systems Laboratory	0	0	4	2
8.	PC	CI20507	Database Management Systems Laboratory	0	0	4	2
9.	EE	EN20501	Career Development Laboratory I	0	0	2	1
			TOTAL	**18**	**0**	**10**	**23**

SEMESTER VI

S.No.	Category	Course Code	Course Title	L	T	P	C
Theory							
1.	PC	CI20601	Compiler Design	3	0	0	3
2.	PC	CI20602	Machine Learning	3	0	0	3
3.	PC	CI20603	IOT and Its Applications	3	0	0	3
4.	PC	CI20604	Data Warehousing and Data Mining	3	0	0	3
5.	PE	CI2025*	Professional Elective Course II	3	0	0	3
6.	OE	CI2090*	Open Elective I	3	0	0	3
Practical							
7.	PC	CI20605	Compiler Design Laboratory	0	0	4	2
8.	PC	CI20606	IOT and Its Applications Laboratory	0	0	4	2
9.	EE	EN20601	Career Development Laboratory II	0	0	2	1
			TOTAL	**15**	**0**	**10**	**23**

PAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
BE CSE (IOT)
AUTONOMOUS

PROFESSIONAL ELECTIVE COURSES
(PE-I)

S.No.	Category	Course Code	CourseTitle	L	T	P	C
1.	PE	CI20151	Object Oriented Modeling and Design	3	0	0	3
2.	PE	CI20152	Cloud Computing	3	0	0	3
3.	PE	CI20153	IoT Architecture and Design	3	0	0	3
4.	PE	CI20154	Soft Computing	3	0	0	3
			TOTAL	**12**	**0**	**0**	**12**

PROFESSIONAL ELECTIVE COURSES
(PE-II)

S.No.	Category	Course Code	CourseTitle	L	T	P	C
1.	PE	CI20251	Data Science in IOT	3	0	0	3
2.	PE	CI20252	Software Testing	3	0	0	3
3.	PE	CI20253	Block Chain Technology	3	0	0	3
4.	PE	CI20254	Software Quality Assurance	3	0	0	3
			TOTAL	**12**	**0**	**0**	**12**

OPEN ELECTIVE COURSES (OE-I)

S.No.	Category	Course Code	Course Title	L	T	P	C
1.	OE	CI20901	Distributed Systems	3	0	0	3
2.	OE	CI20902	Software Project Management	3	0	0	3
			TOTAL	**6**	**0**	**0**	**6**

SEMESTER – V

CI20501	DESIGN AND ANALYSIS OF ALGORITHMS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	know the fundamental concepts and techniques for problem solving and algorithm design.
2	analyze the importance of computational complexity of the algorithm.
3	familiarize the important algorithm design techniques.
4	design various techniques to solve the problem.
5	understand the limitations of algorithmic power.

UNIT I	INTRODUCTION	9

Notion of Algorithm - Fundamentals of Algorithmic Problem Solving - Important Problem Types – Fundamentals of the Analysis of Algorithm Efficiency –Analysis Framework, Asymptotic Notations and its Properties; Mathematical Analysis of Recursive and Non - Recursive Relations (Insertion sort, bubble sort, Selection sort, Towers of Hanoi).

UNIT II	BRUTE FORCE AND DIVIDE-AND-CONQUER	9

Brute Force - Closest-Pair and Convex-Hull Problems, Exhaustive Search, Travelling Salesman Problem, Knapsack Problem, Assignment Problem; Divide and Conquer methodology - Merge sort, Quick sort, Binary Search, Multiplication of Large Integers, Strassen's Matrix Multiplication, Closest Pair Problem and Convex Hull Problem.

UNIT III	DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE	9

Dynamic Programming - Computing a Binomial Coefficient, Warshall's and Floyd's algorithm, Optimal Binary Search Trees, 0/1 Knapsack Problem and Memory functions; Greedy Technique - Prim's algorithm, Kruskal's algorithm, Dijikstra's algorithm, Huffman trees.

UNIT IV	ITERATIVE IMPROVEMENT	9

The Simplex Method - The Maximum-Flow Problem - Maximum Matching in Bipartite Graphs – The Stable marriage Problem.

UNIT V	ALGORITHM DESIGN TECHNIQUE AND ITS LIMITATIONS	9

Backtracking-n-Queen problem, Hamiltonian Circuit Problem, Subset Sum Problem; Branch and Bound - Assignment problem, Knapsack problem, Travelling Salesman Problem; Limitation of Algorithm Power - P, NP, NP Complete Problems, Approximation Algorithms for NP-hard Problems.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	design algorithms for various computing problems.	Applying (K3)
CO2	analyze the time and space complexity of algorithms.	Analysing (K4)

CO3	identify various algorithms design techniques for different problems	Applying (K3)
CO4	analyze the different algorithm design techniques for a given problem	Analysing (K4)
CO5	differentiate algorithm design techniques of NP complete and NP hard problems.	Understanding (K2)

TEXT BOOKS

1.	Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.
2.	Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivestand Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.

REFERENCES

1.	Alfred V.Aho, John E Hopcroft and Jeffrey D.Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.
2.	Donald E.Knuth, "The Art of Computer Programming", Volumes 1&3 Pearson Education 2009.
3.	Steven S.Skiena, "The Algorithm Design Manual", Second Edition, Springer 2008.
4.	Harsh Bhasin, "Algorithms Design and Analysis", Oxford University Press, 2015.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	2	1	-	-	-	-	-	2	1	2	1
CO2	3	1	1	2	1	-	-	-	-	-	2	1	2	1
CO3	3	1	1	2	1	-	-	-	-	-	2	1	2	1
CO4	3	1	1	2	1	-	-	-	-	-	2	1	2	1
CO5	3	1	1	2	1	-	-	-	-	-	2	1	2	1

CI20502	ARTIFICIAL INTELLIGENCE	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	acquire knowledge of various methods of different problem solving and searching.
2	understand the concepts of knowledge representation.
3	understand about inference and how to solve the problems using various inference technique.
4	realize the concepts of planning and learning.
5	understand the method of various ai applications.

UNIT I	INTRODUCTION	9

Introduction to AI- Problem formulation, Problem Definition; Production systems-Control strategies, Search strategies, Problem characteristics, Production system characteristics, Specialized productions system; Problem solving methods; Problem graphs; Matching; Indexing and Heuristic functions; Hill Climbing; Depth first and Breath first; Constraints satisfaction; Related algorithms; Measure of performance and analysis of search algorithms.

UNIT II	REPRESENTATION OF KNOWLEDGE	9

Game playing; Knowledge representation - Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus; Knowledge representation using other – Structured representation of knowledge.

UNIT III	KNOWLEDGE INFERENCE	9

Knowledge representation; Production based system; Frame based system. Inference- Backward logic chaining, Forward chaining; Rule value approach; Fuzzy reasoning.

UNITIV	PLANNING AND EXPERT SYSTEM	9

Basic plan generation systems - Strips, Advanced plan generation systems, K strips; Strategic explanations - Why,Why not and how explanations; Expert systems-Architecture of expert systems, Roles of expert systems, Knowledge Acquisition; Typical expert systems Applications- MYCIN, DART, XOON.

UNIT V	AI APPLICATIONS	9

AI Applications- Language Models, Information Retrieval, Information Extraction, Natural Language Processing, Machine Translation, Speech Recognition; Robot - Hardware, Perception, Planning, Moving.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	demonstrate awareness of intelligent agents and problem solving using uninformed, informed and local search methods	Applying (K3)

CO2	develop knowledge about usage of propositional logic and first order logic for making inferences.	Applying (K3)
CO3	use the knowledge and the process of inference to derive new facts	Understanding (K2)
CO4	describe the use of planning and explain about various expert systems	Analysing (K4)
CO5	design and develop various ai systems	Applying (K3)

TEXT BOOKS

1.	Kevin Night and Elaine Rich, Nair B, "Artificial Intelligence", 3rdEdition, McGraw Hill 2017.
2.	Stuart Russel and Peter Norvig,"AI-AModernApproach",3rd Edition, Pearson Education 2015.

REFERENCES

1.	Lavika Goel, "Artificial Intelligence Concepts and Applications", Wiley 2021.
2.	Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2015.
3.	Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education 2013.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	-	-	-	-	1	2	2
CO2	3	2	1	1	2	-	-	-	-	-	-	1	2	2
CO3	3	2	1	1	2	-	-	-	-	-	-	1	2	2
CO4	3	2	1	1	2	-	-	-	-	-	-	1	2	2
CO5	3	2	1	1	2	2	-	-	-	-	-	1	2	2

CI20503	OPERATING SYSTEMS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the basic concepts and functions of operating systems.
2	acquire knowledge about processes, threads, scheduling algorithms and concept of deadlocks.
3	analyze various memory management schemes.
4	learn file system interfaces and implementation process.
5	study i/o streams and mass storage management.

UNIT I	INTRODUCTION TO OPERATING SYSTEMS	9

Introduction - Computer system organization - Operating Systems and types - Operating system structures - Services - System calls - System programs; Processes - Process concept - Process scheduling – Operations on Processes - Cooperating processes - Inter process communication; Threads - Overview, Multi-threading models - Threading issues.

UNIT II	PROCESS MANAGEMENT AND DEADLOCK	10

CPU Scheduling - Concepts-scheduling criteria - Scheduling algorithms - Algorithm Evaluation; Process Synchronization - The critical-section problem - Synchronization hardware - Semaphores - Classic problems of synchronization - Monitors; Deadlock-System model - Deadlock Characterization - Methods for handling deadlocks - Deadlock prevention - Deadlock avoidance - Deadlock detection - Recovery from deadlock.

UNIT III	MEMORY MANAGEMENT	9

Main Memory - Background - Swapping - Contiguous memory allocation - Paging Segmentation - Segmentation with paging; Virtual Memory - Background - Demand paging - Page replacement - Allocation of frames - Thrashing.

UNITIV	FILE SYSTEMS	9

File-System Interface - File concept - Access methods - Directory structure - File system mounting - File sharing - Protection; File-System Implementation - Directory implementation - Allocation methods - Free-space management - efficiency and performance – recovery - Network file systems.

UNIT V	I/O SYSTEMS AND MASS STORAGE MANAGEMENT	8

I/O Systems-I/O Hardware-Application I/O interface-kernel I/O subsystem-streams-Performance; Mass - Storage Structure; Disk attachment - Disk scheduling - Disk management - Storage Device Management - Swap-space management - RAID -stable storage. CASE STUDY: LINUX system and Mobile OS-iOS and Android.

TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	evaluate various scheduling algorithms	Applying (K3)
CO2	analyze deadlock, prevention and avoidance algorithms	Analysing (K4)
CO3	compare and contrast various memory management schemes	Applying (K3)
CO4	understand the functionality of file systems	Understanding (K2)
CO5	demonstrate administrative skills on linux and windows servers	Applying (K3)

TEXT BOOKS

1.	Silberschatz, Galvin, and Gagne, "Operating System Concepts", Tenth Edition, Wiley India Pvt Ltd, 2018.
2.	William Stallings, "Operating Systems – internals and design principles", Prentice Hall, 7th Edition, 2011.

REFERENCES

1.	AndrewS.Tanenbaum,"ModernOperatingSystems",FourthEdition,PearsonEducation,2014.
2.	HarveyM.Deital,"OperatingSystems",ThirdEdition,PearsonEducation,2007.
3.	AndrewS.Tannenbaum&AlbertS.Woodhull,"OperatingSystemDesignandImplementation", Prentice Hall, 3rd Edition, 2006.
4.	GaryJ.Nutt,"OperatingSystems",Pearson/AddisonWesley,3rdEdition,2004.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(3/2/1indicates strength of correlation) 3-Strong,2-Medium,1-Weak

	Programme Outcomes(POs)												PSOs	
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	-	-	-	-	-	-	1	-	-	-	2	1
CO2	3	2	1	-	1	-	-	-	1	-	-	1	2	1
CO3	2	2	3	-	1	-	-	-	1	-	1	2	2	1
CO4	2	2	3	-	1	-	-	-	1	-	2	2	2	1
CO5	3	1	-	-	-	-	-	-	1	1	2	2	1	1

CI20504	DATABASE MANAGEMENT SYSTEMS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	learn the fundamentals of database management systems.
2.	make the students to understand the relational models
3.	study the SQL and relational database design.
4.	understand the internal data storage methods using different file and indexing techniques.
5.	acquire an introductory knowledge about the case studies and recent trends.

UNIT I	INTRODUCTION	9

Purpose of Database System, Views of data, Data Models, Database System Architecture, Database users and Administrator; Entity-Relationship model (E-Rmodel) -E-R Diagrams, Introduction to relational databases.

UNIT II	RELATIONAL MODEL	9

The relational Model - The catalog, Types, Keys; Relational Algebra - Domain Relational Calculus, Tuple Relational Calculus, Fundamental operations, Additional l/O operations; SQL fundamentals-Integrity,Triggers, Security, Advanced SQL features, Embedded SQL, Dynamic SQL; Missing Information - Views; Introduction to Distributed Databases and Client/Server Databases.

UNIT III	DATABASE DESIGN	9

Functional Dependencies-Non-loss Decomposition, Functional Dependencies, First, Second, Third Normal Forms, Dependency Preservation, Boyce / Code Normal Form, Multi-valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

UNIT IV	STORAGE MANAGEMENT	9

RAID - File Organization, Organization of Records in Files, Indexing and Hashing, Ordered Indices, B+ tree Index Files, B tree Index Files, Static Hashing, Dynamic Hashing; Query Processing Overview – Algorithms for SELECT and JOIN operations ,Query optimization using Heuristics and Cost Estimation.

UNIT V	CASE STUDIES AND RECENT TRENDS	9

Case Studies - Hospital Management System, Railway Reservation System, Timetable Management System, Hotel Management System; Distributed Databases - Architecture, Data Storage, Transaction Processing; Object-based Databases - Object Database Concepts, Object- Relational features, ODMG ObjectModel, ODL, OQL; XML.

TOTAL PERIODS	**45**

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	classify the modern and futuristic database applications based on size and complexity	Understanding (k2)
CO2	map ER model to relational model to perform database design effectively	Applying (K3)
CO3	write queries using normalization criteria and optimize queries	Analysing (K4)
CO4	compare and contrast various indexing strategies in different database systems	Applying (K3)
CO5	appraise how advanced database differ from traditional database	Analysing (K4)

TEXT BOOKS

1.	Abraham Silberschatz, HenryF.Korth, S.Sudharshan, - Database System Concepts, Sixth Edition, Tata McGrawHill, 2011.
2.	Raghu Ramakrishnan, - Database Management Systems, Fourth Edition, McGraw- Hill College Publications, 2015.

REFERENCES

1.	Elmasri R.and Shamakant B.Navathe,"Fundamentals of Database Systems", 6th Edition, Addision Wesley, 2011.
2.	C.J.Date, A.Kannan, S.Swamynathan, - An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006.
3.	Ramez Elmasri, Shamkant B.Navathe, - Fundamentals of Database Systems, Sixth Edition, Pearson, 2011
4.	G.K.Gupta, "Database Management Systems", Tata McGraw Hill, 2011.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(3/2/1 indicates strength of correlation)3-Strong,2-Medium,1-Weak

Cos	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	1	-	2	1	1	1	2	1	1	-
CO2	3	2	1	2	2	-	2	-	-	-	2	1	2	-
CO3	3	2	1	2	2	-	2	-	-	-	2	1	2	2
CO4	3	2	1	2	2	-	2	-	-	-	2	1	2	1
CO5	3	2	1	2	2	-	2	-	-	-	2	1	2	1

CI20505	SENSORS AND DEVICES	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	learn sensor fundamentals, its characteristics also the fundamentals and basics of vibration sensors.
2.	know the concepts of practical sensors which includes bio, chemical and mechanical type.
3.	study about the applications of optical, radiation and temperature sensors.
4.	find the smart sensor basics and applications.
5.	acquire the knowledge of physical device interfaces.

UNIT I	FUNDAMENTALS OF SENSORS AND SIGNAL CONDITIONING	9

Sensor Fundamentals – basic sensor technology, sensor systems; Application considerations – sensor characteristics, system characteristics, instrument selection, data acquisition and readout; Acceleration, shock and vibration sensors – technology fundamentals, piezoresistive accelerometers, capacitive accelerometers, servo or (force balance) accelerometers, applicable standards, interfacing and designs.

UNIT II	BASIC CONCEPTS OF BIO, CHEMICAL AND MECHANICAL SENSORS	9

Biosensors – overview of bio sensors – applications of bio sensors – origin of biosensors – application range of biosensor; Chemical sensors – technology fundamentals – applications; Capacitive sensors – inductive sensors - capacitive and inductive sensor types; Flow and level sensor – methods for measuring flow, selecting flow sensors, recent advances in flow sensors, level sensors force; load and weight sensor - quartz sensors, strain gage sensors; Humidity sensor.

UNIT III	BASIC CONCEPTS OF OPTICAL, RADIATION AND TEMPERATURE SENSORS	9

Optical and Radiation Sensors – photo sensors, thermal infrared detectors; Position and motion sensors - contact and non-contact position sensors; Pressure sensor –piezo resistive pressure sensing; Piezoelectric pressure sensors; Temperature sensor - sensor types and technologies; Nanotechnology - enabled sensors - wireless sensor networks: principles and applications.

UNIT IV	SMART SENSORS AND APPLICATIONS	9

Smart Sensors - introduction, primary sensors, excitation, amplification, filters, converters, information coding/processing, data communication, standards for smart sensor interface, the automation; recent trends in sensor technologies – Film sensors, micro electromechanical systems; Sensors Applications: Introduction, on-board automobile sensors (automotive sensors), home appliance sensors, medical diagnostic sensors, sensors for manufacturing, sensors for environmental monitoring.

UNIT V	IOT PHYSICAL DEVICES AND ENDPOINTS	9

Introduction to Arduino and Raspberry Pi - Installation, interfaces (serial, SPI, I2C); Controlling hardware-connecting led, 7-segment led display, optocoupler, unipolar and bipolar stepper motors, relay, piezo buzzer, push button switch, keyboard, controlling servo motor, speed control of DC motor.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	understand the characteristics of sensors and fundamentals of vibration sensors	Understanding (K2)
CO2	identify the practical sensor such as mechanical and chemical applications	Applying (k3)
CO3	recognize the implementation of sensor networks with optical and radiation sensors	Understanding (K2)
CO4	know the idea about smart sensor implementation in practical environment	Applying (k3)
CO5	detect the appropriate IoT endpoint devices and its interfaces	Analysing (K4)

TEXT BOOKS

1.	Jon S. Wilson, "Sensor Technology", Newnes is an imprint of Elsevier, 2005.
2.	D. Patranabis,"Sensors and Transducers", PHI, 2013.

REFERENCES

1.	Arshdeep Bhaga, Vijay Madisetti, Internet of Things, Hands on Approach, Universities Press, 2016.
2.	Nathan Ida, "Sensors, Actuators and their Interfaces", A multidisciplinary Introduction, Scitech Publishing, 2014.
3.	Sabrie Soloman, "Sensors Handbook", 2nd Edition, McGraw Hill, 2010.
4.	Ambika Nagaraj, "Introduction to Sensors in IoT and Cloud Computing Applications", Bentham Science Publishers Pte. Ltd, 2021

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(3/2/1 indicates strength of correlation)3-Strong,2-Medium,1-weak

Cos	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	2	-	-	-	-	1	2	2
CO2	3	2	2	2	2	-	2	-	-	-	-	1	2	2
CO3	3	2	2	2	2	-	2	-	-	-	-	1	2	2
CO4	3	2	2	2	2	-	2	-	-	-	-	1	2	2
CO5	3	2	2	2	2	-	2	-	-	-	-	1	2	2

CI20506	OPERATING SYSTEMS LABORATORY	0	0	4	2

COURSE OBJECTIVE

To enable the students to

1.	understand shell programming and the use of filters in the unix environment.
2.	analyze the file system related system calls and to process creation and interprocess communication.
3.	evaluate various cpu scheduling algorithms, page replacement algorithms and deadlock avoidance.
4.	understand shell programming and the use of filters in the unix environment.

LIST OF EXPERIMENTS

1.	Basics of UNIX commands.
2.	Shell Programming.
3.	Implement the following CPU scheduling algorithms. FCFS b) SJF c) Priority d) Round Robin
4.	Implement the following file allocation strategies. Sequential b) Indexed c) Linked
5.	Implement Semaphores.
6.	Implement Bankers Algorithm for DeadLock Avoidance.
7.	Implement an Algorithm for DeadLock Detection.
8.	Implement the following page replacement algorithms FIFO b)LRU c) Optimal
9.	Implement Paging Technique of memory management.
10.	Implement Shared memory and IPC.

TOTAL PERIODS 60

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	implement deadlock avoidance and detection algorithms	Analysing (k4)
CO2	compare the performance of various cpu scheduling algorithm	Applying (k3)
CO3	understand the performance of the various page replacement algorithms	Understanding (K2)
CO4	analyze various ipc techniques in the operating system	Analysing (k4)

LAB EQUIPMENT FOR A BATCH OF 30 STUDENTS

SOFTWARE: Turbo C, Linux.

HARDWARE: Stand alone desktops 60 Nos.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(3/2/1indicatesstrengthofcorrelation)3-Strong,2-Medium,1-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	1				2	1
CO2	3	2	2	1	2	-	-	-	1				2	1
CO3	3	2	2	1	2	-	-	-	1		1	2	2	1
CO4	3	2	2	1	2	-	-	-	1		2	2	2	1

CI20507	DATABASE MANAGEMENT SYSTEMS LABORATORY	0	0	4	2

COURSE OBJECTIVE

To enable the students to

1.	develop conceptual understanding of database management system.
2.	understand the problem which can be mapped to SQL table.
3.	develop different applications using oracle and MySQL.
4.	learn to create and use a database.

LIST OF EXPERIMENTS

1.	Creation of a database and writing SQL queries to retrieve information from the database.
2.	Performing Insertion, Deletion, Modifying, Altering, Updating and Viewing records based on conditions.
3.	Creation of Views, Synonyms, Sequence, Indexes, Save point.
4.	Creating an Employee database to set various constraints.
5.	Creating relationship between the databases.
6.	Study of PL/SQL block.
7.	Write a PL/SQL block to satisfy some conditions by accepting input from the user.
8.	Write a PL/SQL block that handles all types of exceptions.
9.	Creation of Procedures.
10.	Creation of database triggers and functions
11.	Mini project (Application Development using Oracle/Mysql) a) Hospital Management System. b) Personal Information System. c) Web Based User Identification System.

TOTAL PERIODS 60

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	design and implement a database schema for a given problem domain	Applying (k3)
CO2	create a database for given applications	Applying (k3)
CO3	create and maintain tables using pl/sql.	Applying (k3)
CO4	prepare forms and reports	Understanding (K2)

LAB EQUIPMENT FOR A BATCH OF 30 STUDENTS

SOFTWARE: Front end: VB/VC++/JAVA or Equivalent

Backend: Oracle/ SQL/ MySQL/Post Gress/ DB2 or Equivalent

HARDWARE: Stand alone desktops 30 Nos.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(3/2/1 indicates strength of correlation)3-Strong,2-Medium,1-weak

	Programme Outcomes (POs)												PSOs	
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	2	3	-	2	1	1	1	2	3	1	-
CO2	3	3	1	2	3	-	2	-	-	-	2	3	2	-
CO3	3	3	-	2	3	-	2	-	-	-	2	3	2	2
CO4	3	3	1	2	3	-	2	-	-	-	2	3	2	1

EN20501	CAREER DEVELOPMENT LABORATORY I	0	0	2	1

COURSE OBJECTIVES

To enable the students to

1	enhance their own potential strength and reduce weakness to survive in corporate world
2	evaluate their own personality skills to face the interviews in a successful way
3	solve the quantitative aptitude problems and improve their problem-solving skills
4	solve the quantitative aptitude in advance level tests to get placed in Tier 1 companies
5	improve their reasoning skills to get placed in reputed companies

UNIT I	BASICS - SELF ANALYSIS	6

Introduction - Self Explorations - Who Am I; Know yourself; SWOT Analysis - Corporate resume building - Group Discussion: Level - 0 - Role Play: Team.

UNIT II	PERSONALITY DEVELOPMENT	6

Just A Minute (JAM): Level 0 - Extempore - Johari Window Model - Goal Setting - Achievement worksheet - Group Discussion: Leve-1 - Mock Interview Practice: Level 0

UNIT III	QUANTITATIVE APTITUDE I	6

Number System - LCM & HCF - Square root & Cube root - Percentage - Time - Speed & Distance

UNIT IV	QUANTITATIVE APTITUDE II	6

Trains - Boats & Streams - Average - Ages - Area

UNIT V	LOGICAL AND VERBAL REASONING	6

Series Completion: Number Series, Letter Series, Symbol Series - Blood Relation - Coding and Decoding - Logical Sequence - Analogy - Character Puzzles - Classification - Data Sufficiency

	TOTAL PERIODS	30

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	demonstrate the interpersonal skills in Group Discussions	Applying (K3)
CO2	enhance their verbal and written ability	Applying (K3)
CO3	practice soft skills to excel in their jobs	Analysing (K4)
CO4	compute problems based on quantitative aptitude	Applying (K3)
CO5	reveal their logical and verbal reasoning by scoring the expected percentage to get placed in reputedcompanies	Understanding(K2)

TEXT BOOKS

1. Agarwal, R.S." a modern approach to Verbal & Non Verbal Reasoning", S.Chand& Co Ltd, new delhi.
2. Agarwal, R.S. " Objective General English", S.Chand&Co

REFERENCES

1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill.
2. Word Power Made Easy By Norman Lewis ,Wr.Goyal Publications
3. Johnson, D.W. Reaching out – Interpersonal Effectiveness and self actualization. Boston: Allyn and Bacon
4. Infosys Campus Connect Program – students' guide for soft skills

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome

(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

CO	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	1	-	-	-	-	-	-	3	2
CO2	-	2	3	-	2	-	2	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	1	-	-	-	-	-	2	3
CO4	3	2	2	-	-	1	-	-	-	-	2	-	2	3
CO5	2	3	3	2	1	3	3	1	-	1	2	-	2	3

SEMESTER VI

CI20601	COMPILER DESIGN	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1. learn the design principles of a compiler.
2. understand the various parsing techniques
3. learn different levels of translation.
4. learn to optimize machine codes
5. learn to generate machine codes.

UNIT I	INTRODUCTION TO COMPILERS	5

Translators – Compilation and Interpretation, Language processors; The Phases of Compiler – Errors Encountered in Different Phases, The Grouping of Phases; Compiler Construction Tools; Programming Language Basics.

UNIT II	LEXICAL ANALYSIS	9

Need and Role of Lexical Analyzer - Lexical Errors; Expressing Tokens by Regular Expressions –Converting Regular Expression to DFA, Minimization of DFA; Language for Specifying Lexical Analyzers-LEX, Design of Lexical Analyzer for a sample Language.

UNIT III	SYNTAX ANALYSIS	10

Need and Role of the Parser; Context Free Grammars; Top Down Parsing - General Strategies, Recursive Descent Parser Predictive Parser, LL(1); Parser - Shift Reduce Parser, LR Parser, LR (0)Item, Construction of SLR Parsing Table, Introduction to LALR Parser; Error Handling and Recovery in Syntax Analyzer- YACC -Design of a syntax Analyzer for a Sample Language.

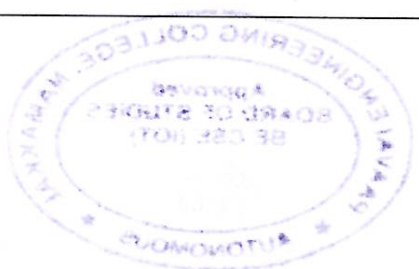
UNIT IV	SYNTAX DIRECTED TRANSLATION AND RUNTIME ENVIRONMENT	12

Syntax directed Definitions-Construction of Syntax Tree-Bottom-up Evaluation of S-Attribute Definitions - Design of predictive translator- Type Systems- Specification of a simple type checker-Equivalence of Type Expressions- Type Conversions; Run-Time Environment - Source Language Issues, Storage Organization, Storage Allocation- Parameter Passing- Symbol Tables- Dynamic Storage Allocation- Storage Allocation in FORTAN.

UNIT V	CODE OPTIMIZATION AND CODE GENERATION	9

Principal Sources of Optimization- DAG- Optimization of Basic Blocks- Global Data Flow Analysis- Efficient Data Flow Algorithms- Issues in Design of a Code Generator- A Simple Code Generator Algorithm.

TOTAL PERIODS	45



COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	design and implement a prototype compiler	Applying (K3)
CO2	use the knowledge of patterns, tokens and regular expressions for solving a problem in the field of data mining	Understanding (K2)
CO3	apply the various optimization techniques	Applying (K3)
CO4	develop the runtime structures used to represent constructs in typical programming languages	Applying (K3)
CO5	use the different compiler construction tools.	Understanding (K2)

TEXT BOOKS

1.	Alfred VAho, Monica S.Lam, Ravi Sethi and Jeffrey D Ullman, "Compilers–Principles, Techniques and Tools", 2nd Edition, Pearson Education, 2007.

REFERENCES

1.	Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence Based Approach", Morgan Kaufmann Publishers, 2002.
2.	Steven S. Muchnick, "Advanced Compiler Design and Implementation, "Morgan Kaufmann Publishers–Elsevier Science, India, Indian Reprint 2003.
3.	Keith D Cooper and Linda Torczon, "Engineering a Compiler", Morgan Kaufmann Publishers Elsevier Science, 2004.
4.	Charles N. Fischer, Richard. J. LeBlanc, "Crafting a Compiler with C", Pearson Education, 2008.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	-	-	-	1	2	1
CO2	1	2	-	3	-	1	-	-	-	-	-	2	-	2
CO3	3	-	1	2	2	-	-	-	-	-	2	1	-	2
CO4	2	2	-	3	-	-	-	2	-	-	-	-	-	2
CO5	3	1	2	1	2	-	-	1	-	-	-	2	-	2

CI20602	MACHINE LEARNING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	teach the theoretical foundations of various learning algorithms
2.	train the students better understand the context of supervised learning methods
3.	apply all unsupervised learning algorithms over appropriate real-time dataset
4.	evaluate the algorithms neural network models
5.	perform sample machine learning applications

UNIT I	INTRODUCTION TO MACHINE LEARNING	9

Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off

UNIT II	SUPERVISED LEARNING	9

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests

UNIT III	UNSUPERVISED LEARNING	9

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

UNIT IV	NEURAL NETWORKS	9

Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error back propagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyper parameter tuning, batch normalization, regularization, dropout.

UNIT V	MACHINE LEARNING IN PRACTICE	9

Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test.

TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	explain the basic concepts of machine learning	Analysing (K4)
CO2	construct supervised learning models	Applying (K3)
CO3	construct unsupervised leaning algorithms	Applying (K3)
CO4	analyze the results of algorithm and Neural Networks models	Analysing (K4)
CO5	evaluate and compare different models	Analysing (K4)

TEXT BOOKS

1.	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
2.	Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "Second Edition", CRC Press, 2014.

REFERENCES

1.	Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2.	Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.
3.	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2012, 2018.
4.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

Cos	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	3	-	1	-	-	-	1	3	3
CO2	2	2	3	2	1	3	-	1	-	-	-	1	3	3
CO3	2	2	3	2	1	3	-	1	-	-	-	1	3	3
CO4	2	3	3	2	3	3	-	1	-	-	-	1	3	3
CO5	2	2	3	2	2	3	-	1	-	-	-	1	3	3

CI20603	IOT AND ITS APPLICATIONS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	know the fundamentals about IoT
2.	understand about IoT access technologies
3.	learn the design methodology and different IoT hardware platforms
4.	study the basics of IoT Data Analytics and supporting services
5.	study about various IoT case studies and industrial applications

UNIT I	FUNDAMENTALS OF IoT	9

Evolution of Internet of Things, enabling technologies, M2M communication, IoT World Forum (IoTWF) standardized architecture, simplified IoT architecture, core IoT functional stack, fog, edge and cloud in IoT, functional blocks of an IoT ecosystem, sensors, actuators, smart objects and connecting smart objects.

UNIT II	IoT PROTOCOLS	9

IoT Access Technologies: Physical and MAC layers, topology and security of IEEE 802.15.4, 802.11a and Lora WAN, Network Layer: IP versions, constrained nodes and constrained networks, 6LoWPAN, Application transport methods: SCADA, Application layer protocols: CoAP and MQTT.

UNIT III	DESIGN AND DEVELOPMENT	9

Design methodology, embedded computing logic, microcontroller, system on chips, IoT system building blocks IoT Platform overview: Overview of IoT supported hardware platforms such as: Raspberry pi, Arduino board details.

UNIT IV	DATA ANALYTICS AND SUPPORTING SERVICES	9

Data Analytics: Introduction, structured versus unstructured data, data in motion versus data at rest, IoT data analytics challenges, data acquiring, organizing in IoT/M2M, Supporting services: computing using a cloud platform for IoT/M2M applications/services, everything as a service and cloud service models.

UNIT V	INDUSTRIAL APPLICATIONS	9

IoT applications in home, infrastructures, buildings, security, industries, home appliances, other IoT electronic equipments, industry 4.0 concepts.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	understand the basics of IOT	Understanding (K2)
CO2	implement the state of the architecture of an IOT	Applying (K3)
CO3	understand design methodology and hardware platforms involved in IOT	Understanding (K2)
CO4	understand how to analyze and organize the data	Understanding (K2)
CO5	compare iot applications in industrial & real world	Applying (K3)

TEXT BOOKS	
1.	IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017.
2.	Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015.
3.	Internet of Things: Architecture, Design Principles and Applications, Rajkamal, McGraw Hill Higher Education.
REFERENCES	
1.	The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit2).
2.	"From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Ho¨ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3.	Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.
4.	Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O"Reilly Media, 2011.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	2	-	-	-	-	-	-	1	2	2
CO2	3	1	1	1	2	-	-	-	-	-	-	1	2	2
CO3	3	1	1	1	2	-	-	-	-	-	-	1	2	2
CO4	3	1	1	1	2	-	-	-	-	-	-	1	2	2
CO5	3	1	1	1	2	2	-	-	-	-	-	1	2	2

CI20604	DATA WAREHOUSING AND DATA MINING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	understand the design and implementation of a data store.
2.	acquire knowledge on data and various preprocessing techniques.
3.	study the various correlation based frequent patterns mining in large datasets.
4.	learn various classifiers in data mining.
5.	understand the data mining techniques and methods to be applied on large datasets.

UNIT I	DATA WAREHOUSING	9

Data warehouse - Basic Concept, Modeling, Design and usage; Implementation - Data cube Computation Methods, Data Generalization by Attribute, Oriented Induction Approach.

UNIT II	DATA MINING	9

Introduction - Kinds of Data and Patterns, Major Issues in Data Mining, Statistical Description of Data, Measuring Data Similarity and Dissimilarity; Data preprocessing - Data Cleaning, Data Integration, Data Transformation Data Reduction; Data Discretization- Concept Hierarchy Generation.

UNIT III	ASSOCIATION RULE MINING	9

Basic concepts-Frequent Item set Mining Methods, A priori algorithm; A Pattern Growth Approach for Mining Frequent Item sets; Mining Various Kinds of Association Rules; Correlation Analysis; Constraint Based Association Mining.

UNIT IV	CLASSIFICATION	9

Basic Concepts- Decision Tree Induction, Bayes Classification Methods, Rule Based Classification, Classification by Back propagation, Support vector machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction.

UNIT V	CLUSTERING AND DATA MINING APPLICATIONS	9

Cluster analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data, Constraint Based Clustering Analysis - Outlier Analysis; Data Mining Applications - Financial Data Analysis, Science and Engineering, Intrusion Detection and Prevention.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	understand the basics of IOT	Understanding (K2)
CO2	implement the state of the architecture of an IOT	Applying (K3)
CO3	understand design methodology and hardware platforms involved in IOT	Understanding (K2)
CO4	understand how to analyze and organize the data	Understanding (K2)
CO5	compare iot applications in industrial & real world	Applying (K3)

TEXT BOOKS

1.	Jiawei Hanand Micheline Kamber,- Data Mining Concepts and Techniques, 3rd Edition,Elsevier, 2012

REFERENCES

1.	Alex Berson and Stephen J.Smith,—Data Warehousing, Data Mining & OLAP ǁ, Tata McGraw–Hill Edition,35th Reprint 2016.
2.	K.P.Soman, Shyam Diwakar and V.Ajay,—Insight into Data Mining Theory and Practice, Eastern Economy Edition, Prentice Hall of India, 2006.
3.	Ian H.Witten and Eibe Frank,—Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, Second Edition.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	2	-	1	-	-	-	1	2	1
CO2	2	2	3	2	1	2	-	1	-	-	-	1	2	-
CO3	2	2	3	2	1	2	-	1	-	-	-	1	2	1
CO4	2	2	3	2	2	2	-	1	-	-	-	1	2	1
CO5	2	2	3	2	2	2	-	1	-	-	-	1	2	1

CI20605	COMPILER DESIGN LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable the students to

1.	be exposed to compiler writing tools
2.	learn to implement the different Phases of compiler
3.	be familiar with control flow and data flow analysis
4.	learn simple optimization techniques

LIST OF THE EXPERIMENTS

1.	. Implementation of Symbol Table
2.	Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.)
3.	Implementation of Lexical Analyzer using Lex Tool
4.	Generate YACC specification for a few syntactic categories. a) Program to recognize a valid arithmetic expression that usesoperator +, - , * and /. b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits. c)Implementation of Calculator using LEX and YACC
5.	Convert the BNF rules into Yacc form and write code to generate Abstract Syntax Tree.
6.	Implement type checking
7.	Implement control flow analysis and Data flow Analysis
8.	Implement any one storage allocation strategies(Heap,Stack,Static)
9.	Construction of DAG
10.	Implementation of Simple Code Optimization Techniques (Constant Folding., etc.)
	TOTAL PERIODS 60

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	implement the different phases of compiler using tools	Applying (K3)
CO2	analyze the control flow and data flow of a typical program	Analysing (K4)
CO3	optimize a given program	Applying (K3)
CO4	generate an assembly language program equivalent to a source language program	Applying (K3)

CO –PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	-	1	-	1	1	2	2
CO2	3	2	1	1	2	-	-	-	1	-	1	1	2	2
CO3	3	2	1	1	2	-	-	-	1	-	1	1	2	2
CO4	3	2	1	1	2	-	-	-	1	-	1	1	2	2

PAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
BE CSE (IOT)
AUTONOMOUS

CI20606	IOT AND ITS APPLICATIONS LABORATORY	0	0	4	2

COURSE OBJECTIVES

To enable the students to

1.	understand the fundamentals of LED and light intensity control
2.	understand about the components such as Buzzer and LCD.
3.	understand how to work with sensors such as temperature and LDR
4.	understand about key input and servo motor

LIST OF THE EXPERIMENTS

1.	Implement a program to interface a relay with Arduino.
2.	Implement a program to interface servo motor with Arduino.
3.	Implement a program for LCD Display using Arduino.
4.	Implement a program for LDR using Arduino.
5.	Implement a program for DC Motor Control using Arduino.
6.	Implement a program for blinking LED using NODEMCU with Blynk.
7.	Implement a program for Sensor value logging in Cloud.
8.	Implement a program to interface stepper motor with R-Pi
9.	Implement a program for controlling relay state based on input from IR sensors using R-Pi
10.	Design for displaying humidity and temperature data on web based applications.

TOTAL PERIODS	**60**

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	acquire knowledge about Arduino, LED and control intensity of light	Understanding (K2)
CO2	implement buzzer and LCD in applications	Applying (K3)
CO3	implement LM35sensor, LDR in applications.	Applying (K3)
CO4	implement applications with NODEMCU with Blynk app and upload sensor value in Cloud	Applying (K3)

CO –PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	-	-	1	-	1	1	2	2
CO2	3	2	2	2	2	-	-	-	1	-	1	1	2	2
CO3	3	2	2	2	2	-	-	-	1	-	1	1	2	2
CO4	3	2	2	2	2	-	-	-	1	-	1	1	2	2

PAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
BE CSE (IOT)
AUTONOMOUS

EN20601	CAREER DEVELOPMENT LABORATORY II	0	0	2	1

COURSE OBJECTIVES

To enable the students to

1	enhance their own potential strength and reduce weakness to survive in corporate world
2	evaluate their own personality skills to face the interviews in a successful way
3	solve the quantitative aptitude problems and improve their problem-solving skills
4	solve the quantitative aptitude in advance level tests to get placed in Tier 1 companies
5	improve their reasoning skills to get placed in reputed companies

UNIT I	CORPORATE READINESS	6

Writing Skills: Email Writing - Paragraph writing - Time Management - Stress Management - JAM: Level 1 - Self Introduction - JAM: Level 2 - Buddy Presentation - Role Play: Individual.

UNIT II	INTERVIEW SKILLS	6

Group Discussion: Level II - Group Discussion: Level III - General - Interview Techniques - Selection process - Grooming - Dress code - Body Language - Mock Interview Practice: Level 1.

UNIT III	QUANTITATIVE APTITUDE I	6

Simplification - Time and work - Pipes and cisterns - Ratio and Proportion - Partnership.

UNIT IV	QUANTITATIVE APTITUDE II	6

Simple interest and Compound interest - Profit and loss - Permutation and combination Probability - Calendar

UNIT V	LOGICAL AND VERBAL REASONING	6

Seating arrangement - Direction - Arithmetic reasoning - Syllogisms - Making Judgments - Statements and conclusions - Matching definition - Cause and effect

	TOTAL PERIODS	30

COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	demonstrate the interpersonal skills in Group Discussions	Applying (K3)
CO2	enhance their verbal and written ability	Applying (K3)
CO3	practice soft skills to excel in their jobs	Analysing (K4)
CO4	compute problems based on quantitative aptitude	Applying (K3)
CO5	reveal their logical and verbal reasoning by scoring the expected percentage to get placed in reputed companies	Understanding(K2)

TEXT BOOKS

1. Agarwal, R.S." a modern approach to Verbal & Non Verbal Reasoning", S.Chand& Co Ltd, new delhi.
2. Agarwal, R.S. " Objective General English",S.Chand&Co

REFERENCES

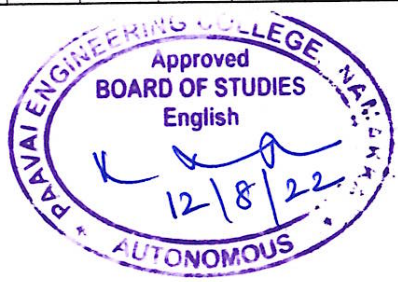
1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill.
2. Word Power Made Easy By Norman Lewis ,Wr.Goyal Publications
3. Johnson, D.W. Reaching out – Interpersonal Effectiveness and self actualization. Boston: Allyn and Bacon
4. Infosys Campus Connect Program – students' guide for soft skills

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome

(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

CO	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	1	-	-	-	-	-	-	3	2
CO2	-	2	3	-	2	-	2	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	1	-	-	-	-	-	2	3
CO4	3	2	2	-	-	1	-	-	-	-	2	-	2	3
CO5	2	3	3	2	1	3	3	1	-	1	2	-	2	3



PROVISIONAL ELECTIVE COURSE I					
CI20151	OBJECT ORIENTED MODELING AND DESIGN	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	understand the concept of object oriented programming and its software domains.
2.	symbolic representation of methods using diagram.
3.	know about different design techniques of a model with help of tools.
4.	develop the model for the proper, accountable domain, in a specific software logics for usage.
5.	implement the model with the practical physical process.

UNIT I	INTRODUCTION	9

Abstraction, Encapsulation, Inheritance, Polymorphism, Message passing, OOAD methodologies, Object model, Elements, Class and object, Relationship among objects and classes, Quality classes and objects, Unified approach, Introduction to UML, Usage of UML, Views of UML.

UNIT II	USE CASE MODELING	9

Use cases in UML - Relationships between use cases, Describing use cases, Testing use cases, Realizing use cases.

UNIT III	OBJECT MODELING	9

Class diagrams, Perspectives, Associations, Attributes, Operations, Generalization, Constraint rules, Advanced concepts, Object diagram, Multiple and dynamic classification, Aggregation and composition, Derived associations and attributes, Interfaces and abstract classes, Reference objects and value objects, Frozen, Qualified associations, Association and parameterized class.

UNIT IV	DYNAMIC MODELING	9

Interaction diagrams - Sequence diagrams, Communication diagrams, State diagrams, Concurrent state diagrams, Activity diagrams, Dynamic concurrency, Swim lanes; Case study: Automated Teller Machine (ATM).

UNIT V	IMPLEMENTATION MODEL	9

Package diagrams, Deployment diagrams, Component diagrams, Combining component and deploymentdiagrams; Case study: University Enrollment System.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	apply Object oriented concepts in software analysis	Applying (K3)
CO2	prepare Class Model, State Model and Interaction Model for any software system	Analysing (K4)
CO3	analyze the application Domain and Prepare models from different view points	Analysing (k4)
CO4	apply the re-engineering in the applications	Applying (K3)
CO5	use the Concepts of Pattern Oriented design in software design	Applying (K3)

TEXT BOOKS	
1.	James Rumbaugh, Ivar Jacobson and Grady Booch, —The Unified Modeling Language Reference Manuall, Pearson Education, New Delhi, 2009
2.	2. Ali Bahrami, —Object Oriented System Development, Tata McGraw Hill, New Delhi, 2008.
REFERENCES	
1.	Grady Booch, —Object Oriented Analysis and Design with Applications, Addison Wesley, New Delhi, 2010.
2.	Mahesh P Matha, Object Oriented Analysis and Design using UML: An Introduction to Unified Process and Design Patternsl, Prentice Hall, New Delhi, 2008.
3.	Atul Kahate, —Object Oriented Analysis and Design, Tata McGraw Hill, New Delhi, 2007.
4.	Martin Fowler and Kendall Scott, —UML Distilled: A Brief Guide to the Standard Object Modeling Languagel, Pearson Education, New Delhi, 2013

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

COs	Programme Outcomes (POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	-	2	2	2
CO2	3	2	2	2	2	2	1	-	-	-	-	2	2	2
CO3	3	2	2	2	3	2	1	-	-	-	-	2	2	2
CO4	3	2	2	2	2	2	1	-	-	-	-	2	2	2
CO5	3	2	2	2	2	1	1	-	-	-	-	2	2	2

PROVISIONAL ELECTIVE COURSE I					
CI20152	CLOUD COMPUTING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	understand the concept of cloud computing.
2.	appreciate the evolution of cloud fromthe existing technologies.
3.	have knowledge on the various services in cloud computing.
4.	be familiar with the security in cloud.
5.	studythe emergence of cloud as the next generation computing paradigm.

UNIT I	INTRODUCTION	9

Introduction to Cloud Computing - Definition of Cloud, Characteristics and Benefits of Cloud Computing; Historical Developments - Distributed systems, Virtualization, Web 2.0, Service–oriented Computing; Building Cloud Computing Environments - Computing Platforms and Technologies; Principles of Parallel and Distributed Computing.

UNIT II	CLOUD ENABLING TECHNOLOGIES	9

Basics of Virtualization - Characteristics of Virtualized Environments, Levels of Virtualization Implementation, Taxonomy of VirtualizationTechniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples: Para Virtualization, Full Virtualization.

UNIT III	CLOUD ARCHITECTURE, SERVICES AND STORAGE	9

Cloud Reference Model - Architecture, Infrastructure and Hardware as a Service, Platform as a Service,Software as a Service, Case Studies; Types of Clouds - Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud; Open Challenges.

UNIT IV	RESOURCE MANAGEMENT AND SECURITY IN CLOUD	9

Inter Cloud Resource Management - Resource Provisioning and Platform Deployment, Global Exchange of Cloud Resources; Security Overview - Cloud Security Challenges, Software-as-a- Service - Security management, Security Governance, Virtual Machine Security, Identity Access Management, Security Standards.

UNIT V	CLOUD TECHNOLOGIES AND ADVANCEMENTS	9

Hadoop, MapReduce, Virtual Box, Google App Engine, Programming Environment for Google App Engine, Open Stack, Federation in the Cloud, Four Levels of Federation, Federated Services and Applications - Futureof Federation.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	articulatethe main concepts, key technologies, strengths and limitations of cloud computing	Applying (K3)
CO2	explain the various technologies of cloud	Analysing (K4)
CO3	describe the architecture of compute and storage cloud, serviceand delivery models	Applying (K3)
CO4	identify the security mechanisms of cloud	Understanding (K2)
CO5	evaluate and choose the appropriate technologies and approaches for implementation and useofcloud	Analysing (K4)

TEXT BOOKS	
1.	Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, " Mastering Cloud Computing", Tata Mcgraw Hill, 2017.
2.	Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management and Security", CRC Press, 2017.
REFERENCES	
1.	Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2.	Ray J. Rafaels, "Cloud Computing: From Beginning to End", 2015.
3.	Zaigham Mahmood, Ricardo Puttini, Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture", Pearson, 2013.
4.	Sunilkumar Manyi, Gopal Shyam- Cloud Computing: concepts and Technologies, CRC Press 2021.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:

(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

COs	Programme Outcomes(Pos)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	1	1	-	3	3	2
CO2	2	3	1	2	3	2	-	-	2	1	-	3	3	2
CO3	2	3	2	2	3	-	-	-	2	1	-	2	3	2
CO4	2	3	1	3	2	-	-	-	2	1	-	2	3	2
CO5	3	3	2	3	3	2	-	-	2	2	-	2	3	2

CI20153	IOT ARCHITECTURE AND DESIGN	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	understand the concept of IOT architecture
2.	know the design principles of IOT architecture
3.	familiar with web connectivity
4.	understand the different storages
5.	learn the sensor techniques

UNIT I	IOT ARCHITECTURE	9

An Overview, Internet of Things, IoT conceptual framework, IoT architectural view, Technology behind IoT- Server-end Technology, Major Components of IoT System, Development Tools and APIs, Sources of IoT, M2M communication, Examples of IoT.

UNIT II	DESIGN PRINCIPLES FOR CONNECTED DEVICES	9

Introduction, IoT/M2M Systems Layers and Designs Standardisation, Communication technologies, Data Enrichment, Data Consolidation and Device Management at Gateway, Ease of Designing and Affordability.

UNIT III	DESIGN PRINCIPLES FOR WEB CONNECTIVITY	9

Web communication protocols for connected devices, Message communication protocols for connected devices, web connectivity for connected-devices network using gateway, Internet connectivity principles, IP addressing in IoT, Proxy authentication, Media Access control, Application Layer Protocols.

UNIT IV	DATA ACQUIRUNG AND STORAGE	9

Introduction, Organizing the data, Analytics, Knowledge acquiring, managing and storing processes, cloud computing paradigm for data collection storage and computing, IoT cloud based services.

UNIT V	SENSOR TECHNOLOGIES	9

Introduction, Participatory Sensing, Industrial IoT, Automotive IoT, Analog sensors and Digital sensors, Actuator, Sensor data communication protocols, Radio frequency identification technology, wireless sensor networks technology

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	understand the concept of iot architecture	Understanding (K2)
CO2	implement the design principles	Applying (k3)
CO3	understand the web connectivity	Understanding (K2)
CO4	implement the storage accesses	Applying (K3)
CO5	analyze the different sensor techniques	Analyzsing (K4)

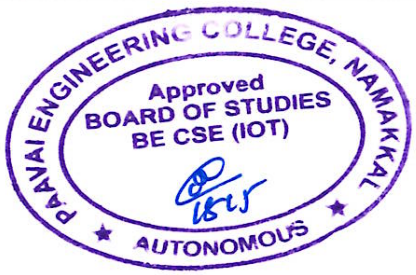
TEXT BOOKS	
1.	Raj kamal, "Internet of Things architecture and design principles ", 1Edition, Mc Graw Hill.
2.	Cirani, Simone, Gianluigi Ferrari, Marco Picone, and Luca Veltri. Internet of Things: Architectures, Protocols and Standards. John Wiley & Sons, 2018.
REFERENCES	
1.	Hassan, Qusay F., ed. Internet of Things A to Z: technologies and applications. John Wiley & Sons,2018..
2.	CunoPfister, "Getting Started with the Internet of Things", O"Reilly Media 2011

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2	PSO1	PSO2
CO1	3	2	-	1	1	-	-	-	-	-	-	2	2	2
CO2	3	2	-	1	1	-	-	-	-	-	-	2	2	2
CO3	3	2	2	1	1	-	-	-	-	-	-	2	2	2
CO4	3	2	2	1	1	-	-	-	-	-	-	2	2	2
CO5	3	2	2	1	1	-	-	-	-	-	-	2	2	2



CI20154	SOFT COMPUTING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	gain knowledge on the preliminaries of evolutionary computing.
2.	learn the fundamentals of intelligent systems.
3.	acquire knowledge on neural networks.
4.	learn the fundamentals of artificial neural networks.
5.	know how cooperative neuro-fuzzy systems work.

UNIT I	EVOLUTIONARY AND SOFT COMPUTING	9

Introduction; Overview of evolutionary computing, Genetic algorithms and optimization, Genetic algorithm operators, Integration of genetic algorithms with neural networks, Evolutionary strategies, ES applications.

UNIT II	INTRODUCTION TO INTELLIGENT SYSTEMS AND SOFT	9

Introduction, Intelligent systems, Knowledge-based systems-Architectures of knowledge-based systems, Production systems, Frame-based systems, Blackboard systems, Object oriented programming, Expert systems, Knowledge representation and processing, Soft computing.

UNIT III	DYNAMIC NEURAL NETWORKS	9

Background, Training algorithms – Back propagation through time (BPTT), Real-time back propagation learning; Fields of applications of RNN, Dynamic neural networks for identification and control, Neural network-based control approaches, Dynamic neural networks for chaos time series prediction, Artificial neural networks for chaos prediction.

UNIT IV	ARTIFICIAL NEURAL NETWORKS	9

Introduction, Learning and Acquisition of Knowledge, Features of Artificial Neural Networks, Fundamentals of Connectionist Modeling; Major Classes of Neural Networks- Multilayer Perceptron, Radial Basis Function Network.

UNITV	NEURO-FUZYSYSTEMS	9

Background, Architectures of Neuro Fuzzy Systems- Cooperative Neuro Fuzzy Systems, Neural Network Driven Fuzzy Reasoning, Hybrid Neuro Fuzzy Systems; Construction of Neuro Fuzzy Systems–Structure Identification Phase,Parameter Learning Phase.

	TOTAL PERIODS	45

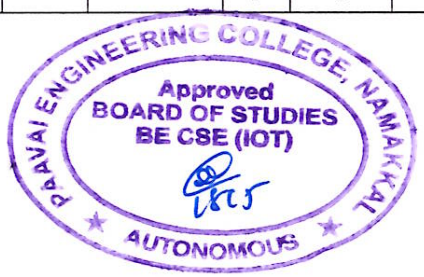
COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	understand the concept of genetic algorithm	Understanding (K2)
CO2	implement the basic concept of intelligent systems	Applying (k3)
CO3	illustrate the network based approach of dynamic neural networks	Applying (k3)
CO4	identify the key features of artificial neural systems	Understanding (K2)
CO5	illustrate the concept of neuro fuzzy systems.	Applying (k3)

TEXT BOOKS	
1.	Fakhereddine OK array and Clarence DeSilva,-"Soft Computing and Intelligent Systems Design: Theory, Tools and Applications", Pearson, 2009.
REFERENCES	
1.	Madan M Gupta and Naresh K Sinha, "Soft Computing and Intelligent Systems: Theory and Applications",Academic Press,1999
2.	S Rajasekaran and GAVijayalakshmi Pai,-"Neural Networks, Fuzzy Logic and Genetic Algorithms Synthesis and Applications", Prentice Hall India, 2003.
3.	SN Sivanandam, S Sumathi and SN Deepa,-"Neural Networks using MATLAB", Tata McGraw-Hill,2005.
4.	"Neural Networks and Learning Machines", (3rdEdn.), Simon Haykin, PHILearning, 2011.

CO PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes
(1/2/3 indicates strength of correlation)3-Strong,2-Medium,1-Weak

COs	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	-	-	-	1	2	1
CO2	3	2	2	1	1	-	-	-	-	-	-	1	2	1
CO3	3	2	2	1	2	-	-	-	-	-	-	1	2	1
CO4	3	2	2	1	2	-	-	-	-	-	-	1	2	1
CO5	3	2	2	1	2	-	-	-	-	-	-	1	2	1



PROFESSIONALELECTIVECOURSES -II					
CI20251	**DATA SCIENCE IN IOT**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

To enable the students to

1. demonstrate an understanding of statistics and machine learning concepts that are vital for data science
2. produce python code to statistically analyze a dataset
3. critically evaluate data visualizations based on their design and use for communicating stories from data
4. able to understand machine to machine web of things
5. know the applications of Data Science in IOT

UNIT I	**INTRODUCTION TO DATA ANALYTICS**	**9**

Defining IoT Analytics and Challenges: The situation, Defining IoT analytics, IoT analytics challenges, Business value concerns, IoT Analytics for the Cloud, Types of Analytics: Streaming Analytics, Spatial, Time Series and Prescriptive Analytics

UNIT II	**DATA COLLECTION**	**9**

Getting to know your data, Types of Data, Data collection strategies, Data Pre - processing, Feature engineering with IoT data, Exploratory Data Analytics, Descriptive Statistics, Mean, Standard Deviation, Skewness and Kurtosis

UNIT III	**DATA VISUALIZATION AND REPRESENTATION**	**9**

Model Development Simple and Multiple Regression, Model Evaluation using Visualization, Residual Plot, Distribution Plot, Polynomial Regression and Pipelines, Measures for In-sample Evaluation, Prediction and Decision Making, Box Plots, Pivot Table, Heat Map

UNIT IV	**STRATEGIES TO ORGANIZE DATA FOR ANALYTICS**	**9**

Linked Analytical Datasets, Linking together datasets, Managing data lakes, Data retention strategy, Economics of IoT Analytics, Cost considerations for IoT analytics, Thinking about revenue opportunities, The economics of predictive maintenance example, Data Analytics Life Cycle

UNITV	**APPLICATION OF ANALYTICS IN IOT**	**9**

IoT based applications, Healthcare, Marketing, Finance, Smart cities, Cyber security, video surveillance, Agriculture and Weather Forecasting and other domains; Real Time IoT based data analysis

	TOTAL PERIODS	**45**

COs	**COURSE OUTCOMES** At the end of this course, the students will be able to	**BT MAPPED** (Highest Level)
CO1	describe what data science is and the skill sets needed to be a data scientist	Analysing (K4)
CO2	explain the significance of exploratory data analysis (eda) in data science	Applying (K3)
CO3	understand the working principle of wireless networking equipment's	Understanding (K2)
CO4	explore the iot protocols and architecture	Applying (K3)
CO5	learn the security aspects in iot in data science	Understanding (K2)

TEXT BOOKS	
1.	JojoMoolayil, "Smarter Decisions : The Intersection of IoT and Data Science", PACKT, 2016
2.	Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from the Frontline. O'Reilly.
REFERENCES	
1.	David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013
2.	Andrew Minteer, "Analytics for the Internet of Things (IoT)" 2017,

CO PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(1/2/3 indicates strength of correlation)3-Strong,2-Medium,1-Weak

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	-	-	-	1	2	1
CO2	3	2	1	1	1	-	-	-	-	-	-	1	2	1
CO3	3	2	1	1	1	-	-	-	-	-	-	1	2	1
CO4	3	2	1	1	1	-	-	-	-	-	-	1	2	1
CO5	3	2	1	1	1	-	-	-	-	-	-	1	2	1

CI20252	SOFTWARE TESTING	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1. understand the overview of maths in software testing.
2. learning the unit testing design.
3. analyze the levels of decision and code-based testing.
4. know and study the testing in object-oriented software.
5. evaluate the beyond the unit testing.

UNIT I	MATH PERSPECTIVE ON TESTING	9

A Perspective on Testing: Basic Definitions -Test Cases-Insights from a Venn Diagram-Identifying Test Cases-Fault Taxonomies-Levels of Testing; Examples: Structural Elements of Pseudo - code and Java –The Triangle Problem-The Garage Door Controller-The Wind shield Wiper Controller; Discrete Math for Testers: Set Theory - Functions - Relations - Propositional Logic; Graph Theory for Testers: Graphs –Directed Graphs-Graphs for Testing.

UNIT II	UNITTESTING	9

Boundary Value Testing : Normal Boundary Value Testing – Robust Boundary Value Testing-Worst Case Boundary Value Testing - Special Value Testing – Examples - Random Testing- Guidelines for Boundary Value Testing; Equivalence Class Testing : Equivalence Classes-Traditional Equivalence Class Testing - Improved Equivalence Class Testing - Equivalence Class Test Cases for the Triangle Problem - Equivalence Class Test Cases for the Next Date Function-equivalence Class Test Cases for the complete Order Method-"Edge Testing"-Reflections on Invalid Classes-Guidelines and Observations

UNIT III	DECISION TABLE AND CODE BASED TESTING	9

Decision Table-Based Testing: Decision Tables-Decision Table Techniques-Test Cases for the Triangle Problem-Test Cases for the Next Date Function-Cause and Effect Graphing-Guidelines and Observations; Code-Based Testing: Program Graphs-DD-Paths-Code Coverage Metrics-Basis Path Testing-Guidelines and Observations.

UNIT IV	TESTING OBJECT-ORIENTED SOFTWARE	9

Testing Object-Oriented Software: Unit Testing Frameworks - Mock Objects and Automated Object Mocking-Dataflow Testing- Object-Oriented Complexity Metrics- Issues in Testing Object-Oriented Software- Slice-Based Testing; Retrospective on Unit Testing : The Test Method Pendulum- Traversing the Pendulum-Insurance Premium Case Study-Specification-Based Testing-Guidelines.

UNITV	BEYOND UNIT TESTING	9

Life Cycle-Based Testing: Traditional Waterfall Testing - Testing in Iterative Lifecycles- Remaining Questions-Pros, cons and Open Questions of TDD-Retrospective on MDD vs TDD; Integration Testing: Decomposition-Based Integration-Call Graph-Based Integration-Path-Based Integration - Example: O-O integration Next Date-Model-Based Integration Testing.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to:	BT MAPPED (Highest Level)
CO1	familiarize the basic concepts used in software testing	Understanding (K2)
CO2	acquire and apply the various testing design	Applying (K3)
CO3	analyze the various level softesting	Analysing (K4)
CO4	obtain the knowledge over object-oriented testing	Applying (K3)
CO5	evaluate the process of integration and life cycle testing	Applying (K3)

TEXT BOOKS

1.	PaulC.Jorgensen,ByronDeVries–"SoftwareTesting_ACraftsman'sApproach"-Auerbach Publications(2021).

REFERENCES

1.	SagarNaik,PiyuTripathy–"SoftwareTestingandQualityAssuranceTheoryandPractice"-Wiley(2008)
2.	Srinivasan Desikan and Gopalaswamy Ramesh, -"Software Testing - Principles and Practices", PearsonEducation,2011.
3.	Rex Black, "Managing the Testing Process", John Wiley & Sons, 2009.
4.	AdityaP.Mathur,—"FoundationsofSoftwareTesting",PearsonEducation,2008.

CO PO MAPPING

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	-	-	1	1	-	-	-	2	2
CO2	3	2	2	1	2	-	-	1	1	1	2	1	2	1
CO3	3	2	2	2	2	-	-	2	2	-	-	1	2	1
CO4	3	2	2	1	2	-	-	2	2	2	2	-	2	1
CO5	3	2	3	2	3	-	-	2	2	2	2	-	2	2

CI20253	BLOCK CHAIN TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	understand the basic concepts of block chain technology.
2.	familiarize the mechanism of Cryptography in Crypto currency.
3.	understand the fundamentals of bit coin and its applications.
4.	learn the standard rules and regulations of crypto currency.
5.	explore the applications of Block chain to crypto currencies.

UNIT I	INTRODUCTION TO BLOCK CHAIN TECHNOLOGY	9

Distributed systems -The history of blockchain, Introduction to blockchain, definitions, elements, Features, Applications of blockchain technology; Tiers; Types of blockchain; Consensus in blockchain; CAP theorem; Benefits and limitations ofblockchain.

UNIT II	DECENTRALIZATION, CRYPTOGRAPHY AND TECHNICAL FOUNDATIONS	9

Introduction - Cryptography, Confidentiality, Integrity, Authentication; Cryptographic primitives;Asymmetric cryptography; Public and private keys-RSA, Discrete logarithm problem, Hash functions, Elliptic Curve Digital signature algorithm.

UNIT III	BIT COIN AND ALTERNATIVE COINS	9

Bitcoin; Transactions; Blockchain; Bitcoinpayments; AlternativeCoins - Theoretical foundations, Bitcoinlimitations;Namecoin; Litecoin;Primecoin;Zcash; Smart Contracts.

UNIT IV	ETHEREUM	9

Introduction - Ethereum block chain, Elements of the Ethereum block chain, Precompiled contracts, Accounts, Block, Ether, Messages, Mining; Clients and wallets; The Ethereum network; Ethereum Development.

UNITV	HYPERLEDGER	9

Projects; protocol; Hyperledger Fabric; Sawtooth lake; Corda; Blockchain; Outside of Currencies - Internet of Things, Government, Health, Finance.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	outline the history and different applications of block chain	Applying (K3)
CO2	illustrate decentralization and practical aspects of cryptography	Applying (K3)
CO3	present bitcoin technology, alternative coins and smart contracts	Understanding (K2)
CO4	develop a distributed application using Ethereum	Applying (K3)
CO5	deploy an application using Hyper ledger	Applying (K3)

TEXT BOOKS	
1.	Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2ndEdition, Packt Publishing Ltd, March 2018.
2.	Andreas Antonopoulos, "Mastering Bitcoin: Programming the open blockchain", 2nd Edition, O"Reilly Media, 2017.
REFERENCES	
1.	Brenn Hill, Samanyu Chopra & Paul Valencourt, "Blockchain Quick Reference: A guide to exploring decentralized blockchain application development", Packt,2018.
2.	William Stallings, "Network Security Essentials (Applications and Standards)", Pearson Education, India, 2017.
3.	Aravind Narayanan, Joesph Bonneau, Edward Felten, Andrew Miler and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.
4.	Bellaj Badr, Richard Horrocks, Xun (Brian) Wu, "Blockchain By Examples: A developer's guide to creating decentralized applications using Bitcoin, Ethereum and Hyperledger", Packt Publishing Limited, 2018.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

Cos	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO2	1	2	3	2	2	2	-	2	-	-	-	2	2	2
CO3	2	2	3	2	2	2	-	2	-	-	-	2	2	2
CO4	1	3	2	2	2	2	-	2	-	-	-	2	2	2
CO5	1	3	2	2	2	2	-	2	-	-	-	2	2	2

CI20254	SOFTWARE QUALITY ASSURANCE	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1	understand the basic tenets of software quality and quality factors
2	learn the software quality assurance (SQA) components and project life cycle
3	understand procedures and work instructions to maintain software quality management
4	familiarize with the objectives of software quality metrics
5	identify the Quality management standards and project management responsibilities

UNIT I	INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE	9

Need for Software quality - quality challenges, software quality assurance, definition and objectives, software quality factor, McCall's quality model; SQA system and architecture - software project life cycle components, pre project quality components, development and quality plans.

UNIT II	SQA COMPONENTS AND PROJECT LIFE CYCLE	9

Software Development methodologies - quality assurance activities in the development process, verification and validation, reviews; Software Testing - software testing implementations, quality of software maintenance, pre-maintenance of software quality component, quality assurance tools, case tools for software quality; software maintenance quality; project management.

UNIT III	SOFTWARE QUALITY INFRASTRUCTURE	9

Procedures and work instructions - templates, checklists, 3s development, staff training and certification corrective and preventive actions; configuration management - software change control, configuration management audit, documentation control, storage and retrieval

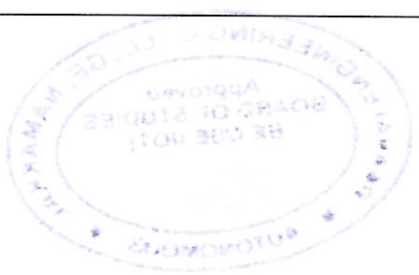
UNIT IV	SOFTWARE QUALITY MANAGEMENT AND METRICS	9

Project process control - computerized tools, software quality metrics; objectives of quality measurement, process metrics, product metrics, implementation, limitations of software metrics, cost of software quality, classical quality cost model, extended model, application of cost model.

UNIT V	STANDARDS, CERTIFICATIONS AND ASSESSMENTS	9

Quality management standards - ISO 9001 and ISO 9000-3, capability maturity models, cmm and cmmi assessment methodologies, bootstrap methodology, spice project, SQA project process standards, ieee st 1012 and 1028, organization of quality assurance, department management responsibilities, project management responsibilities - SQA units and other actors in SQA systems

	TOTAL PERIODS	45



COURSE OUTCOMES At the end of this course, the students will be able to		BT MAPPED (Highest Level)
CO1	define software quality assurance system and architecture	Applying (K3)
CO2	discuss the software quality assurance (SQA) components and project life cycle	Applying (K3)
CO3	understand procedures and work instructions to maintain software quality management	Understanding(K2)
CO4	state the objectives of software quality metrics	Applying (K3)
CO5	identify the Quality management standards and project management responsibilities	Understanding(K2)

TEXT BOOKS

1. Daniel Galin, "Software Quality Assurance", Pearson Publication, 2009
2. Alan C. Gillies, "Software Quality: Theory and Management", International Thomson Computer Press, 1997

REFERENCES

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C,Silicon Press, 2009
2. Mordechai Ben-Menachem "Software Quality: Producing Practical Consistent Software", International Thompson Computer Press, 1997
3. Software Testing and Quality Assurance: Theory and Practice K. Shirasagar Naik, Priyadarshi Tripathy
4. Software Quality Assurance: Principles and Practice by Nina S.Godbole

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcome
(1,2,3 indicates the strength of correlation) 3 - Strong, 2 - Medium, 1 - Weak

CO	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	2	1	-	-	1	-	1	3	1
CO2	3	2	1	2	1	1	1	2	-	1	1	1	2	1
CO3	3	2	1	2	1	1	-	2	-	1	1	1	2	2
CO4	3	3	1	2	1	-	-	1	-	1	-	1	2	2
CO5	3	2	1	2	2	1	-	-	-	1	-	1	1	1

OPEN ELECTIVE COURSES - I

CI20901	DISTRIBUTED SYSTEMS	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	acquire knowledge on foundations of distributed Systems.
2.	introduce the idea of RMI and distributed objects related issues.
3.	understand in detail about middleware services and file system for distributed system.
4.	apply synchronization and replication methods.
5.	understand the distributed environment.

UNIT I	INTRODUCTION	9

Fundamentals of Distributed System - Examples of Distributed Systems, Advantages, Disadvantages and issues, Trends in Distributed Systems, Focus on resource sharing; Case Study - Web Challenges.

UNIT II	COMMUNICATION IN DISTRIBUTED SYSTEM	9

Distributed System Models; Inter process Communication the API for internet protocols; External data representation - Multicast communication Distributed Systems; Network virtualization - Overlay networks; Case study - Message Passing Interface (MPI).

UNIT III	REMOTE METHOD INVOCATION AND OBJECTS	9

Remote Method Invocation (RMI) Architecture - Request-Reply protocols, Remote Procedure Call (RPC); Case study - Java RMI; Group communication - Publish Subscribe Assessment; Distributed Message queue - Shared memory - Distributed objects; Case study - CORBA features, Objects to Components.

UNIT IV	PEER TO PEER SERVICES AND FILE SYSTEM	9

Peer-to-Peer Systems - Napster and its legacy, Middleware, Routing Overlays; overlay case studies - Pastry; Distributed File Systems – Introduction, File service architecture, Andrew File system.

UNIT V	SYNCHRONIZATION AND REPLICATION	9

Clocks, events states, Clock Synchronizing physical clock, Logical clocks, Global states; Distributed mutual exclusion - Election Algorithm (Bully Algorithm), Concurrency Control, Transactions Execution, Nested transactions, Optimistic Concurrency Control, Timestamp ordering; Case study - Coda.

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	develop the principles and standard practices underlying the design of distributed and parallel systems	Applying (K3)
CO2	explain the core issues of distributed and parallel systems	Applying (K3)
CO3	analyze the difficulties in implementing basic communication in parallel and distributed systems	Analysing (K4)
CO4	solve the difficulty in designing parallel and distributed algorithms	Applying (K3)
CO5	apply the centralized algorithm for applications	Applying (K3)

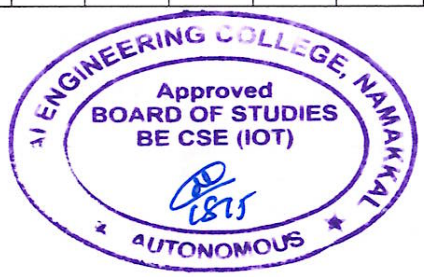
TEXT BOOKS	
1.	George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems Concepts and Design" Fifthedition – 2011 – Addison Wesley.
2.	Pradeep K Sinha , "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, New Delhi, 2009.
REFERENCES	
1.	Andrew S Tanenbaum, Marteen Van Steen , "Distributed Systems Principles and Paradigms", Pearson Education / Prentice Hall of India, New Delhi, 2007
2.	Liu M.L., "Distributed Computing, Principles and Applications", Pearson and education,2004.
3.	David S Linthicium, "Cloud Computing and SOA Convergence in your Enterprise", Pearson, USA, 2010.
4.	Sebastien Goasguen , "Docker in the Cloud –Recipes for AWS, Azure, Google, and More", O'Reilly Media, USA, 2016.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes

(3/2/1 indicates strength of correlation) 3-Strong,2-Medium,1-Weak

Cos	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	1	-	1	-	1	1	3	3	2
CO2	1	-	1	3	2	3	2	-	2	3	-	1	1	1
CO3	-	1	-	2	1	2	1	-	1	2	3	3	3	1
CO4	1	1	2	3	-	1	3	1	-	1	2	1	2	3
CO5	3	2	2	1	-	1	-	1	-	1	1	3	3	2



CI20902	SOFTWARE PROJECT MANAGEMENT	3	0	0	3

COURSE OBJECTIVES

To enable the students to

1.	understand the importance of project planning and project evaluation techniques.
2.	acquire knowledge in software effort estimation and calculating the project duration.
3.	analyze the risk and allocate the resources.
4.	gain knowledge about the monitoring and controlling the software projects and its quality.
5.	learn the fundamental issues in project management.

UNIT I	INTRODUCTION TO PROJECT PLANNING AND EVALUATION	9

Project Definition, Importance of Software Project Management, Software Projects Vs Other Projects, Activities Covered by SPM, Setting Objectives; Cost Benefit Evaluation Techniques; Stepwise Project Planning.

UNIT II	SOFTWARE EFFORT ESTIMATION AND ACTIVITY PLANNING	9

Project Approach , Agile Methods, Extreme Programming, Scrum; Software Effort Estimation - Problems with over and under estimates, Software effort estimation techniques, Bottom-up estimating, Top down estimating, Estimating by analogy, Albrecht function point analysis. Activity Planning, Objectives of Activity planning, Project Schedules, Project and Activities, Sequencing and Scheduling, Activity on Arrow Networks, Forward Pass, Backward Pass, Identifying Critical Path, Activity Float, Shortening Project Duration.

UNIT III	RISK MANAGEMENT AND RESOURCE ALLOCATION	9

Risk Management - Categories of Risk, A Framework for dealing Risk, Risk Identification, Risk Assessment, Risk Planning, Risk Management, Risk Evaluation, Applying the PERT technique, Monte Carlo Simulation; Resource Allocation - The Nature of resources, Identifying Resource Requirements, Scheduling Resources, Creating critical paths, Counting the cost, Publishing the resource schedule, The Scheduling Sequence.

UNIT IV	MONITORING AND CONTROLLING OF PROJECTS AND ITS QUALITY	9

Monitoring and Controlling of Software Projects - Collecting the data, Visualizing Progress, Cost monitoring, Earned value analysis, Prioritizing monitoring; Software Quality - The importance of Software Quality, Software Quality Definition, ISO9126, Product Vs Process Quality Management, Process Capability Models, and Techniques to help enhance software quality.

UNIT V	GLOBALIZATION ISSUES IN PROJECT MANAGEMENT	9

Globalization issues in project management - Evolution of globalization, challenges in building global Teams, Models for the execution of some effective management techniques for managing global teams;Impact of the internet on project management: Introduction, The effect of the internet on project management,Managing projects for the internet, Effect on project management activities; Comparison of projectmanagement software - Dot Project, Launch pad, openProj; Case study - PRINCE2

	TOTAL PERIODS	45

COs	COURSE OUTCOMES At the end of this course, the students will be able to	BT MAPPED (Highest Level)
CO1	desire the project by applying various evaluation techniques	Applying (K3)
CO2	identify the project duration by scheduling the activities	Applying (K3)
CO3	understandthe risk and allocate the resources accordingly	Understanding (K2)
CO4	know the progress of project and find the quality of project	Applying (K3)
CO5	implement the issues inproject	Applying (K3)

TEXT BOOKS

1.	Bob Hughes, Mike Cotterell & Rajib Mall "Software Project Management", McGraw- Hill Publications, 6th Edition 2017.
2.	Ian Somerville, "Software Engineering", 10th Edition, Pearson Education, 2017.

REFERENCES

1.	Robert T. Futrell , "Quality Software Project Management", Pearson Education India, 2008.
2.	Gopalaswamy Ramesh, "Managing Global Software Projects: How to Lead Geographically Distributed Teams, Manage Processes and Use Quality Models", McGraw Hill Education, 2017.
3.	Walker Royce, "Software Project Management", Addison-Wesley, 1998.

CO-PO MAPPING:

Mapping of Course Outcomes with Programme Outcomes:

(1/ 2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	POs												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	1	-	-	2	1	-	3	1	3	2	2	1
CO2	-	2	2	1	-	-	1	1	1	2	3	1	1	1
CO3	1	2	1	1	-	-	-	1	2	1	3	-	1	-
CO4	-	3	1	1	-	-	1	-	2	1	2	-	1	1
CO5	1	3	1	-	-	1	1	-	2	1	3	1	2	2