Proposed for the academic years 2020-2024

FACULTY OF ENGINEERING

OSMANIA UNIVERSITY

FOR AFFLIATED COLLEGES

Scheme of Instruction & Examination

(AICTE Model Curriculum)

Syllabi of Four Year Degree Program of

Bachelor of Engineering (B.E.) CSE

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

(2020 – 2024)

Proposed for the academic years 2020-2024

SCHEME OF INSTRUCTION
BE (COMPUTER SCIENCE AND ENGINEERING)
(Artificial Intelligence and Data Science)
AICTE MODEL CURRICULUM
I-SEMESTER
AI and DS as Prescribed by OU

S. No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P	Contact Hrs/Week	CIE	SEE	Duration in Hours	
Theory Courses										
	Induction Program for 3 weeks									
1	MC801PO	Indian Constitution	2	-	-	2	30	70	3	-
2	HS101EG	English	2	-	-	2	30	70	3	2
3	BS202PH	Physics	3	1	-	4	30	70	3	4
4	BS203MT	Mathematics-I	3	1	-	4	30	70	3	4
5	ES301EE	Basic Electrical Engineering	3	1	-	4	30	70	3	4
Practical/Laboratory Courses										
6	HS151EG	English Lab	-	-	2	2	25	50	2	1
7	BS251PH	Physics Lab	-	-	3	3	25	50	3	1.5
8	ES353CE	Engineering Graphics	-	-	3x2	6	50	50	3	3
9	ES354EE	Basic Electrical Engineering Lab	-	-	2	2	25	50	2	1
Total			13	3	13	29	275	550	-	20.5

BS: Basic Sciences ES: Engineering Sciences MC: Mandatory Course

L:Lectures T:Tutorials P:Practicals D:Drawing

CIE: Continuous Internal Evaluation SEE: Semester End Examination

Proposed for the academic years 2020-2024

SCHEME OF INSTRUCTION & EXAMINATION
B.E. II - SEMESTER
(Artificial Intelligence and Data Science)

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P/D	Contact Hours/ Week	CIE	SEE	Duration in Hours	
Theory Courses										
1	MC802CE	Environmental Science	2	-	-	2	30	70	-	
2	MC803PY	Essence of Indian Traditional knowledge	2	-	-	2	30	70	-	
3	BS201MT	Mathematics-II	3	1	-	4	30	70	3	4
4	BS204CH	Chemistry	3	1	-	4	30	70	3	4
5	ES302CS	Programming for Problem Solving	3	1	-	4	30	70	3	4
Practical/Laboratory Courses										
6	BS252CH	Chemistry Lab	-	-	3	3	25	50	3	1.5
7	ES352ME	Workshop Practice	-	-	2x3	6	50	50	3	3
8	ES351 CS	Programming for Problem Solving Lab	-	-	2	2	25	50	3	1
Total			13	03	11	26	250	500		17.5

SCHEME OF INSTRUCTION & EXAMINATION
B.E. III - SEMESTER
(Artificial Intelligence and Data Science)

S.No	Course Code	Course Title	Scheme of Instruction				Scheme of examination			Credits
			L	T	Pr/Drg	Contact Hrs / Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PC301AD	Data Structures & Algorithms	3			3	30	70	3	3
2	PC302AD	OOPS Using Java	3		-	3	30	70	3	3
3	PC303AD	Discrete Mathematics	2		-	2	30	70	3	2
4	ES216EC	Digital Electronics	3	1		4	30	70	4	4
5	ES214EC	Basic Electronics	3	1	-	4	30	70	4	4
6	BS205MT	Mathematic –III (Probability and Statistics)	3		-	3	30	70	3	3
Practical / Laboratory Courses										
7	PC351AD	Data Structure & Algorithms using C	-	-	2	2	25	50	2	1
8	PC352AD	OOPS Using Java lab			2	2	25	50	2	1
9	ES 351EC	Basic Electronics lab	-	-	2	2	25	50	2	1
Total			1	2	6	25	255	570		22

BS: Basic Sciences ES: Engineering Sciences MC: Mandatory Course
PC: Professional Course HS: Humanities and Sciences
L: Lectures T: Tutorials Pr: Practicals Drg: Drawing
CIE: Continuous Internal Evaluation SEE: Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour

2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

3) Students admitted into B.E./B.Tech. Courses under lateral entry scheme (through ECET) from the academic year 2017-18 should undergo the following bridge course subjects at III Semester (CBCS).

(1) ES 154 CS	Computer Programming Lab
(2) MC 156 EG	Engineering English Lab

SCHEME OF INSTRUCTION & EXAMINATION
B.E. IV - SEMESTER
(Artificial Intelligence and Data Science)

S. No	Course Code	Course Title	Scheme of Instruction				Scheme of examination			Credits
			L	T	Pr/Drg	Contact Hrs / Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PC401AD	Computer Organization & Microprocessor	3	0	-	3	30	70	3	3
2	PC402AD	Design Analysis & Algorithms	2	0	-	2	30	70	2	2
3	PC403AD	Foundation of Data Science	3	0	-	3	30	70	3	3
4	PC404AD	Operating Systems	3	0	-	3	30	70	3	3
5	PC405AD	Computer Networks	3	0	-	3	30	70	3	3
6	HS105CM	Financial and Accounting	3	0	-	3	30	70	3	3
Practical / Laboratory Courses										
7	PC451AD	Computer Organization & Microprocessor lab	-	-	2	2	25	50	2	1
9	PC452AD	Computer Networks and Operating Systems Lab	-	-	2	2	25	50	2	1
10	PC453AD	Data Science lab	-	-	2	2	25	50	2	1
Total			1	0	08	25	280	620		20

BS: Basic Sciences ES: Engineering Sciences MC: Mandatory Course
PC: Professional Course HS: Humanities and Sciences
L: Lectures T: Tutorials Pr: Practicals Drg: Drawing
CIE: Continuous Internal Evaluation SEE: Semester End Examination (Univ. Exam)

Note: 1) Each contact hour is a Clock Hour
2) The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.

With effect from the academic year2021-25

SCHEME OF INSTRUCTION & EXAMINATION
B.E. V - SEMESTER
(Artificial Intelligence and Data Science)

S.No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	D/P	Contact Hrs / W	CIE	SEE	Duration in Hrs	
Theory Course										
1.	PC501AD	Software Engineering	3	0	-	3	30	70	3	3
2.	PC502AD	Database Management System	3	0	-	3	30	70	3	3
3.	PC503AD	Artificial Intelligence	3	0	-	3	30	70	3	3
4.	PC504AD	Automata languages & Computation	3	-	-	3	30	70	3	3
5.	PC505AD	Computer Vision	3	-	-	3	30	70	3	3
6.	PE-I	Professional Elective-I	3	-	-	3	30	70	3	3
Practical/Laboratory Course										
7.	PC551AD	AI & CV lab (python MATLAB)	-	-	2	2	25	50	2	1
8.	PC552AD	DBMS Lab			2	2	25	50	2	1
9.	PW553AD	Mini Project	-	-	4	4	25	50	4	2
Total			20	00	08	32	280	640		22

Professional Elective–I	
Course Code	**Course Title**
PE511AD	Data Visualization
PE512AD	Pattern Recognition and Neural Networks /ANN
PE513AD	Distributed system
PE514AD	Web Technologies
PE515AD	Foundation of Cryptography
PE516AD	Internet of Things

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VI - SEMESTER
(Artificial Intelligence and Data Science)

S.No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	D/P	Contact Hrs/Wk	CIE	SEE	Duration	
Theory Courses										
1.	PC601AD	Machine Learning and Techniques	3	0	-	3	30	70	3	3
2.	PC602AD	Big Data Analytics	3	0	-	3	30	70	3	3
3.	PE-II	Professional Elective-II	3	0	-	3	30	70	3	3
4.	PE–III	Professional Elective-III	3	-	-	3	30	70	3	3
5	OE-I	Open Elective-I	3	-	-	3	30	70	3	3
6	HS	Effective Technical Communication	3			3	30	70	3	3
Practical/Laboratory Courses										
7	PC654AD	BDA Lab	-	-	2	2	25	50	2	1
8	PC655AD	ML Lab	-	-	2	2	25	50	2	1
9	SI671AD	Summer Internship*	-	-	-	-	25	25	-	2
Total			15	0	4	22	280	620		22

Profession Elective–II	
Course Code	Course Title
PE631AD	Mining of Massive Datasets
PE632AD	Responsible AI
PE633AD	Soft Computing
PE634AD	Scripting Languages
PE635AD	Block chain Technologies
PE636AD	Design Thinking

Profession Elective–III	
Course Code	Course Title
PE641AD	Information Retrieval Systems
PE642AD	Human Computer Interaction
PE643AD	Quantum Computing
PE644AD	Web Services
PE645AD	Cyber Security
PE646AD	open source tools

Open Elective-I

Sl.No	Code	Name of Subject
1	OE601 EE	Electrical Energy Conservation and Safety (Not for EEE & EIE Students)
2	OE601 EG	Soft Skills & Interpersonal Skills
3	OE602 MB	Human Resource Development and Organizational Behaviour
4	OE601 LW	Cyber Law and Ethics
5	OE601 CE	Disaster Mitigation (Not for Civil Engg. Students)
6	Code from OU	Introduction to Data Science(Not for AI & DS ,CSE students)
7	Code from OU	Introduction to AI(Not for AI & DS,CSE,IT students)

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VII – SEMESTER
(Artificial Intelligence and Data Science)

S.No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	D/P	Contact Hrs/Wk	CIE	SEE	Duration	
Theory Course										
1.	PC701AD	Deep Learning	3		-	3	30	70	3	3
2.	PC702AD	Cloud Computing	3		-	3	30	70	3	3
3.	PC703AD	Speech and Natural Language Processing	3	-	-	3	30	70	3	3
4.	PE–IV	Professional Elective–IV	3	-	-	3	30	70	3	3
5.	PE–V	Open Elective II	3	-	-	3	30	70	3	3
Practical/Laboratory Course										
6	PC751AD	Deep Learning Lab	-	-	2	2	25	50	2	1
7	PC752AD	Cloud Computing Lab	-	-	2	2	25	50	2	1
8	PW751AD	Project Work (Phase-I)	-	-	6	6	50			3
Total			15		10	25	250	450		20

Profession Elective–IV

With effect from the academic year2021-25

Course Code	Course Title
PE751AD	Business Intelligence
PE752AD	AI & Robotics
PE753AD	Web Intelligence
PE754AD	Digital Forensics
PE755AD	Computer Graphics

Sl.No	Code	Name of Subject
1	OE603 EE	Non-Conventional Energy Sources (Not for EEE & EIE Students)
2	OE621 ME	Industrial Robotics (Not for Mech Engg& Prod. Engg. students)
3	OE602 CE	Green Building Technologies (Not for Civil Engg. Students)
4	OE 603 IT	Cyber Security (Not for IT Students)
5	AIDS code	Data Handling & Data Visualization(Not for CSE,AI & DS Students)
6	OE775ME	Entrepreneurship

With effect from the academic year2021-25

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VIII – SEMESTER
(Artificial Intelligence and Data Science)

S.No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	D/P	Contact Hrs/Wk	CIE	SEE	Duration In Hrs/Wk	
Theory Course										
1.	OE-III	Open Elective III	3		-	3	30	70	3	3
2	PE-V	Professional Elective–V	3		-	3	30	70	3	3
Practical/Laboratory Course										
3	PW861CS	Technical Seminar			4	4	50			2
4	PW862AD	Project Work-II			16	16	50	100		8
Total			6		20	26	160	240		16

Profession Elective–V	
Course Code	Course Title
PE871AD	Social Media Analytics
PE872AD	Fundamentals of AR and VR
PE873AD	Parallel and High performance computing
PE874AD	Digital Marketing
PE875AD	Network Programming
PE876AD	Introduction to Drones

Open Elective – III With effect from the academic year2021-25		
1	OE605 EE	Smart Building Systems (Not for EEE & EIE Students)
2	OE631 AE	Automotive Safety and Ergonomics (Not for Auto. Engg students)
3	OE603 CE	Road Safety Engineering (Not for Civil Engg. Students)
4	OE604 IT	Software Engineering (Not for IT Students)
5	AI DS code	Machine Learning (Not for IT & CSE ,CSE stream Students)

Program Electives For V, VI , VII and VIII SEM

Elective	Sem V	Sem VI		Sem VII	Sem VIII
	PE-I	PE-II	PE-III	PE-IV	PE-V
Data Science	Data Visualization	Speech & Natural Language Processing	Information Retrieval Systems	Business Intelligence	Social Media Analytics
AI		Mining of Massive Datasets	Human Computer Interaction	AI & Robotics	Fundamentals of AR and VR
Computing	Distributed system	Soft Computing		Quantum Computing	Parallel and High performance computing
Web Programming	Web Technologies	Scripting Languages	Web Services	Web Intelligence	Digital Marketing
Networks	Foundation of Cryptography	Blockchain Technologies	Cyber Security	Digital Forensics	Network Programming
General	Internet of Things	Design Thinking	open source tools	Computer Graphics	Introduction to Drones

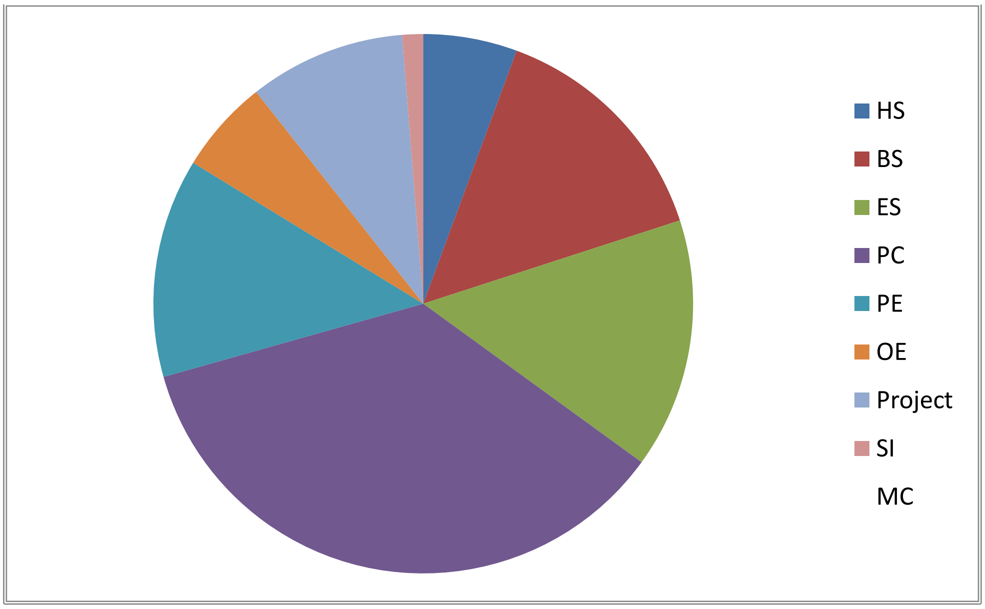
Credit Contribution Group-wise With effect from the academic year2021-25

Semester	CIE	SEE	Credits
1	275	550	20.5
2	250	500	17.5
3	255	575	22
4	280	620	20
5	280	640	24
6	280	620	20
7	250	450	20
8	160	240	16
Total	2030	4195	160
	6225		

Category	Sem1	Sem2	Sem3	Sem4	Sem-5	Sem-6	Sem-7	Sem-8	Total Credits group wise
HS	1+1(3)			1(3)	1(3)				9
BS	2+1(9.5)	2+1(10.5)	1(3)						23
ES	1+2(8)	1+2(7)	2+1(9)						24
PC			3+2(10)	5+3(17)	4+2(13)	3+3(9)	2+2(8)		57
PE					2(6)	2(6)	2(6)	1(3)	21
OE						1(3)	1(3)	1(3)	9
Project					1(2)		1(3)	2(10)	15
SI						1(2)			2
MC	1	2							
Totalsemwise	9(20.5)	10(17.5)	9(22)	10(20)	9(24)	9(20)	8(20)	3(14)	160

	AICTE
Humanities & Social Science including Management Courses	12
Basic Sciences Courses	26
Engineering Sciences Courses including workshop, drawing, basics of electrical/ mechanical / computer etc	29
Professional Core Courses	47
Professional Elective Courses relevant to Chosen specialization/branch	23
Open Subjects- Electives form Courses technical and /or emerging subjects	11
Project work, seminar and internship in industry or elsewhere	12
Mandatory courses(Environmental Sciences, induction program, Indian constitution , Essence of Indian Knowledge Tradition)	
Total	160

Number of Credits with Respective to Category Pie Chart


HS
BS
ES
PC
PE
OE
Project
SI
MC

SCHEME OF INSTRUCTION & EXAMINATION
B.E. IV - SEMESTER
(Artificial Intelligence and Data Science)

S. No	Course Code	Course Title	Scheme of Instruction				Scheme of examination			Credits
			L	T	Pr/Drg	Contact Hrs / Wk	CIE	SEE	Duration in Hrs	
Theory Courses										
1	PC401AD	Computer Organization & Microprocessor	3	0	-	3	30	70	3	3
2	PC402AD	Design Analysis & Algorithms	2	0	-	2	30	70	2	2
3	PC403AD	Foundation of Data Science	3	0	-	3	30	70	3	3
4	PC404AD	Operating Systems	3	0	-	3	30	70	3	3
5	PC405AD	Computer Networks	3	0	-	3	30	70	3	3
6	HS105CM	Financial and Accounting	3	0	-	3	30	70	3	3
Practical / Laboratory Courses										
7	PC451AD	Computer Organization & Microprocessor lab	-	-	2	2	25	50	2	1
8	PC452AD	Computer Networks and Operating Systems Lab	-	-	2	2	25	50	2	1
9	PC453AD	Data Science lab	-	-	2	2	25	50	2	1
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Syllabus

B.E. IV – SEMESTER

(Artificial Intelligence and Data Science)

Course Code	Course Title						Core/Elective
PC401AD	**Computer Organization & Microprocessors**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- To understand basic components of computers
- To explore the I/O organizations in depth.
- To explore the memory organization.
- To understand the basic chip design and organization of 8086 with assembly language.

Course Outcomes

After completing this course, the student will be able to:

1. Understand the I/O and memory organization in detail
2. Understand the merits and pitfalls in computer performance measurements.
3. Identify the basic elements and functions of 8086 microprocessors.
4. Understand the instruction set of 8086 and use them to write assembly language programs.
5. Demonstrate fundamental understanding on the operation between the microprocessor and its interfacing devices.

UNIT-I

Basic Computer Organization: Functions of CPU, I/O Units and Memory: Instruction: Instruction Formats One address, two addresses, zero addresses and three addresses and comparison; addressing modes with numeric examples: Program Control- Status bit conditions, conditional branch instructions, Program Interrupts: Types of Interrupts.

UNIT-II

Input-Output Organizations: I/O Interface, I/O Bus and Interface modules: I/O Vs Memory Bus, Isolated Vs Memory-Mapped I/O, Asynchronous data Transfer- Strobe Control, Hand Shaking: Asynchronous Serial transfer-Asynchronous Communication interface, Modes of transfer Programmed I/O, Interrupt Initiated I/O, DMA; DMA Controller, DMA Transfer, IOP-CPU-IOP Communication, Intel 8089 IOP.

UNIT-III

Memory Organizations: Memory hierarchy, Main Memory, RAM, ROM Chips, Memory Address Map, Memory Connection to CPU, associate memory, Cache Memory, Data Cache, Instruction cache, Miss and Hit ratio, Access time, associative, set associative, mapping, waiting into cache, Introduction to virtual memory.

UNIT-IV

8086 CPU Pin Diagram: Special functions of general purpose registers, Segment register, concept of pipelining, 8086 Flag register, Addressing modes of 8086.

8086-Instruction formats: assembly Language Programs involving branch & Call instructions, sorting, evaluation of arithmetic expressions. Interfacing with peripherals.

UNIT-V

Interfacing: 8255.8253,8257, 8259, RS-232, 555 Timer

Suggested books:

1. Computer System Architecture 3 rd Edition M. Morris Mano Pearson Education
2. Advanced microprocessors and peripherals 3 rd Edition Mc Graw Hill.

References:

3. Fundamentals of microprocessor and Microcontrollers, by Ram B Ganpath Rai Publications
4. Computer Fundamentals Architecture and Organization, 6 th Edition, B Ram, Sanjay Kumar
5. Hall Douglas V,SSSP Rao, Microprocessors and Its Interfacing, , Tata McGraw Hill, 3rd Edition
6. SK Sen, Understanding 8085/8086 Microprocessors and peripheral ICs, New Age International publishers
7. Sunil Mathur, Microprocessor 8086 Architecture, Programming and Interfacing, Prentice Hall India

Course Code	Course Title						Core/Elective
PC402AD	**Design and Analysis of Algorithms**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	2	-	-	-	30	70	2

Course Objectives

- Analyze the asymptotic performance of algorithms
- Write rigorous correctness proofs for algorithms
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis
- Synthesize efficient algorithms in common engineering design situations.

Course Outcomes

After completing this course, the student will be able to:

1. Analyze the performance of algorithms.
2. Choose appropriate algorithm design techniques for solving problems.
3. Understand how the choice of data structures and the algorithm design methods impact the performance of programs

UNIT-I

Introduction: Algorithm definition, and specification, asymptotic analysis – best, average, and worst-case behavior; Performance measurements of Algorithms, Time and Space complexities, Analysis of recursive algorithms. Basic Data Structures: Disjoint set operations, union and find algorithms, Dictionaries, Graphs, Trees.

UNIT-II

Divide and Conquer: General method, Control abstraction, Merge sort, Quick Sort – Worst, Best and average case. Binary search. Brute Force: Computing an– String Matching – Closest-Pair and Convex-Hull Problems - Exhaustive Search – Travelling Salesman Problem – Knapsack Problem – Assignment problem.

Greedy method: General method, applications- Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees, Single source shortest path problem.

UNIT-III

Dynamic Programming: General Method, applications- All pairs shortest path problem, Optimal binary search trees, 0/1 knapsack problem, Reliability design, Traveling sales person problem. Backtracking: General method, Recursive backtracking algorithm, Iterative backtracking method. 8-Queen problem, Hamiltonian Cycle, 0/1 Knapsack Problem. Branch and Bound: Control abstractions for Least Cost Search, Bounding, FIFO branch and bound, LC branch and bound, 0/1 Knapsack problem – LC branch and bound and FIFO branch and bound solution, Traveling sales person problem.

UNIT-IV

Graph Algorithms: Graph Traversals DFS, BFS, Transitive Closure, Directed Acyclic Graphs - Topological Ordering, Network Flow algorithms. Tries: Standard Tries, Compressed Tries, Suffix Tries, Search Engine Indexing. External Searching and B-Trees: (a, b) Trees, B-Trees

UNIT-V

Computational Complexity: Non Deterministic algorithms, The classes: P, NP, NP Complete, NP Hard, Satisfiability problem, Proofs for NP Complete Problems: Clique, Vertex Cover.

Parallel Algorithms: Introduction, models for parallel computing, computing with complete binary tree.

Suggested books:

1. E. Horowitz, S. Sahni, Fundamentals of Computer Algorithms.
2. 2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.
3. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.
4. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Third Edition, PHI Learning Private Limited, 2012.

Course Code	Course Title						Core / Elective
PC403AD	**Foundation of Data Sciences**						Core / Open Elective-II
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

- Provide basics of R Programming environment: R language, R- studio and R packages
- Demonstrate an understanding of statistics concepts that are vital for data science
- Provide Classification algorithm viz KNN & Regression model like linear and logistic regression, K-mean Clustering

Course Outcomes:

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

1. Understand the key concepts in data science, including real world applications and the toolkit used by data scientists
2. Identify the kind of statistical analysis to be applied for given problem/understand the concept of random variable and few basic principles such as CLT, Hypothesis testing
3. Understand various data structures and packages in R for data visualization and summarization
4. Choose linear, non-linear regression models and classification techniques for data analysis
5. Make use of clustering method as K-means for develop a data science application

UNIT – I

Data Science: Introduction to Core concepts and Terminology: Introduction to Data science, Data Science Process, Data Science toolkit, Types of Data, Example Application, Linear Algebra for data science, Linear equations, Distance, Hyper planes, Half spaces, Eigen values, Eigenvectors.

UNIT II

Statistical Modeling, Random variables, Probability mass/density functions, sample statistics, hypothesis testing.

UNIT III

Predictive Modeling: Linear Regression, Simple Linear Regression model building, Multiple Linear Regression, Logistic regression

UNIT IV

Introduction to R Programming, getting started with R: Installation of R software and using the interface, Variables and data types, R Objects, Vectors and lists, Operations: Arithmetic, Logical and Matrix operations, Data frames, functions, Control structures, Debugging and Simulation in R.

UNIT V

Classification: performance measures, Logistic Regression, K-Nearest neighbors (KNN), **Clustering**: K-Means Algorithm. Case Study

Suggested books:

1. Nina Zumel, Practical Data Science with R, Manning Publications, 2014.
2. Peter Bruce and Andrew Bruce, Practical Statistics for Data Scientists, O’Reilly, 2017.
3. Hadley Wickham and Garrett Grolemund, R for Data Science, O’Reilly, 2017.
4. Rafael A Irizarry, Introduction to Data Science, Lean Publishing, 2016
5. Seema Acharya , Data Analytics using R, McGraw Hill education.
6. Michael J. John ,The R book, Crawley, Wiley & Sons, Ltd

Course Code	Course Title						Core/ Elective
PC 404 AD	**Operating Systems**						CORE
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	p			
	3	0			30	70	3

Course Objectives

- To learn the fundamentals of Operating Systems.
- To learn the mechanisms of OS to handle processes and threads and their communication
- To learn the mechanisms involved in memory management in contemporary OS
- To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection
- To know the components and management aspects of concurrency management

Course Outcomes

- Identify System calls and evaluate process scheduling criteria of OS.
- Develop procedures for process synchronization of an OS.
- Demonstrate the concepts of memory management and of disk management
- Solve issues related to file system interface and implementation, I/O systems
- Describe System model for deadlock, Methods for handling deadlocks.

UNIT-I

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkemel Operating Systems, Concept of Virtual Machine.

UNIT-II

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching, Threads: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads,

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling Criteria, Scheduling algorithms, multiprocessor scheduling.

UNIT-III

Process Synchronization: Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Peterson's Solution, classical problems of synchronization: The Bounded buffer problem,

Producer\Consumer Problem, reader's & writer problem, Dinning philosopher's problem. Semaphores, Event Counters, Monitors, Message Passing, Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Methods for Handling: Deadlocks: Deadlock prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

UNIT-IV

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation, fragmentation and Compaction; Paging: Principle of operation - Page allocation - Hardware support for paging, structure of page table, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory - Hardware and control structures - Locality of reference, Page fault, Working Set, Dirty page/Dirty bit - Demand paging, Page Replacement algorithms, Trashing.

UNIT-V

I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software,

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods, Free-space management, directory implementation, efficiency and performance. Secondary-Storage Structure: Disk structure, Disk scheduling algorithms, Disk Management, RAID structure

Suggested books:

1. *Abraham Silberschatz, Peter Galvin, Greg Gagne,,* Operating System Concepts Essentials, 9th Edition, Wiley Asia Student Edition, 2017.
2. William Stallings, Operating System.Internals and Design Principles, 5th Edition, Prentice Hall of India, 2016.
3. Maurice Bach, Design of the Unix Operating .ij!Stems, gth Edition,Prentice-Hall of
   India, 2009.
4. Daniel P. Bovet, Marco Cesati, Understanding the Linux Kernel, 3rdEdition, O'Reilly and Associates.

Course Code	Course Title						Core/ Elective
PC405AD	**Computer Networks**						CORE
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	p			
	3	0			30	70	3

Course Objectives

- To develop an understanding of communication in modern network architectures froma design and performance perspective.
- To understand Data Transmission standards and MAC protocols.
- To introduce the protocols functionalities in Network Layer and Transport Layer.
- To understand DNS and supportive application protocols.
- To provide basic concepts of Cryptography.

Course Outcomes

After completing this course, the student will be able to:

- Explain the functions of the different layer of the OSI and TCP/IP Protocol.
- Understand wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
- Illustrate network layer and transport layer protocols. For a given problem related TCP/IP protocol developed the network programming.
- Configure DNS , EMAIL, SNMP, Bluetooth, Firewalls using open source available software and tools.
- Identify the types of encryption techniques.

UNIT-I

Data communication Components: Representation of data communication, flow of Networks, Layered architecture, OSI and TCP/IP model, Transmission Media. (William stalling)Techniques for Bandwidth utilization: Line configuration, Multiplexing - Frequency division, Time division and Wave division, Asynchronous and Synchronous transmission, XDSL , Introduction to Wired and Wireless LAN

UNIT-II

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC;

Flow Control and Error control protocols: Stop and Wait, Go back - N ARQ, Selective Repeat ARQ, Sliding Window, and Piggybacking.

Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA

UNIT-III

Network Layer: Switching techniques (Circuit and Packet) concept,Logical addressing:

IPV4(Header), IPV6(Header), NAT, Sub-Netting concepts.

Inter-Networking: Tunneling, Fragmentation, congestion control (Leaky Bucket and Token Bucket algorithm), Internet control protocols: ARP, RARP, BOOTP and DHCP.

Network Routing Algorithms: Delivery, Forwarding and Unicast Routing protocol, Gateway protocols.

UNIT-IV

Transport Layer: Process to Process Communication, Elements of transport protocol, Internet Transport Protocols: UDP, TCP. Congestion and Quality of Service, QoS improving techniques.

UNIT-V

Application Layer: Domain Name Space (DNS), EMAIL, SNMP, Bluetooth. Basic concepts of Cryptography: Network Security Attacks, firewalls, symmetric encryption, Data encryption Standards, public key Encryption (RSA), Hash function, Message authentication, Digital Signature.

Suggested books:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGrawHill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
3. W. Richard Stevens, Unix Network Programming, Prentice Hall/ Pearson Education, 2009

Course Code	Course Title						Core/Elective
HS105CM	**Finance and Accounting**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

The course will introduce the students

- To provide basic understanding of Financial and Accounting aspects of a business unit
- To provide understanding of the accounting aspects of business
- To provide understanding of financial statements
- To provide the understanding of financial system
- To provide inputs necessary to evaluate the viability of projects
- To provide the skills necessary to analyze the financial statements

Course Outcomes

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

1. Evaluate the financial performance of the business unit.
2. Take decisions on selection of projects.
3. Take decisions on procurement of finances.
4. Analyze the liquidity, solvency and profitability of the business unit.
5. Evaluate the overall financial functioning of an enterprise

UNIT-I :

Basics of Accounting: Financial Accounting–Definition- Accounting Cycle – Journal - Ledger and Trial Balance-Cash Book-Bank Reconciliation Statement (including Problems)

UNIT-II:

Final Accounts: Trading Account-Concept of Gross Profit- Profit and Loss Account-Concept of Net Profit Balance Sheet (including problems with minor adjustments)

UNIT-III :

Financial System and Markets: Financial System-Components-Role-Considerations of the investors and issuers- Role of Financial Intermediaries. Financial Markets-Players- Regulators and instruments - Money Markets Credit Market- Capital Market (Basics only)

UNIT-IV:

Basics of Capital Budgeting techniques: Time Value of money- Compounding- Discounting- Future Value of single and multiple flows- Present Value of single and multiple Flows- Present Value of annuities Financial Appraisal of Projects– Payback Period, ARR- NPV, Benefit Cost Ratio, IRR (simple ratios).

UNIT-V:

Financial statement Analysis: Financial Statement Analysis- Importance-Users-Ratio Analysis- liquidity, solvency, turnover and profitability ratios.

Suggested books:

1. Satyanarayana. S.V. and Satish. D., Finance and Accounting for Engineering, Pearson Education
2. Rajasekharan, Financial Accounting, Pearson Education

3. Sharma.S.K. and Rachan Sareen, Financial Management, Sultan Chand
4. Jonathan Berk, Fundamentals of Corporate Finance, Pearson Education
5. Sharan, Fundamentals of Financial Management, Pearson Education

Course Code	Course Title						Core/Elective
PC451AD	**Computer Organization & Microprocessor lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

The objectives of the course are to impart knowledge of the:

- To become familiar with the architecture and Instruction set of Intel 8086 microprocessor.
- To provide practical hands on experience with Assembly Language Programming.
- To familiarize the students with interfacing of various peripheral devices with 8085 microprocessors.

Course Outcomes

After the completion of the course, the student will be able to:

1. Interpret the principles of Assembly Language Programming, instruction set in developing microprocessor based applications.
2. Develop Applications such as: 8-bit Addition, Multiplication, and Division, array operations, swapping,negative and positive numbers.
3. Analyze the interfaces like serial ports, digital-to-analog Converters and analog-to-digital converters etc.
4. Build interfaces of Input-output and other units like stepper motor with 8086.
5. Analyze the function of traffic light controller.

1. Tutorials with 8086 kit / MASM software tool.
2. Fixed-point multiplication and division.
3. Floating-point multiplication and division.
4. Sorting hexadecimal array.
5. Code conversion from hexadecimal to decimal.
6. Sum of set of BCD numbers.
7. Searching.
8. Display a string of characters using 8279.
9. Interfacing traffic light controller using 8255.
10. Interfacing seven-segment LED using 8255.
11. Interfacing stepper motor using 8255.
12. Interfacing 8253 counter.
13. D/A conversion using 8255.
14. A/D conversion using 8255.

<table>
<tr><td>Course Code</td><td colspan="6">Course Title</td><td>Core/
Elective</td></tr>
<tr><td>PC 452 AD</td><td colspan="6"><b>Computer Networks & Operating Systems LAB</b></td><td>CORE</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td>L</td><td>T</td><td>D</td><td>p</td></tr>
<tr><td>DC</td><td></td><td></td><td></td><td>2</td><td>30</td><td>70</td><td>1</td></tr>
</table>

Course Objectives

- Learn to communicate between two desktop computers.
- Learn to implement the different protocols
- Be familiar with socket programming.
- Be familiar with the various routing algorithms
- Be familiar with simulation tools.
- To use simulation tools to analyze the performance of various network protocols
- Learn different types of CPU scheduling algorithms
- Demonstrate the usage of semaphores for solving synchronization problem
- Understand memory management techniques and different types of fragmentation that occur in them and various page replacement policies Learn various disk scheduling algorithms.

Course Outcomes

After completing this course, the student will be able to:

- Implement various protocols using TCP and UDP.
- Program using sockets.
- Use simulation tools to analyze the performance of various network protocols.
- Implement and Analyze various routing algorithms.
- Evaluate the performance of different types of CPU scheduling algorithms.
- Implement producer-consumer problem, reader-writers problem, Dining philosopher's problem.
- Implement paging replacement and disk scheduling techniquesUse different system calls for writing application programs.

Part – A

Computer Networks Lab

1. Configuration of router, hub, switch etc. (using real devices or simulators)
2. Running and using services/commands like ping, traceroute, nslookup, arp, telnet, ftp, etc.
3. Network packet analysis using tools like Wireshark, tcpdump, etc.
4. Network simulation using tools like Cisco Packet Tracer, NetSim, OMNeT++, NS2, NS3, etc.
5. Socket programming using UDP and TCP (e.g., simple DNS, data & time client/server, echo client/server, iterative & concurrent servers)
6. Programming using raw sockets
7. Programming using RPC

Part -B

Operating Systems Lab:

1. Write C programs to Simulate the following CPU scheduling algorithms
   a) FCFS b) SJF c)Round Robin d) Priority
2. Write C programs to Simulate IPC techniques
   a) Pipes b) Message Queues c) Shared Memory
3. Write C Programs to Simulate Classical Problems of Synchronization
   a) Readers-Writers b) Producers-Consumers C) Dining Philosophers
4. Write C Program to simulate Bankers Algorithm for Dead Lock Avoidance
5. Write C Programs to Simulate all page replacement algorithms
   a) FIFO b) LRU c) Optimal etc.
6. Write C program to Simulate Disk Scheduling Algorithms
   a) FCFS b) SSTF etc.
7. Write Unix Shell Programs

Course Code	Course Title						Core/Elective
PC453AD	**Data Science Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- Understand the R Programming Language.
- Exposure on solving of data science problems.
- Understand The classification and Regression Model..

Course Outcomes

After completing this course, the student will be able to:

- Work with Data Science using R Programming environment
- Implement various statistical concept like linear and logistic regression
- Perform Classification and Clustering using appropriate dataset

1. CALCULATOR APPLICATION

a. Using with and without R objects on console

b. Using mathematical functions on console

c. Write an R script, to create R objects for calculator application and save in a specifiedlocation in disk

2. DESCRIPTIVE STATISTICS IN R

a. Write an R script to find basic descriptive statistics using summary

b. Write an R script to find subset of dataset by using subset ()

3. READING AND WRITING DIFFERENT TYPES OF DATASETS

a. Reading different types of data sets (.txt, .csv) from web and disk and writing in file inspecific disk location.

b. Reading Excel data sheet in R.

c. Reading XML dataset in R.

4. VISUALIZATIONS

a. Find the data distributions using box and scatter plot.

b. Find the outliers using gplot.

c. Plot the histogram, bar chart and pie chart on sample data

5. CORRELATION AND COVARIANCE

a. Find the correlation matrix.

b. Plot the correlation plot on dataset and visualize giving an overview of relationshipsamong data on iris data.

c. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data

6. REGRESSION MODEL

Import a data from web storage. Name the dataset and now do Logistic Regression to find outrelation between variables that are affecting the admission of a student in a institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not. require (foreign), require(MASS).

7. Build CLASSIFICATION MODEL using KNN algorithm

a. Install relevant package for classification.

b. Choose classifier for classification problem.

c. Evaluate the performance of classifier.

8. Build CLUSTERING MODEL using K-mean algorithm

a. Clustering algorithms for unsupervised classification.

b. Plot the cluster data using R visualizations.

With effect from the academic year2021-25

SCHEME OF INSTRUCTION & EXAMINATION
B.E. V - SEMESTER
(Artificial Intelligence and Data Science)

S.No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	D/P	Contact Hrs / W	CIE	SEE	Duration in Hrs	
Theory Course										
1.	PC501AD	Software Engineering	3	0	-	3	30	70	3	3
2.	PC502AD	Database Management System	3	0	-	3	30	70	3	3
3.	PC503AD	Artificial Intelligence	3	0	-	3	30	70	3	3
4.	PC504AD	Automata Language and Computation	3	-	-	3	30	70	3	3
5.	PC505AD	Computer Vision	3	-	-	3	30	70	3	3
6.	PE-I	Professional Elective-I	3	-	-	3	30	70	3	3
Practical/Laboratory Course										
7.	PC551AD	AI & CV lab (python MATLAB)	-	-	2	2	25	50	2	1
8.	PC552AD	DBMS Lab			2	2	25	50	2	1
9.	PW553AD	Mini Project	-	-	4	4	25	50	4	2
Total			20	00	08	32	280	640		22

Professional Elective–I	
Course Code	**Course Title**
PE511AD	Data Visualization
PE512AD	Pattern Recognition and Neural Networks /ANN
PE513AD	Distributed system
PE514AD	Web Technologies
PE515AD	Foundation of Cryptography
PE516AD	Internet of Things

Course Code	Course Title						Core/Elective
PC501AD	**Software Engineering**						**Core**
Prerequisite	Contact Hours per Week				CI E	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- To introduce the basic concepts of software development- processes from defining a product to shipping and maintaining that product
- To impart knowledge on various phases, methodologies and practices of software development
- To understand the importance of testing in software development and study various testing strategies and software quality metrics

Course Outcomes

Students will be able to:

- Define different software development processes and their usability in different problem domains.
- Explain the process of requirements collection, analyzing, and modeling requirements for effective understanding and communication with stakeholders.
- Design and Develop the architecture of real world problems towards developing a blueprint for implementation.
- Understand the concepts of software quality, testing and maintenance.
- Discuss the concepts related to Risk management and Software project Estimation

UNIT-I

Introduction to Software Engineering: A generic view of Process: Software Engineering, Process Framework, CMM Process Patterns, Process Assessment.

Process Models: Prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

An Agile view of Process: Introduction to Agility and Agile Process, Agile Process Models.

UNIT-II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modeling Principles, Construction Principles, Deployment.

System Engineering: Computer-based Systems, The System Engineering Hierarchy, Business Process Engineering, Product Engineering, System Modeling.

Requirements Engineering: A Bridge to Design and Construction, Requirements Engineering Tasks, Initiating Requirements Engineering Process, Eliciting Requirements, Developing Use- Cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

UNIT-III

Building the Analysis Model: Requirements Analysis Modeling Approaches, Data Modeling Concepts, Object-Oriented Analysis, Scenario-based Modeling, Flow-oriented Modeling, Class-based Modeling, Creating a Behavioral Model.

Design Engineering: Design within the context of SE, Design Process and Design Quality, Design Concepts, The Design Model, Pattern-based Software Design.

UNIT-IV

Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design.

Modeling Component-Level Design: Definition of Component, Designing Class-based Components, Conducting Component-level Design, Object Constraint Language, Designing Conventional Components.

Performing User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface

Analysis, Interface Design Steps, Design Evaluation.

UNIT-V

Testing: Strategies: A Strategic Approach to Conventional Software Testing, Test Strategies for O-OSoftware. **Tactics:** Software Testing Fundamentals, Black-box and White-box Testing, Basis Path Testing, Control Structure Testing, O-O Testing Methods.

Debugging: Debugging Techniques, The Art of Debugging.

Product Metrics: A Framework for Product Metrics, Metrics for each phase of software development.

Software Quality: Definition, **Quality Assurance:** Basic Elements, Formal Approaches, Statistical Software Quality Assurance, Software Reliability, ISO9000 Quality Standards, SQA Plan.

Suggested Reading:

1. Roger S. Pressman, *Software Engineering: A Practitioner's Approach*, 7th Edition, McGraw Hill, 2009
2. Ali Behforooz and Frederick J. Hudson, *Software Engineering Fundamentals*, Oxford University Press, 1996
3. PankajJalote, *An Integrated Approach to Software Engineering*, 3rd Edition, Narosa Publishing House, 2008

Course Code	Course Title						Core/Elective
PC502AD	**Database Management Systems**						**Core**
Prerequisite	Contact Hours per Week				CI E	SEE	Credits
	L	T	D	P			
-	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

- Train in the fundamental concepts of database management systems, database modeling and design, SQL, PL/SQL and system implementation techniques.
- Enable students to model ER diagrams for any customized application
- Inducting appropriate strategies for optimization of queries.
- Provide knowledge on concurrency techniques
- Demonstrate the organization of Databases

Course Outcomes

Students will be able to:

- Design a database for a real-world information system
- Define transactions that preserve the integrity of the database
- Generate tables for a database
- Organize the data to prevent redundancy
- Pose queries to retrieve the information from the database

UNIT-I

Introduction: Database systems applications, Purpose of Database Systems, view of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Information Retrieval, Specialty Databases, Database users and Administrators, Introduction to Relational Model: Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, Relational Operations

UNIT-II

Introduction to SQL: Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Sub-queries, Modification of the Database. Intermediate SQL: Joint Expressions, Views, Transactions, Integrity Constraints, SQL Data types and schemas, Authorization. Advanced SQL: Accessing SQL from a Programming Language, Functions and Procedures, Triggers, Recursive Queries, OLAP, Formal relational query languages.

UNIT-III

Database Design and the E-R Model: Overview of the Design Process, The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams, Reduction to Relational Schemas, Entity-Relationship Design Issues. Relational Database Design: Features of Good Relational Designs, Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies, Functional-Dependency Theory, Algorithms for Decomposition, Decomposition Using Multivalued Dependencies, More Normal Forms.

UNIT-IV

Query Processing: Overview, Measures of Query cost, Selection operation, sorting, Join Operation, other operations, Evaluation of Expressions. Query optimization: Overview, Transformation of Relational Expressions, Estimating statistics of Expression results, Choice of Evaluation Plans, Materialized views, Advanced Topics in Query Optimization.

UNIT-V

Transaction Management:

Transactions: Concept, A Simple Transactional Model, Storage Structures, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Isolation and Atomicity, Transaction Isolation Levels, Implementation of Isolation Levels, Transactions as SQL Statements. Concurrency Control: Lock-based Protocols, Deadlock Handling, Multiple granularity, Timestamp-based Protocols, and Validation-based Protocols. Recovery System: Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with Loss of Nonvolatile Storage, Early Lock Release and Logical Undo Operations.

Suggested Reading:

1. A. Silberschatz, H.F.Korth, S.Sudarshan, “Database System Concepts”,6/e, TMH 2019
2. Database Management System, 6/e RamezElmasri, Shamkant B. Navathe, PEA
3. Database Principles Fundamentals of Design Implementation and Management, Carlos Coronel, Steven Morris, Peter Robb, Cengage Learning.
4. Database Management Systems, 3/e, Raghurama Krishnan, Johannes Gehrke,TMH

Course Code	Course Title						Core/Elective
PC 503 AD	**Artificial Intelligence**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Understand the importance of the field of AI by discussing its history and various applications.
- Learn about one of the basic applications of A.I, search state formulations.
- Learn methods of expressing knowledge by a machine with appropriate reasoning and different mathematics involved behind it.
- Learn how to reason when an agent has only uncertain information about its task.
- Know various supervised and unsupervised learning algorithms.

Course Outcomes

After completion of course, students would be able to:

- Formalize a problem in the language/framework of different AI methods.
- Illustrate basic principles of AI in solutions that require problem solving, search, Inference.
- Represent natural language/English using Predicate Logic to build knowledge through various representation mechanisms.
- Demonstrate understanding of steps involved in building of intelligent agents, expert systems, Bayesian networks.
- Differentiate between learning paradigms to be applied for an application.

UNIT - 1

Problem Solving & Search: Introduction- What is intelligence? Foundations of artificial intelligence (AI). History of AI, Structure of Agents.

Problem Solving - Formulating problems, problem types, states and operators, statespace. **Search Strategies. -** Informed Search Strategies- Best first search, A* algorithm, heuristic functions, Iterative deepening A*.

Adversarial Search/ Game playing - Perfect decision game, imperfect decision game, evaluation function, alpha-beta pruning.

UNIT - II

Knowledge, Reasoning &Planning: Reasoning - Knowledge based agent, Propositional Logic, Inference, Predicate logic (first order logic), Resolution

Structured Knowledge Representation – Frames, Semantic Nets

Planning - A Simple Planning Agent, Form Problem Solving to Planning, Basic representation of plans, partial order planning, hierarchical planning.

UNIT - III

Expert Systems, Reasoning with Uncertainty: Expert System and Applications: Introduction, Phases in Building Expert Systems, Expert System Architecture, Applications. **Uncertainty -** Basic probability, Bayes rule, Belief networks, Inference in Bayesian Networks**,** Fuzzy sets, and fuzzy logic: Fuzzy logic system architecture, membership function.

Decision Making- Utility theory, utility functions.

UNIT - IV

Learning: Machine-Learning Paradigms: Introduction, Machine Learning Systems, Supervised and Unsupervised Learning, Inductive Learning, Learning Decision Trees

Artificial Neural Networks: Introduction, Artificial Neural Networks, Single-Layer Feed-Forward Networks, Multi-Layer Feed-Forward Networks

Reinforcement learning: Learning from rewards, Passive and Active reinforcement learning, Applications.

UNIT - V

Communicating & Perceiving: Introduction to NLP- Progress & applications of NLP, Components of NLP, Grammars, Parsing.

Automatic Speech Recognition (ASR) – Speech Processing, Ex: DRAGON, HARPY,

Machine Vision – Applications, Basic Principles of Vision, Machine vision techniques: Low, Middle and High-level vision.

AI Today & Tomorrow - Achievements, ubiquitous AI.

Suggested Readings:

1. Stuart Russell and Peter Norvig. *Artificial Intelligence – A Modern Approach*, 3rd Edition, Pearson Education Press, 2009.
2. Kevin Knight, Elaine Rich, B. Nair, *Artificial Intelligence*, 3rd Edition, McGraw Hill, 2008.
3. Nils J. Nilsson, *The Quest for Artificial Intelligence*, Cambridge University Press, 2009.

Course Code	Course Title						Core/ Elective
PC504AD	**AUTOMATA LANGUAGES & COMPUTATION**						**CORE**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	3

Course Objectives

1.Develop a formal notation for strings, languages, and machines.

2.Design finite automata to accept a set of strings of a language

3. Prove that a given language is regular and apply the closure properties of languages. Design context free grammars to generate strings from a context free language and Convert them into normal forms.

4. Prove equivalence of languages accepted by Push Down Automata and languages generated by context free grammars.

5. Identify the hierarchy of formal languages, grammars, and machines.

6. Distinguish between computability and non-computability and Decidability and undesirability.

Course Outcomes

After completion of course, students would be able to:

1. Write a formal notation for strings, languages, and machines.
2. Design finite automata to accept a set of strings of a language.
3. For a given language determine whether the given language is regular or not.
4. Design context free grammars to generate strings of context free languages.
5. Determine equivalence of languages accepted by Pushdown Automata and languages generated by context free grammars.
6. Write the hierarchy of formal languages, grammars, and machines.
7. Distinguish between computability and non-computability and Decidability and undesirability.

UNIT-I

Introduction: Finite state automata, Non-deterministic finite state automata, FA with € -transitions, Regular expressions, Applications of FA, Properties of regular sets, Pumping Lemma, Closure properties, Myhill-Nerode Theorem, Minimization of FA.

UNIT-II

Context Free Grammars and Languages: Derivations, Parse-trees, Ambiguity in Grammars and Languages. Pushdown Automata–Definitions, The languages of PDA, Equivalence of PDAs and CFGs, Deterministic Pushdown Automata**.**

UNIT-III

Properties of CFLs: Normal forms for CFGs, Pumping Lemma, Closure properties,

Deterministic Context Free Languages, Decision properties.

UNIT IV

Turing Machines: Introduction, Computational Languages and Functions, Techniques for construction of Turing machines. Modifications of TM, TM as enumerator, Restricted TM.

UNIT V

Undecidability: Recursive and Recursively enumerable languages, UTM and undecidable problem, Rice Theorem, Post's correspondence problem. Chomsky's Hierarchy– Regular grammars, Unrestricted grammar, CSL, Relationship between classes of languages.

Suggested Books

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, *Introduction to Automata Theory, Languages, and Computation,* 3rd Edition, Pearson EducationAsia,2007.
2. John Martin, *Introduction toLanguagesandTheTheoryofComputation*,3rd Edition, Tata McGrawHill,2013.

Course Code	Course Title						Core/Elective
PC 505 AD	**Computer Vision**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To review image processing techniques for computer vision.
- To understand shape and region analysis.
- To understand Hough Transform and its applications to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques.
- To understand motion analysis.
- To study some applications of computer vision algorithms.

Course Outcomes

After completion of course, students would be able to:

- Implement fundamental image processing techniques required for computer vision.
- Perform shape analysis.
- Implement boundary tracking techniques.
- Apply chain codes and other region descriptors.
- Apply Hough Transform for line, circle, and ellipse detections.
- Apply 3D vision techniques.
- Implement motion related techniques.
- Develop applications using computer vision techniques.

UNIT – I

Image Processing Foundations: Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture

UNIT – II

Shapes and Regions: Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion –boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

UNIT – III

Hough Transform: Line detection – Hough Transform (HT) for line detection – foot-ofnormal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection– accurate center location – speed problem – ellipse detection – Case study: Human Iris location– hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

UNIT – IV

3D Vision and Motion: Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

UNIT – V

Applications: Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foregroundbackground separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

Suggested Readings:

1. Simon J. D. Prince, ―Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.
2. Mark Nixon and Alberto S. Aquado, ―Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
3. E. R. Davies, ―Computer & Machine Vision, Fourth Edition, Academic Press, 2012.

Professional Elective-I

Course Code	Course Title						Core/Elective
PE514AD	**Web Technologies**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Familiarize the tags of HTML.
- Understand different Client Side Scripting.
- Learn -specific web services of server side Programming.
- Connect different applications using PHP & XML.
- Connect XHTML, Java Scripting, Servlet Programming, Java Server Pages.

Course Outcomes

After completion of course, students would be able to:

- Construct a basic website using HTML and Cascading Style Sheets.
- Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
- Develop server side programs using Servlets and JSP.
- Construct simple web pages in PHP and represent data in XML format.
- Utilize AJAX and web services to develop interactive web applications.

UNIT-I

Web Essentials: Clients, Servers and Communication – The Internet – Basic Internet protocols – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements – Semantic elements – Drag and Drop – Audio – Video controls - CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations.

UNIT-II

Java Script: An introduction to JavaScript–JavaScript DOM Model-Date and Objects, -Regular Expressions- Exception Handling-Validation-Built-in Objects-Event Handling - DHTML with JavaScript-JSON introduction – Syntax – Function Files – Http Request – SQL.

UNIT-III

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST Actions-Session Handling-Understanding Cookies- Installing and Configuring Apache Tomcat Web Server- DATABASE CONNECTIVITY: JDBC perspectives, JDBC program example - JSP: Understanding Java Server Pages-JSP Standard Tag Library (JSTL)-Creating HTML forms by embedding JSP code.

UNIT-IV

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in Functions-Form Validation- Regular Expressions - File handling – Cookies - Connecting to Database. XML: Basic XML-Document Type Definition- XML Schema DOM and Presenting XML, XML Parsers and Validation, XSL and XSLT Transformation, News Feed (RSS and ATOM).

UNIT-V

AJAX: Ajax Client Server Architecture-XML Http Request Object-Call Back Methods; Web Services: Introduction- Java web services Basics – Creating, Publishing, Testing and Describing a Web services (WSDL)-Consuming a web service, Database Driven web service from an application –SOAP.

Suggested Readings:

1. Deitel and Deitel and Nieto, ―Internet and World Wide Web - How to Program‖, Prentice Hall, 5th Edition, 2011.
2. Web Technologies, Uttam K. Roy, Oxford Higher Education., 1st edition, 10th impression, 2015.
3. The Complete Reference PHP by Steven Holzner, MGH HILL Education, IndianEdition, 2008.

Course Code	Course Title						Core/ Elective
PC 551 AD	**AI & CV LAB**						CORE
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	p			
DC				2	30	7 0	1

Course Objectives

- To study the applications of AI and agent based approach to AI.
- To study first-order predicate calculus, logical reasoning and problem solving using Prolog language.
- To study and discuss various techniques and algorithms of AI used in general problem solving, optimization problems, constraint satisfaction problems, and game programming.
- To familiarize students with various sub-areas of AI, such as expert systems, natural language processing and machine learning.

Course Outcomes

After completing this course, the student will be able to:

- Explain artificial intelligence, its characteristics and its application areas.
- Formulate real-world problems as state space problems, optimization problems or constraint satisfaction problems.
- Select and apply appropriate algorithms and AI techniques to solve complex problems.
- Design and develop an expert system by using appropriate tools and techniques.

List of Experiments:

1. Write a program to implement Uninformed search techniques:
a. BFS
b. DFS

2. Write a program to implement Informed search techniques
a. Greedy Best first search
b. A* algorithm

3. Study of Prolog, its facts, and rules.
a. Write simple facts for the statements and querying it.
b. Write a program for Family-tree.

4. Write a program to train and validate the following classifiers for given data (scikit-learn):
a. Decision Tree
b. Multi-layer Feed Forward neural network

5. Text processing using NLTK
a. Remove stop words
b. Implement stemming
c. POS (Parts of Speech) tagging
In addition to the above programs, students should be encouraged to study implementations of one of the following
• Game bot (Tic Tac toe, 7 puzzle)
• Expert system (Simple Medical Diagnosis)
• Text classification
• Chat bot

Course Code	Course Title						Core/ Elective
PC 552 AD	**Database Management Systems LAB**						CORE
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	p			
DC				2	30	7 0	1

Course Objectives

- To implement the basic knowledge of SQL queries and relational algebra.
- To construct database models for different database applications.
- To apply normalization techniques for refining of databases.
- To practice various triggers, procedures, and cursors using/SQL.
- To design and implementation of a database for an organization

Course Outcomes

After completing this course, the student will be able to:

- Design database for any real world problem
- Implement PL/SQL programs
- Define SQL queries
- Decide the constraints
- Investigate for data inconsistency

CREATION OF TABLES:

1. Create a table called Employee with the following structure.

Name	Type
Empno	Number
Ename	Varchar2(20)
Job	Varchar2(20)
Mgr	Number
Sal	Number

a. Add a column commission with domain to the Employee table.
b. Insert any five records into the table.
c. Update the column details of job
d. Rename the column of Employ table using alter command.
e. Delete the employee whose empno is19.

2. Create department table with the following structure.

Name	Type
Deptno	Number
Deptname	Varchar2(20)
location	Varchar2(20)

a. Add column designation to the department table.
b. Insert values into thetable.
c. List the records of emp table grouped bydeptno.
d. Update the record where deptno is9.
e. Delete any column data from thetable

2. Create a table called Customertable

Name	Type
Cust name	Varchar2(20)
Cust street	Varchar2(20)

Cust city	Varchar2(20)

a. Insert records into the table.

b. Add salary column to the table.

c. Alter the table columndomain.

d. Drop salary column of the customertable.

e. Delete the rows of customer table whose ust_city is ‘hyd’.

f. Create a table called branchtable.

Name	Type
Branch name	Varchar2(20)
Branch city	Varchar2(20)
asserts	Number

4. Increase the size of data type for asserts to the branch.

a. Add and drop a column to the branch table.

b. Insert values to the table.

c. Update the branch name column

d. Delete any two columns from the table

5. Create a table called sailor table

Name	Type
Sid	Number
Sname	Varchar2(20)
rating	Varchar2(20)

a. Add column age to the sailor table.

b. Insert values into the sailor table.

c. Delete the row with rating>8.

d. Update the column details of sailor.

e. Insert null values into the table.

6. Create a table called reserves table

Name	Type
Boat	id Integer
Sid	Integer
day	Integer

a. Insert values into the reservestable.

b. Add column time to the reservestable.

c. Alter the column day data type todate.

d. Drop the column time in thetable.

e. Delete the row of the table with somecondition.

QUERIES USING DDL AND DML:

1. a. Create a user and grant all permissions to the user.

b. Insert the any three records in the employee table and use rollback. Check the result.

c. Add primary key constraint and not null constraint to the employee table.

d. Insert null values to the employee table and verify the result.

2. a. Create a user and grant all permissions to the user.

b. Insert values in the department table and use commit.

c. Add constraints like unique and not null to the department table.

d. Insert repeated values and null values into the table.

3. a. Create a user and grant all permissions to the user.

b. Insert values into the table and use commit.

c. Delete any three records in the department table and use rollback.

d. Add constraint primary key and foreign key to the table.

4. a. Create a user and grant all permissions to the user.

b. Insert records in the sailor table and use commit.

c. Add save point after insertion of records and verify save point.

d. Add constraints not null and primary key to the sailor table.

5. a. Create a user and grant all permissions to the user.

b. Use revoke command to remove user permissions.

c. Change password of the user created.

d. Add constraint foreign key and not null.
6. a. Create a user and grant all permissions to the user.
b. Update the table reserves and use save point and roll back.
c. Add constraint primary key, foreign key and not null to the reserves table
delete constraint not null to the table column

QUERIES USING AGGREGATE FUNCTIONS:

1. a. By using the group by clause, display the enames who belongs to deptno 10 along with average salary.
b. Display lowest paid employee details under each department.
c. Display number of employees working in each department and their department number.
d. Using built in functions, display number of employees working in each department and their department name from dept table. Insert deptname to dept table and insert deptname for each row, do the required thing specified above.
e. List all employees which start with either B or C.
f. Display only these ename of employees where the maximum salary is greater than or equalto 5000.
2. a. Calculate the average salary for each different job.
b. Show the average salary of each job excluding manager.
c. Show the average salary for all departments employing more than three people.
d. Display employees who earn more than thelowest salary in department 30
e. Show that value returned by sign (n)function.
f. How many days between day of birth to current date
3. a. Show that two sub string as single string.
b. List all employee names, salary and 15% rise in salary.
c. Display lowest paid emp details under each manager
d. Display the average monthly salary bill for each deptno.
e. Show the average salary for all departments employing more than two people.
f. By using the group by clause, display the eid who belongs to deptno 05 along with average salary.
4. a. Count the number of employees in department20
b. Find the minimum salary earned byclerk.
c. Find minimum, maximum, average salary of all employees.
d. List the minimum and maximum salaries for each jobtype.
e. List the employee names in descending order.
f. List the employee id, names in ascending order byempid.
5. a. Find the sids ,names of sailors who have reserved all boats called “INTERLAKE Find the age of youngest sailor who is eligible to vote for each rating level with at least two such sailors.
b. Find the sname , bid and reservation date for each reservation.
c. Find the ages of sailors whose name begin and end with B and has at least 3characters.
d. List in alphabetic order all sailors who have reserved redboat.
e. Find the age of youngest sailor for each rating level.
6. a. List the Vendors who have delivered products within 6 months from order date.
b. Display the Vendor details who have supplied both Assembled and Subparts.
c. Display the Sub parts by grouping the Vendor type (Local or NonLocal).
d. Display the Vendor details in ascending order.
e. Display the Sub part which costs more than any of the Assembled parts.
f. Display the second maximum cost Assembled part

PROGRAMS ON PL/SQL

1. a. Write a PL/SQL program to swap two numbers. b. Write a PL/SQL program to find the largest of three numbers. 2. a. Write a PL/SQL program to find the total and average of 6 subjects and display the grade. b. Write a PL/SQL program to find the sum of digits in a given number.
3. a. Write a PL/SQL program to display the number in reverse order.
b. Write a PL/SQL program to check whether the given number is prime or not.
4. a. Write a PL/SQL program to find the factorial of a given number. b. Write a PL/SQL code block to calculate the area of a circle for a value of radius varying from 3 to 7. Store the radius and the corresponding values of calculated area in an empty table named areas, consisting of two columns radius and area.
5. a. Write a PL/SQL program to accept a string and remove the vowels from the string. (When ‘hello’ passed to the program it should display ‘Hll’ removing e and o from the world Hello).
b. Write a PL/SQL program to accept a number and a divisor. Make sure the divisor is less than or equal to 10. Else display an error message. Otherwise Display the remainder in words.

PROCEDURES AND FUNCTIONS

1.Write a function to accept employee number as parameter and return Basic +HRA together as single column.
2. Accept year as parameter and write a Function to return the total net salary spent for a given year.
3. Create a function to find the factorial of a given number and hence find NCR.
4. Write a PL/SQL block o pint prime Fibonacci series using local functions.
5. Create a procedure to find the lucky number of a given birthdate. 6. Create function to the reverse of given number

PROCEDURES
1. Create the procedure for palindrome of given number.
2. Create the procedure for GCD: Program should load two registers with two Numbers and then apply the logic for GCD of two numbers. GCD of two numbers is performed by dividing the greater number by the smaller number till the remainder is zero. If it is zero, the divisor is the GCD if not the remainder and the divisors of the previous division are the new set of two numbers. The process is repeated by dividing greater of the two numbers by the smaller number till the remainder is zero and GCD is found.
3. Write the PL/SQL programs to create the procedure for factorial of given number.
4. Write the PL/SQL programs to create the procedure to find sum of N natural number.
5. Write the PL/SQL programs to create the procedure to find Fibonacci series.
6. Write the PL/SQL programs to create the procedure to check the given number is perfect or not

CURSORS
1.Write a PL/SQL block that will display the name, dept no, salary of fist highest paid employees.
2. Update the balance stock in the item master table each time a transaction takes place in the item transaction table. The change in item master table depends on the item id is already present in the item master then update operation is performed to decrease the balance stock by the quantity specified in the item transaction in case the item id is not present in the item master table then the record is inserted in the item master table.
3. Write a PL/SQL block that will display the employee details along with salary using cursors.
4. To write a Cursor to display the list of employees who are working as a ManagersorAnalyst.
5. To write a Cursor to find employee with given job and deptno.
6. Write a PL/SQL block using implicit cursor that will display message, the salaries of all the employees in the ‘employee’ table are updated. If none of the employee’s salary are updated, we get message 'None of the salaries were updated'. Else we get a message like for example, 'Salaries for 1000 employees are updated' if there are 1000 rows in ‘employee’ table

Suggested Readings:

1. RamezElmasri, Shamkant, B. Navathe, “Database Systems”, Pearson Education, 6th Edition, 2013.
2. Peter Rob, Carles Coronel, “Database System Concepts”, Cengage Learning, 7th Edition, 2008

SCHEME OF INSTRUCTION & EXAMINATION
B.E. VI - SEMESTER
(Artificial Intelligence and Data Science)

S.No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	D/P	Contact Hrs/Wk	CIE	SEE	Duration In Hrs/Wk	
Theory Courses										
1.	PC601AD	Machine Learning and Techniques	3	0	-	3	30	70	3	3
2.	PC602AD	Big Data Analytics	3	0	-	3	30	70	3	3
3.	PE-II	Professional Elective-II	3	0	-	3	30	70	3	3
4.	PE–III	Professional Elective-III	3	-	-	3	30	70	3	3
5	OE-I	Open Elective-I	3	-	-	3	30	70	3	3
6	HS	Effective Technical Communication	3			3	30	70	3	3
Practical/Laboratory Courses										
7	PC654AD	BDA Lab	-	-	2	2	25	50	2	1
8	PC655AD	ML Lab	-	-	2	2	25	50	2	1
9	SI671AD	Summer Internship*	-	-	-	-	25	25	-	2
Total			15	0	6	21	280	620		22

Profession Elective–II	
Course Code	Course Title
PE631AD	Mining of Massive Datasets
PE632AD	Responsible AI
PE633AD	Soft Computing
PE634AD	Scripting Languages
PE635AD	Blockchain Technologies
PE636AD	Design Thinking

Profession Elective–III	
Course Code	Course Title
PE641AD	Information Retrieval Systems
PE642AD	Human Computer Interaction
PE643AD	Quantum Computing
PE644AD	Web Services
PE645AD	Cyber Security
PE646AD	open source tools

Open Elective-I		
Sl.No	Code	Name of Subject
1	OE601 EE	Electrical Energy Conservation and Safety (Not for EEE & EIE Students)
2	OE601 EG	Soft Skills & Interpersonal Skills
3	OE602 MB	Human Resource Development and Organizational Behaviour
4	OE601 LW	Cyber Law and Ethics
5	OE601 CE	Disaster Mitigation (Not for Civil Engg. Students)
6	Code from OU	Introduction to Data Science(Not for AI & DS ,CSE students)
7	Code from OU	Introduction to AI(Not for AI & DS,CSE,IT students)

Course Code	Course Title	Core/Elective
PC 601AD	**Machine Learning and Techniques**	**Core**

Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To learn the concept of how to learn patterns and concepts from data correlation.
- To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
- Explore supervised and unsupervised learning paradigms of machine learning.
- To explore Deep learning technique and various feature extraction strategies.

Course Outcomes

After completing this course, the student will be able to:

1. Extract features that can be used for a particular machine learning approach in various applications.
2. To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
3. To mathematically analyse various machine learning approaches and paradigms

UNIT-I

Supervised Learning (Regression/Classification) - Basic methods: Distance-based methods, Nearest- Neighbours, Decision Trees, Naive Bayes, Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

UNIT-II

Unsupervised Learning - Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)

UNIT-III

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

UNIT-IV

Sparse Modelling and Estimation, Modelling Sequence/Time-Series Data, Deep Learning and FeatureRepresentation Learning

UNIT-V

Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference. Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.

Suggested Readings:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning,

Springer2009 (freely available online)

3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
4. Uma N. Dulhare , Khaleel Ahmad , Khairol Amali Bin Ahmad , Machine Learning and Big Data: Concepts, Algorithms, Tools and Applications, Scrivener Publishing,Wiley,2020

Course Code	Course Title						Core/Elective
PC 602AD	**Big Data Analytics**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Java, SQL and Linux	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Understand the Big Data Platform and its Use cases
- Provide an overview of Apache Hadoop
- Provide HDFS Concepts and Interfacing with HDFS
- Understand Map Reduce Jobs
- Provide hands on Hodoop Eco System
- Apply analytics on Structured, Unstructured Data.
- Exposure to Data Analytics with R.

Course Outcomes

After completing this course, the student will be able to:

- Identify Big Data and its Business Implications.
- List the components of Hadoop and Hadoop Eco-System
- Manage Job Execution in Hadoop Environment
- Develop Big Data Solutions using Hadoop Eco System
- Analyze Infosphere Big Insights Big Data Recommendations.
- Apply Machine Learning Techniques using R.

UNIT I :

INTRODUCTION TO BIG DATA AND HADOOP

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analyzing Data with Unix tools, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Info sphere Big Insights and Big Sheets.

UNIT II :

HDFS(Hadoop Distributed File System)

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

UNIT III:

Map Reduce

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Unit IV :
Hadoop Eco System

Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.
Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.
Hbase :HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.
Big SQL : Introduction.

UNIT V:
Data Analytics with R

Machine Learning : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with Big R.

Suggested Readings:

1.Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2. Seema Acharya, SubhasiniChellappan, "Big Data Analytics" Wiley 2015.
3. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
4. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
5. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.
6. AnandRajaraman and Jefrey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.
7. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.
8. Glen J. Myat, "Making Sense of Data", John Wiley & Sons, 2007.
9. Pete Warden, "Big Data Glossary", O'Reily, 2011.
10. Michael Mineli, Michele Chambers, AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.
11. ArvindSathi, "BigDataAnalytics: Disruptive Technologies for Changing the Game", MC Press, 2012
12. Paul Zikopoulos ,Dirk DeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan , "Harness the Power of Big Data The IBM Big Data Platform ", Tata McGraw Hill Publications, 2012

PROFESSIONAL ELECTIVE-II

Course Code	Course Title						Core/Elective
PE633AD	**Soft Computing**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To understand the fundamental concepts used in Soft computing.
- To learn about fuzzy logic, Artificial Neural Networks (ANNs) and optimization techniques using Genetic Algorithm (GA).

Course Outcomes

After completing this course, the student will be able to

- Explain the Fuzzy logic and its applications.
- Apply Artificial neural networks and for soft computing.
- Solve single-objective optimization problems using GAs.
- Solving multi-objective optimization problems using Evolutionary algorithms (MOEAs).

UNIT I :

Introduction to Soft Computing

Concept of computing systems,"Soft" compiting versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques

UNIT II :

Fuzzy logic

Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques, Fuzzy logic controller design, Some applications of Fuzzy logic.

UNIT III:

Genetic Algorithms

Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques,Basic GA framework and different GA architectures.GA operators: Encoding, Crossover, Selection, Mutation, etc.Solving single-objective optimization problems using GAs.

UNIT IV :

Multi-objective Optimization Problem Solving

Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA). Non-Pareto approaches to solve MOOPs.Pareto-based approaches to solve MOOPs.Some applications with MOEAs.

UNIT V :

Artificial Neural Networks

Biological neurons and its working, Simulation of biolgical neurons to problem soloving, Different ANNs architectures, Training techniques for ANNs, Applications of ANNs to solve some real life problems

Suggested Readings:

1. Fuzzy Logic: A Pratical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional, 2000.
2. Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010.
3. Foundations of Neural Networks, Fuzzy Systems, and Knowldge Engineering, Nikola K. Kasabov, MIT Press, 1998.
4. Fuzzy Logic for Embedded Systems Applications, Ahmed M. Ibrahim, Elesvier Press, 2004.
5. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.
6. Genetic Algorithms In Search, Optimization And Machine Learning, David E. Goldberg, Pearson Education, 2002.
7. Practical Genetic Algorithms, Randy L. Haupt and sue Ellen Haupt, John Willey & Sons, 2002.
8. Neural Networks, Fuzzy Logis and Genetic Algorithms : Synthesis, and Applications, S. Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India, 2007.
9. Soft Computing, D. K. Pratihar, Narosa, 2008.
10. Neuro-Fuzzy and soft Computing, J.-S. R. Jang, C.-T. Sun, and E. Mizutani, PHI Learning, 2009.
11. Neural Networks and Learning Machines, (3rd Edn.), Simon Haykin, PHI Learning, 2011.

ourse Code	Course Title						Core/Elective
PE634AD	**Scripting Languages**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- This course introduces the script programming paradigm.
- Introduces scripting languages such as Perl, Ruby and TCL
- Learning TCL.

Course Outcomes

After completing this course, the student will be able to

- Comprehend the differences between typical scripting languages and typical system and application programming languages.
- Gain knowledge of the strengths and weakness of Perl, TCL and Ruby; and select an appropriate language for solving a given problem.
- Acquire programming skills in scripting language.

UNIT- I

Introduction: Ruby, Rails, the structure and Execution of Ruby Programs, Package Management with RUBYGEMS, Ruby and web: Writing CGI scripts, cookies, Choice of Webservers, SOAP and web services RubyTk – Simple Tk Application, widgets, Binding events, Canvas, scrolling.

UNIT-II

Extending Ruby: Ruby Objects in C, the Jukebox extension, Memory allocation, Ruby Type System, Embedding Ruby to Other Languages, Embedding a Ruby Interpreter

UNIT-III

Introduction to PERL and Scripting Scripts and Programs, Origin of Scripting, Scripting Today, Characteristics of Scripting Languages, Uses for Scripting Languages, Web Scripting, and the universe of Scripting Languages. PERL- Names and Values, Variables, Scalar Expressions, Control Structures, arrays, list, hashes, strings, pattern and regular expressions, subroutines.

UNIT-IV

Advanced Perl

Finer points of looping, pack and unpack, filesystem, eval, data structures, packages, modules, objects, interfacing to the operating system, Creating Internet ware applications, Dirty Hands Internet Programming, security Issues.

UNIT-V

TCL: TCL Structure, syntax, Variables and Data in TCL, Control Flow, Data Structures, input/output, procedures, strings, patterns, files, Advance TCL- eval, source, exec and uplevel commands, Name spaces, trapping errors, event driven programs, making applications internet aware, Nuts and Bolts Internet Programming, Security Issues, C Interface.

TK: TK-Visual Tool Kits, Fundamental Concepts of TK, TK by example, Events and Binding, Perl-TK.

Suggested Readings:

1. The World of Scripting Languages, David Barron, Wiley Publications.
2. Ruby Programming language by David Flanagan and Yukihiro Matsumoto O'Reilly

3. “Programming Ruby” The Pramatic Progammers guide by Dabve Thomas Second edition
4. Open Source Web Development with LAMP using Linux Apache, MySQL, Perl and PHP, J.Lee and B.Ware (Addison Wesley) Pearson Education.
5. Perl by Example, E. Quigley, Pearson Education.
6. Programming Perl, Larry Wall, T. Christiansen and J. Orwant, O’Reilly, SPD.
7. Tcl and the Tk Tool kit, Ousterhout, Pearson Education.
8. Perl Power, J.P. Flynt, Cengage Learning.

Course Code	Course Title	Core/Elective
PE635AD	**Block chain Technologies**	Elective

Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- Understand how block chain systems (mainly Bitcoin and Ethereum) work.
- To securely interact with them.
- Design, build, and deploy smart contracts and distributed applications.
- Integrate ideas from block chain technology into their own projects.

Course Outcomes

After completing this course, the student will be able to

- Explain design principles of Bitcoin and Ethereum.
- Explain Nakamoto consensus.
- Explain the Simplified Payment Verification protocol.
- List and describe differences between proof-of-work and proof-of-stake consensus.
- Interact with a block chain system by sending and reading transactions.
- Design, build, and deploy a distributed application.
- Evaluate security, privacy, and efficiency of a given block chain system.

UNIT – I

Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete.
Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

UNIT – II

Blockchain: Introduction, Advantage over conventional distributed database, Block chain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Block chain application, Soft & Hard Fork, Private and Public block chain.

UNIT – III

Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

UNIT – IV

Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum -
Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Side chain, Name coin

UNIT – V

Cryptocurrency Regulation: Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy.
Applications: Internet of Things, Medical Record Management System, Domain Name

Service, and future of Block chain.

Case study: Naive Blockchain construction, Memory Hard algorithm - Hash cash implementation, Direct Acyclic Graph, Play with Go-Ethereum, Smart Contract Construction, Toy application using Block chain, Mining puzzles

Suggested Readings:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016.
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System.
3. DR.GavinWood,"ETHEREUM:ASecureDecentralizedTransactionLedger,"Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and TizianaCimoli, A survey of attacks on Ethereum smart contracts.

Course Code	Course Title						Core/Elective
PE636AD	**Design Thinking**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To familiarize students with design thinking concepts and principles
- To ensure students can practices the methods, processes and tools of design thinking.
- To ensure students can apply the design thinking approach and have ability to model real world situations.
- To enable students to analyze primary and secondary research in the introduction to design thinking

Course Outcomes

After completing this course, the student will be able to

- Apply Design Thinking methodology to solve problems.
- Develop problem identification skills so as to respond to user needs with appropriate and creative solutions.
- Use tools for generation of ideas

UNIT-I:

DESIGN THINKING FOR INNOVATION:
Introduction to Design Thinking, Understanding the principles of Design thinking,Business Model Innovation, Challenges Best-Suited for Design Thinking, Product Life Cycle

UNIT-II:

PROCESS OF DESIGN: Introduction - Design Process - Four Step - Five Step - Twelve Step - Creativity and Innovation in Design Process - Design limitation, Creative Thinking, Lean Canvas Model and other Business Models

UNIT-III:

PHASES IN DESIGN THINKING : Understand, Observe, Define, Ideate, Prototype, Test, Reflect. Problem Statement, Empathy, The 5 Whys, stakeholder map, Empathy map, personas, peer observation, Trend analysis

UNIT-IV:

SOLUTION/IDEA GENERATION : Story Telling, Context mapping, Critical items diagram, Brainstroming, Matrix and Voting methods, Analogies, benchmarking, Utility maps

UNIT-V:

TOOLS AND TECHNIQUES FOR PROTOTYPE AND TEST:

Types of Prototype, Exploration Map, Blueprint, MVP, Testing Sheets, Solution Feedback Capturing Tools, Structured Usability Testing, A/B Testing, Design Thinking Applications Case Studies.

Suggested Readings :

1. An AVA Book, “Design Thinking”, AVA Publishing, 2010.
2. David Ralzman, “History of Modern Design”, 2nd edition, Laurence King Publishing Ltd., 2010
3. The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods – Micheal Lewrick, Patrick Link, Larry Leifer , Wiley Publishing
4. Design Thinking for Dummies - Wiley
5. Tom Kelley, Jonathan Littman, “Ten Faces in Innovation”, Currency Books, 2006
6. G. Pahl, W.Beitz, J. Feldhusen, KH Grote, “Engineering Design: A Systematic Approach”, 3rd edition, Springer, 2007.
7. The field guide to human centered design by Design Kit.

Professional Elective -III

Course Code	Course Title						Core/Elective
PE641AD	**Information Retrieval Systems**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To provide the knowledge on information retrieval system capabilities.
- To introduce different computational search problems and evaluate search engines.
- To introduce different applications of informational retrieval techniques in the internet or web environment.
- To discuss about information visualization and system evaluation.

Course Outcomes

After completing this course, the student will be able to

- Understand various functionalities and capabilities of Information Retrieval System.
- Gain knowledge on cataloging and data structure methodology for IRS.
- Differentiate various clustering algorithms and indexing.
- Differentiate various user search techniques and system search techniques.
- Understand the concepts of information visualization and text search.

UNIT-I

Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management Systems, Digital Libraries and Data Warehouses.
Boolean Retrieval: An example information, Building an inverted index, processing Boolean queries, the extended Boolean model versus ranked retrieval.
The term vocabulary and postings lists: Document delineation and character sequence decoding, determining the vocabulary of terms, Faster postings list intersection via skip pointers, Positional postings, and Phrase queries.
Dictionaries and tolerant retrieval: Search structures for dictionaries, Wildcard queries, spelling correction.

UNIT-II

Index construction: Hardware basics, blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing, Other types of indexes.
Index compression: Statistical properties of terms in information retrieval, Dictionary compression, Postings file compression.
Cataloging and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction.
Scoring, term weighting and the vector space model: Parametric and zone indexes, Term frequency and weighting, the vector space model for scoring, and Variant tf-idf functions.

UNIT-III

Evaluation in information retrieval: Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance.

Relevance feedback and query expansion: Relevance feedback and pseudo relevance feedback, Global methods for query reformulation.

UNIT-IV

Text classification and Naive Bayes: The text classification problem, Naive Bayes text classification, The Bernoulli model, Properties of Naive Bayes, and Feature selection.

Vector space classification: Document representations and measures of relatedness in vector spaces, Rocchio classification, k- nearest neighbour, Linear versus nonlinear classifiers.

Hierarchical clustering: Hierarchical agglomerative clustering, Centroid clustering, Divisive clustering.

UNIT-V

Matrix decompositions and Latent semantic indexing: Linear algebra review, Term-document matrices and singular value decompositions, Low-rank approximations, Latent semantic indexing. **Web search basics:** Background and history, Web characteristics, Advertising as the economic model,

Suggested Readings:

1.Christopher D. Manning, Prabhakar Raghavan, HinrichSchütze, *An Introduction to Information Retrieval,* Cambridge University Press, Cambridge, England,2008

2. David A. Grossman, Ophir Frieder, *Information Retrieval–Algorithms and Heuristics,* Springer, 2nd Edition (Distributed by Universities Press), 2004.

3. Gerald J Kowalski, Mark T Maybury. *Information Storage and Retrieval Systems,* Springer,2000

Course Code	Course Title						Core/Elective
PE644AD	**Web Services**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
XML, HTTP, TCP/IP concepts	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives:

- To Understand Web Services and implementation model for SOA
- To Understand the SOA, its Principles and Benefits
- To Understand XML concepts
- To Understand paradigms needed for testing Web Services
- To explore different Test Strategies for SOA-based applications

Course Outcomes

After completing this course, the student will be able to

- Understand the principles of SOA
- Efficiently use market leading environment tools to create and consume web services
- Identify and select the appropriate framework components in creation of web service Solution
- Apply OOP principles to creation of web service solutions.

UNIT- I

Evolution and Emergence of Web Services – Evolution of distributed computing. Coredistributed computing technologies – client/server, CORBA, JAVA RMI, Micro Soft DCOM,MOM, Challenges in Distributed Computing, Introduction to Web Services – The definition ofweb services, basic operational model of web services, tools and technologies enabling webservices, benefits and challenges of using web services.

UNIT-II

Web Service Architecture – Web services Architecture and its characteristics, corebuilding blocks of web services, standards and technologies available forimplementing web services, web services communication, basic steps ofimplementing web services.

UNIT-III

Brief Over View of XML – XML Document structure, XML namespaces, Definingstructure in XML documents, Reuse of XML schemes, Document navigation andtransformation. SOAP : Simple Object Access Protocol, Inter-application communicationand wire protocols, SOAP as a messaging protocol, Structure of a SOAP message, SOAPenvelope, Encoding, Service Oriented Architectures, SOA revisited, Service roles in a SOA,Reliable messaging,

UNIT-IV

Describing Web Services – WSDL introduction, non functional service description,WSDL1.1 Vs WSDL 2.0, WSDL document, WSDL elements, WSDL binding, WSDLtools, WSDL port type, limitations of WSDL.

UNIT-V

Registering and Discovering Services : The role of service registries, Service discovery,Universal Description, Discovery, and Integration, UDDI Architecture, UDDI Data Model,Interfaces, UDDI Implementation.

Suggested Readings:

1. Web Services & SOA Principles and Technology, Second Edition, Michael P.Papazoglou.
2. Developing Java Web Services, R. Nagappan, R. Skoczylas, R.P. Sriganesh,Wiley India.
3. Developing Enterprise Web Services, S. Chatterjee, J. Webber, Pearson Education.
4.XML, Web Services, and the Data Revolution, F.P.Coyle, Pearson Education.
5. Building web Services with Java, 2nd Edition, S. Graham and others, Pearson Education.
6. Java Web Services, D.A. Chappell & T. Jewell, O‟Reilly, SPD.

Course Code	Course Title						Core/Elective
PE646AD	**Open Source Tools**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	**-**	**-**	**-**	**30**	**70**	**3**

Course objectives:

- To Understand the difference between open source software and commercial software.
- To Understand and develop the web applications using open source web technologies like Apache, MySql and PHP (LAMP/XAMP).

Course Outcomes:

After completion of the course, student should be able to:

- Understand the difference between open source software and commercial software
- Identify, install and run Linux operating system.
- Install and manage applications.
- Identify, install open source web technologies Apache, MySql, PHP.
- Develop web applications using LAMP.
- Write session control PHP code for a website

UNIT I

OPEN SOURCE: Introduction to Open Source – Open Source vs. Commercial Software – What is Linux? - Free Software – Where I can use Linux? Linux Kernel – Linux Distributions

UNIT II

LINUX: Introduction to Linux Essential Commands - Filesystem Concept - Standard Files 1. The Linux Security Model - Vi Editor - Partitions creation – Shell Introduction 2. String Processing - Investigating and Managing Processes - Network Clients - Installing Application

UNITIII

APACHE: Apache Explained - Starting, Stopping, and Restarting Apache - Modifying the Default Configuration - Securing Apache - Set User and Group - Consider Allowing Access to Local Documentation - Don't Allow public html Web sites - Apache control with .htaccess

UNITIV

MYSQL: Introduction to MYSQL - The Show Databases and Table - The USE command - Create Database and Tables - Describe Table - Select, Insert, Update, and Delete statement - Some Administrative detail - Table Joins - Loading and Dumping a Database.

UNITV

PHP: Introduction- General Syntactic Characteristics - PHP Scripting - Commenting your code -

Primitives, Operations and Expressions - PHP Variables - Operations and Expressions Control Statement - Array - Functions - Basic Form Processing - File and Folder Access - Cookies - Sessions - Database Access with PHP - MySQL - MySQL Functions - Inserting Records - Selecting Records - Deleting Records - Update Records.

TEXT BOOK:

1. James Lee and Brent Ware ,"Open Source Web Development with LAMP using Linux, Apache, MySQL, Perl and PHP", , Dorling Kindersley(India) Pvt. Ltd, 2008.

SUGGESTED READINGS:

1. Eric Rosebrock, Eric Filson ,"Setting Up LAMP: Getting Linux, Apache, MySQL, and PHP and working Together", Published by John Wiley and Sons, 2004.

Course Code	Course Title						Core/ Elective
PC 655 AD	**Machine Learning LAB**						CORE
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	p			
DC				2	30	7 0	1

Course Objectives

- Demonstration of different classifiers on different data.
- Demonstrate ensembling of classifiers for solving real world problems.
- Make use of real world data to implement machine learning models.

Course Outcomes

After completing this course, the student will be able to:

- Students must be able to.
- Apply machine learning algorithms: dataset preparation, model selection, model building etc.
- Evaluate various Machine Learning approaches.
- Use scikit-learn, Keras and Tensorflow to apply ML techniques.
- Design and develop solutions to real world problems using ML techniques.
- Apply unsupervised learning and interpret the results.

LIST OF EXPERIMENTS:

1. **Basic Data Preprocessing**
   a. Installation of python environment/Anaconda IDE for machine learning: installing python modules/Packages like scikit-learn, Keras and Tensorflow etc.
   b. Programs involving pandas, Numpy and Scipy libraries.

2.Programs for classification

1. Build models using linear regression and logistic regression and apply it to classify a new instance
2. Write a program to demonstrate the following classifiers. Use an appropriate data set for building the model. Apply the model to classify a new instance.
   a) Decision tree
   b) K nearest neighbour
   c) Naïve bayes
   d) Support vector machine

3.Demonstration of Clustering algorithms using

1. k-means

2.Hierarchical algorithms(agglomerative etc).
Interpret the clusters obtained.

4.Demonstrate ensemble techniques like boosting, bagging, random forests etc.

5.Build a classifier, compare its performance with an ensemble technique like random forest.

6.Evaluate various classification algorithms performance on a dataset using various measures like True Positive rate, False positive rate, precision, recall etc.

7.Demonstrate GA for optimization (minimization or maximization problem).

8.Case study on supervised/unsupervised learning algorithm:

a) Handwritten digits' classification using CNN.

b) Text classification using python libraries.