PONDICHERRY UNIVERSITY
(A CENTRAL UNIVERSITY)
SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE

M.Sc. Computer Science (Data Analytics)

REGULATIONS, CURRICULUM & SYLLABUS

In compliance to the UGC - Curriculum and Credit Framework for PG Programmes, June 2024

(Under the National Education Policy 2020)

Effective from the Academic Year 2025 - 2026

July 2025

PG Board of Studies in M.Sc. Computer Science (Data Analytics)

S.No	Name	Affiliation	BoS
1	Dr. S.K.V. Jayakumar	Dept. of CS, Pondicherry University	Chairman
2	Dr. Venkatakrishna	Dept. of CS, Sri Padmavathi Mahila University, Tirupathi	External Members
3	Dr P. Salini	Dept. of CSE, Puducherry Technological University	
4	Dr R. Dhanalakshmi	Dept. of CS, Indian Institute of Information Technology (Tiruchirappalli)	
5	Mr. Jawahar Govindraj	Global Practice Head, AI & Automation, Tech Mahindra, Bangalore.	
6	Mr. Narayanan Kesavan	Project Manager, Radian Generation India Pvt Ltd, Chennai.	
7	Dr. R. Subramanian	Dept. of CS, Pondicherry University	Internal Members
8	Dr. T. Chithralekha	Dept. of CS, Pondicherry University	
9	Dr. S. Sivasathya	Dept. of CS, Pondicherry University	
10	Dr. K. Suresh Joseph	Dept. of CS, Pondicherry University	
11	Dr. S. Ravi	Dept. of CS, Pondicherry University	
12	Dr. M. Nandhini	Dept. of CS, Pondicherry University	
13	Dr. Pothula Sujatha	Dept. of CS, Pondicherry University	
14	Dr. P. Shanthibala	Dept. of CS, Pondicherry University	
15	Dr. K.S. Kuppusamy	Dept. of CS, Pondicherry University	
16	Dr. T. Vengattaraman	Dept. of CS, Pondicherry University	
17	Dr. S.L. Jayalakshmi	Dept. of CS, Pondicherry University	
18	Dr. G. Krishnapriya	Dept. of CS, Pondicherry University	
19	Dr. R. Nakeeran	Dept. of Electrical Engineering, Pondicherry University	
20	Dr. G. Kumaravelan	Dept. of CS, Pondicherry University (Karaikal)	

Centre for Data science and Artificial Intelligence

S.No.	Name	Designation	Affiliation
1	Dr. SKV. Jayakumar	Professor and Head	Co-ordinator
2	Dr. P. Sujatha	Professor	Members
3	Dr. T. Vengattaraman	Associate Professor	
4	Dr. K.S. Kuppusamy	Associate Professor	
5	Dr. V. Uma	Associate Professor	
6	Dr. Sukhvinder Singh	Assistant Professor	

Syllabus Revision Committee

S.No.	Name	Designation	Affiliation
1	Dr. S. K.V. Jayakumar	Professor and Head	Dept. of Computer Science, Pondicherry University
2	Dr. T. Vengattaraman	Associate Professor	
3	Dr. K.S. Kuppusamy	Associate Professor	
4	Dr. Sukhvinder Singh	Assistant Professor	

Table of Contents

1. PREAMBLE & PROGRAMME OUTCOMES

1.1. Preamble

In today's data-driven world, Data Analytics plays a pivotal role in extracting meaningful insights from vast and complex datasets, thereby enabling informed decision-making across business, science, governance and society. From enhancing customer experiences to optimizing operations and predicting future trends, data analytics empowers organizations to gain competitive advantages and address multifaceted challenges.

The M.Sc. Computer Science programme with specialization in Data Analytics is crafted to develop competent IT professionals with a strong grounding in statistical analysis, data mining, machine learning and data visualization. It bridges theory and practice by integrating computational techniques, domain knowledge and real-world applications. This postgraduate program encourages analytical thinking, problem-solving and ethical data handling.

With a curriculum aligned to current industry needs and academic research advancements, supported by hands-on labs, case studies, and capstone projects, the program prepares graduates to excel as data analysts, scientists and innovators capable of turning data into actionable intelligence.

1.2 Vision and Mission

Vision: To be a leading academic programme in Data Analytics that empowers students to derive insights from data through excellence in education, research and innovation.

Mission:

- To provide strong conceptual and analytical foundations in statistics, data science and data-intensive computing.
- To encourage data-driven problem-solving skills through hands-on learning and interdisciplinary approaches.
- To inculcate ethical practices, continuous learning and collaboration with industry and research communities.

1.3 Programme Educational Objectives (PEOs)

PEO1: Graduates will apply core principles of data analytics to pursue successful careers in industry, research or higher education.

PEO2: Graduates will develop data-driven solutions that support evidence-based decision-making in diverse domains.

PEO3: Graduates will exhibit professionalism, leadership skills, effective communication and ethical responsibility while working in collaborative and interdisciplinary environments.

PEO4: Graduates will engage in lifelong learning to adapt to emerging trends, tools and technologies in data analytics.

1.4 Programme Outcomes (POs)

PO1: Disciplinary Knowledge: Demonstrate comprehensive understanding of core concepts in computing science.

PO2: Tools and Technology Proficiency: Use contemporary computational tools and technology competently.

PO3: Analytical Thinking and Problem Solving: Develop analytical thinking and problem-solving skills to draw insights and solve real-world problems.

PO4: Solution Design and Development: Design and develop innovative computational solutions tailored to domain-specific needs.

PO5: Project Management and Professional Skills: Demonstrate ability to manage projects, timelines and resources with a professional and goal-oriented approach.

PO6: Interdisciplinary Collaboration: Work effectively in groups by integrating knowledge across domains.

PO7: Research Orientation: Formulate research problems, perform literature reviews, apply analytical methods and interpret findings effectively.

PO8: Communication Skills: Communicate findings clearly through reports, presentations and data visualizations to both technical and non-technical audiences.

PO9: Lifelong Learning: Commit to continuous learning to stay updated with advancements in computing methods and technologies.

PO10: Ethics and Social Responsibility: Practice professional standards and ethics and commit to social responsibility.

1.4 Programme Specific Outcomes (PSOs)

PSO1: Gain knowledge of statistical methods, data mining and machine learning techniques to analyze structured and unstructured data across various domains such as business, healthcare, education, environment etc.

PSO2: Design, implement, and evaluate data analysis pipelines using contemporary tools, programming languages and frameworks, ensuring scalability, reproducibility and ethical compliance.

PSO3: Obtain and interpret data-driven insights to support strategic decision-making and policy formulation.

PSO4: Undertake applied research projects in data analytics by identifying relevant problems, collecting and processing data and drawing evidence-based conclusions using relevant techniques and methodologies.

2. DEFINITIONS

Terms used in the NEP Regulations shall have the meaning assigned to them as given below unless the context otherwise requires:

A. Credit: "Credit" is a unit by which the coursework is measured. It determines the number of hours of instruction required per week during a semester (Minimum 15 weeks). One credit is equivalent to 15 hours of teaching (lecture and /or tutorial) or 30 hours of practical and/or field work or community engagement and service per semester.

B. Academic Year: "Academic Year" means the year starting in the month of June and ending in the succeeding month of May.

C. Semester: "Semester" means 15-16 weeks of teaching-learning session of which two weeks shall be set apart for examination and evaluation; A semester comprises of 90 working days and an academic year is divided into two semesters.

D. Summer Term: "Summer term" is for 8 weeks during summer vacation. Internship / projects in higher educational institutions / research organizations evaluated by an internally constituted committee can be carried out during the summer term, especially by students who wish to exit after two semesters.

E. Grade: "Grade" means a letter grade assigned to a student in a Course for her / his performance at academic sessions as denoted in symbols of: O(Outstanding), A+(Excellent), A(Very good), B+(Good), B(Above average), C(Average), P(Pass), F(Fail) and Ab(Absent) with a numeric value of O=10, A+=9, A=8, B+=7, B=6, C=5, P=4, F=0 and Ab=0.

F. SGPA: "Semester Grade Point Average (SGPA)" is computed from the grades as a measure of the students' performance in a given semester.

G. CGPA: "Cumulative GPA (CGPA)" is the weighted average of all courses the student has taken in a given programme.

H. Programme: "Programme" means a set of courses that allows a student to structure and study to attain the status of being admitted to a Degree / Diploma of the University.

I. Programme Committee: "Programme Committee" means an Academic Committee constituted by the University for the purpose of conducting an Academic Programme.

J. Credit Requirement: "Credit Requirement" for a Degree / Diploma / Certificate Programme means the minimum number of credits that a student shall accumulate to achieve the status of being qualified to receive the said Degree / Diploma / Certificate as the case may be.

K. Exit Option: "Exit option" means the option exercised by the students, to leave the Programme at the end of any given Academic year.

L. Lateral Entry: "Lateral entry" means a student being admitted into an ongoing Programme of the University other than in the first year of the programme.

3. DURATION, ELIGIBILITY & AWARD OF M.Sc. COMPUTER SCIENCE (DATA ANALYTICS)

3.1. Duration of the Programme

The duration of the M.Sc. Computer Science (Data Analytics) PG programme is 2 years or 4 semesters.

3.2. Eligibility

Candidates seeking admission to the M.Sc. Computer Science (Data Analytics) must possess a **3-year undergraduate degree** with a minimum of **120 credits**, as per the requirements for a postgraduate programme at **Level 6.5 of the National Higher Education Qualifications Framework (NHEQF).** Candidates who have completed a **4-year Undergraduate Degree with**

Honors (or Honors with Research) are eligible to get the admission through lateral entry in the second year of M.Sc. Computer Science (Data Analytics) programme.

Candidates seeking admissions to this programme **must also qualify a National or University-level entrance examination** in subjects prescribed as relevant for the M.Sc. Computer Science (Data Analytics) programme, as outlined in the University's admission brochure.

4. PROGRAMME OVERVIEW

Under the National Higher Education Qualifications Framework (NHEQF), higher education qualifications are classified along a continuum of levels from level 4.5 to level 8. The NHEQF levels represent a series of sequential stages expressed in terms of a range of learning outcomes against which typical qualifications are positioned / located. Learning outcomes are statements of what the learner is expected to know, understand and/or be able to do on the successful completion of an approved programme of study / learning at a specified level. Students on completion of the chosen programme(s) of study under the NHEQF must possess and demonstrate the graduate attributes defined in terms of the expected learning outcomes.

In accordance with the NHEQF (https://www.ugc.gov.in/pdfnews/2990035_Final-NHEQF.pdf), the levels for the PG programme are given in the Table.1. Accordingly, students of this M.Sc. Computer Science (Data Analytics) programme will study courses of Level 6.5 for a total of 80 credits spread across 4 semesters in 2 years.

Table 1: Levels of PG Programme

S.No.	Qualifications	Level	Credits
1	P.G. Diploma	6	40
2	1-Year PG after a 4-year UG	6.5	40
3	2-Year PG after a 3-year UG	6.5	40 + 40
4	2-Year PG after a 4-year UG such as B.E., B.Tech. etc.	7	40 + 40

Table 2: Curricular Components

Curricular Components		**Two-Year PG Programme Minimum Credits**		
		Coursework	**Research thesis/project/patent**	**Total Credits**
PG Diploma		40	--	40
1st Year (1st & 2nd Semester)		40	--	40
Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma				
2nd Year (3rd & 4th Semester) #	Coursework & Research	20	20	40
	Coursework	40	--	40
	Research	--	40	40

#Students entering second year of PG can choose to do any one of the following in the third and fourth semesters:

(i) only course work

(ii) both course work and research

(iii) only research

4.1 Exit Option and Nomenclature

Candidates can exercise the exit option at the end of the first year. Candidates who exercise such option shall be awarded a *PG Diploma in Data Analytics* if the candidate acquires at least 40 credits from the courses registered in the 1st and 2nd semesters as per the curriculum. Students who wish to exit after two semesters should also complete internship / project during the summer term in a higher educational institution / research organization / industry which will be evaluated by an internally constituted committee.

4.2. Description of Types of Courses

The following are the types of courses in this programme:

1. Hardcore
2. Softcore
3. MOOC
4. Summer Term Internship / Project

4.2.1 Hardcore

The compulsory core or essential subjects or components that are considered fundamental and mandatory for a particular field of study. It represents the foundational knowledge and skills that are deemed necessary for students to master, forming the basis for further learning and specialization. In the curriculum, hard core courses are assigned 3 or 4 credits for theory courses, 4 credits for theory and practice combined courses and 2 credits for practical courses.

4.2.2 Softcore

Optional courses that students can choose from a specific pool of subjects within a program or specialization, in contrast to hard core (compulsory) courses. They are typically electives that allow students to tailor their learning to their interests or chosen specialization. Soft core subjects are assigned 3 credits in the curriculum.

4.2.3 MOOC course

Students may only register for proctored exam-based MOOC courses offered by the SWAYAM platform for credit transfer, as guided by UGC. Hard Core Course cannot be substituted by a MOOC

course. Students cannot choose MOOC courses equivalent to the hardcore courses in their respective curriculum. Students are encouraged to finish any 2 electives offered in the III semester through MOOC platform. Students may enroll for at least 2 courses in MOOC platform any time after joining the M.Sc. course. Students should register the course only when approved by the faculty advisor. The faculty advisor will verify the equivalence of the selected MOOC courses and approve them. Upon successful completion of the MOOC courses, the faculty advisor will facilitate the students' registration in SAMARTH for the subsequent semester under the approved course codes. Registration of online courses in SAMARTH will only be permitted in the subsequent semester. 12-week specialization-based MOOC courses will be treated as Soft-core (Elective) courses. Students can earn a maximum of 3 credits for a 12-week course. No student may register for online MOOC courses during the final semester of their programme. Students must register for and complete the exam at the end of each MOOC course. After receiving their results, students must submit their e-certificate to their faculty advisor. The faculty advisor will normalize the marks based on the e-certificate produced by the students and generate grades for the MOOC courses.

4.2.4 Summer Term Internship / Project

Summer Internship / project do not carry any credits. Students who wish to exit after two semesters should complete internship / project during the summer term in a higher educational institution / research organization / industry which will be evaluated by an internally constituted committee.

4.3. Credit-Hours for Different Types of Courses

A three-credit lecture course in a semester means three one-hour lectures per week with each one-hour lecture counted as one credit. One credit for tutorial work means one hour of engagement per week. A one-credit course in lab work in a semester means two-hours engagement per week. In a semester of 15 weeks duration, a one-credit lab work in a course is equivalent to 30 hours of engagement.

The Faculty to Student Ratio in all the practical / laboratory classes shall be maintained at 1:15.

4.3.1. Pedagogical Styles

In order to achieve the expected learning outcomes, the following Pedagogical approaches listed in Table 3 are practiced.

Table 3: Pedagogical Approaches

PEDAGOGY	APPROACH
Lecture	Regular classroom lectures by qualified / experienced expert teachers • These Lectures may also include classroom discussion, demonstrations, case analysis. • Use of Models, Audio-Visual contents, Documentaries, PPTs may supplement.
Tutorial	Problem solving exercise classes, guided discussion, supplementary readings etc.
Lab work	Algorithm design, Program development and executions, Application of tools, simulations and Mini projects.
Seminar	Students study contemporary topics and engage in Group Discussions and Debate, Oral presentation, Poster presentation, Role play participation, Quiz competitions, Business plan preparation & presentation, etc.
Internship / Project	Students *Learn by Doing* in the workplace external to the parent institution. Internships involve working in Software Companies, Research and Higher Educational Institution Laboratories, Corporate Offices, etc. All Internships should be properly guided and inducted for focused learning.
Research Project	Literature review and analysis in their area of specialization, devise and implement innovative techniques and technologies. Outcome of the project work need to be presented as a thesis or research report with necessary experimental results.
Field Visit	Real time learning through an industrial visit and gain insights into industry practice.
Flipped Classrooms	Flipped classrooms reverse traditional teaching by having students learn content at home through instructional videos, then practice and discuss concepts during class time.

5. ADMISSION ELIGIBILITY, LATERAL ENTRY

5.1 Admission Eligibility

Candidates seeking admission to the M.Sc. Computer Science (Data Analytics) must possess a **3-year undergraduate degree** with a minimum of **120 credits**, as per the requirements for a postgraduate program at **Level 6.5 of the National Higher Education Qualifications Framework (NHEQF).** Candidates who have completed a **4-year undergraduate degree with honors (or honors with research)** are eligible to get the admission through lateral entry in the second year of M.Sc Computer Science (Data Analytics) programme.

Candidates seeking admissions to this programme **must also qualify a National or University-level entrance examination** in subjects prescribed as relevant for the M.Sc. Computer Science (Data Analytics) programme, as outlined in the University's admission brochure.

5.2 Admission by Lateral Entry

Candidates seeking lateral entry in the second year, should have completed the relevant PG Diploma with the any of the above-mentioned eligibility requirements mentioned in section 5.1 and should have accumulated the necessary minimum credits in the Academic Bank of Credits (ABC). Such students who get admitted in the second year, other than first year will be guided by the following clauses:

- that the University shall notify the admission process and number of vacancies open for lateral entry.
- that the Lateral entrants shall be admitted only after such transparent screening process and such procedure that the University may prescribe from time to time. University may prescribe different methods of screening for different programmes depending on the circumstances prevailing in each case.
- that the Lateral entry shall be permissible only in the beginning of the second year, provided that the students seeking lateral entry shall have obtained the minimum necessary qualification.

6. ACADEMIC BANK OF CREDITS (ABC)

The scheme of academic bank of credits will facilitate the transfer and consolidation of credits by using an 'Academic Bank Account' opened by students across the country by taking up courses in any of the eligible Higher Education Institutions. The validity of the credits earned and kept in the academic credit account will be to a maximum period of seven years or as specified by the ABC time to time.

7. MINIMUM CREDITS FOR ENROLMENT, ONLINE COURSES, STUDENT STRENGTH AND MENTORSHIP

a) To be considered a full-time student, a student must be enrolled at least for 12 credits in each and every semester. No student, unless specifically permitted by the programme committee, be permitted to enroll in more than 30 credits in any semester (excluding the credits for writing arrear exams).

b) While the hardcore courses are mandatory, students shall be permitted to drop other courses within the time limits prescribed in the Academic Calendar.

c) 40% of the credits of elective courses may be earned through online mode (Swayam or such other similar platforms approved by the department and the University as per the existing UGC regulations). Such decisions may be taken by the department / centre after considering the course requirements and learning outcomes planned and duly approved by the programme committee. This does not apply to the hardcore courses which need to be completed in offline / physical mode. Course code for online courses and the number of credits to be assigned to each such course will be approved by the programme committee and these will be uploaded in the SAMARTH portal.

d) No softcore course shall be offered unless a minimum of 10 students register.

e) Every student upon admission to the University shall be associated with a member of the faculty (faculty advisor) of the programme to which she / he is admitted to, who shall advise and help the student as a mentor in choosing courses that is most appropriate for the goals of the student.

8. EXIT OPTION PROCEDURES

a) Students enrolled in this programme shall have an option to exit at the end of 1st year, subject to fulfilment of required conditions.

b) A student desiring an exit shall give a notice of such intention in writing in the prescribed format at least 8 weeks before the scheduled end of the 1st Academic year.

c) On receipt of the notice, department shall recommend for a PG Diploma, based on the fulfilment of requirements (refer section 4.1) for such award. In case of arrear papers, the PG Diploma shall be provided after passing the arrear papers.

9. LEARNING ASSESSMENT AND GRADES

All credit courses are evaluated for 100 marks. The courses are in three categories and the assessment methods are defined for each category.

9.1. Category of Courses

Table 4: Category of Courses

Category A	Theory Courses with Lecture hours and Tutorial hours.
Category B	Practical Courses with only Laboratory hours, Internships, Research Project.
Category C	Theory & Practice combined Courses.

9.2. Learning Assessment

Table 5: Learning Assessment

<table>
<tr><th>Course Types</th><th>Internal Assessment</th><th>End Semester Assessment</th></tr>
<tr><td>Category A

IA: 40 Marks
EA: 60 Marks</td><td>40 Marks

<table><tr><th>Evaluation Component</th><th>Marks</th></tr><tr><td>I. Internal Exams for 15 Marks (Two)</td><td>30</td></tr><tr><td>II. Assignments/Seminars/Others</td><td>10</td></tr><tr><td>Total</td><td>40</td></tr></table></td><td>60 Marks

(Evaluation Details given in Table 6)</td></tr>
<tr><td>Category B

IA: 40 Marks
EA: 60 Marks</td><td>40 Marks

For Practical / Internship Courses<table><tr><th>Evaluation Component</th><th>Marks</th></tr><tr><td>I. Weekly Observation Book / Report</td><td>15</td></tr><tr><td>II. Practical Record / Internship Report</td><td>10</td></tr><tr><td>III. Model Practical Exam</td><td>15</td></tr><tr><td>Total</td><td>40</td></tr></table>For Research Project Work Course<table><tr><th>Evaluation Component</th><th>Marks</th></tr><tr><td>I. Monthly Review (3 Reviews – 10 Marks each) Average of 3 Reviews</td><td>20</td></tr><tr><td>II. Project Report</td><td>10</td></tr><tr><td>III. Project Work</td><td>10</td></tr><tr><td>Total</td><td>40</td></tr></table></td><td>60 Marks

(Evaluation Details given in Table 6)</td></tr>
</table>

<table>
<tr><td rowspan="2">Category C

IA: 40 Marks
EA: 60 Marks</td><td>40 Marks</td><td rowspan="2">60 Marks

(Evaluation Details given in Table 6)</td></tr>
<tr><td>
<table>
<tr><th>Evaluation Component</th><th>Marks</th></tr>
<tr><td>I. Internal Exams for 10 Marks (Two)</td><td>20</td></tr>
<tr><td>II. Observation Records</td><td>05</td></tr>
<tr><td>III. Model Practical Exam</td><td>15</td></tr>
<tr><td>Total</td><td>40</td></tr>
</table>
</td></tr>
</table>

9.3. End Semester Assessment

The Department schedules the End-Semester exams for all theory and practical subjects based on university calendar. For Theory courses with Practical components, End semester exams shall be conducted separately for Theory and Practicals.

A detailed Exam Time Table shall be circulated at least 15 days before the start of exams. Question Papers shall be set based on BoS approved syllabus. All students who have a minimum of 70% attendance are eligible to attend the end-semester exams.

9.4. Breakup of End Semester Marks

The question paper shall be set as per the Bloom's Taxonomy. Table 6 below gives the details of evaluation methods for Category A, B and C courses. Various levels along with it's description and sample questions are as follows:

Knowledge: Recall or remember previously learned information.
Example: List the basic data types in Python

Comprehension: Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating the main ideas.
Example: Explain how a stack data structure works.

Application: Apply knowledge and concepts to solve problems in new situations. Use learned information in a different context.
Example: Write a Python program to solve the deadlock problem.

Analysis: Break down information into parts and examine the relationships between the parts. Identify motives or causes.

Example: Analyse the efficiency of two sorting algorithms and compare their advantages and disadvantages.

Table 6: End Semester exam assessment details for all three categories of courses

Course Components	Max. Marks	End-Sem Exam Duration
Category A. Theory subjects: Sec A: 10 Questions of 2 Marks each (20 Marks) *(Knowledge: 3, Comprehension: 2, Application: 3, Analysis:2)* Sec B: 5 out of 7 Questions of 4 Marks each (20 Marks) *(Knowledge: 1, Comprehension: 2, Application: 1, Analysis:3)* Sec C: 2 Either/OR choice questions of 10 Marks each (20 Marks) *(Application: 1, Analysis:1)* **Questions from all units of Syllabus equally distributed.**	60 Marks	3 Hours
Category B. Practical: Based on Practical examinations conducted. **Internship / Research Project Work:** Presentation of the work / Report / Viva-voce examinations	60 Marks	3 Hours -
Category C. Theory Subjects with Practical Components:* **i. Theory Component:** Sec A: 10 Questions of 2 Marks each (20 Marks) *(Knowledge: 3, Comprehension: 2, Application: 3, Analysis:2)* Sec B: 5 out of 7 Questions of 4 Marks each (20 Marks) *(Comprehension: 2, Application: 3, Analysis:2)* Sec C: 2 Either or type questions of 10 Marks each (20 Marks) *(Analysis / Synthesis)* **Questions from all units of Syllabus equally distributed.** **The examination shall be conducted for 60 Marks and reduced to 40 Marks.** **ii. Practical Component:** Based on Practical examinations / Presentation / Viva-voce with external examiner appointed by the University Controller of Examinations, and schedules exclusively prepared for such practical examinations by the University Examination Section. **The examination shall be conducted for 40 Marks and reduced to 20 Marks.** **Total Marks: 60 (Theory: 40 Marks + Practical: 20 Marks)**	40 Marks 20 Marks	3 Hours 2 Hours

[*]*It is mandatory for the student to appear in both Theory Component and Practical Component of the End Semester Examination. Absence in either component shall be treated as absence in the entire End Semester Examination and the student shall be required to re-register and repeat the course in its entirety during the next available term.*

Synthesis: Create a new whole by combining elements in novel ways. Use creativity to produce something original.
Example: Design a web application that can generate a time table of a school.

9.5. Consolidation of Marks and Passing Minimum

The Course Teacher of course shall consolidate the Internal Assessment marks and marks secured by students in End-Semester examinations. The total marks will be converted into letter grades.

A student shall be declared to have passed the course only if she / he gets, a minimum of 40% marks in end semester exam and a minimum of 40% marks in aggregate (Internal Assessment + End Semester Assessment put together). However, Pondicherry University considers 40% marks as pass and students who secured less than 50 will be awarded 'P' (Pass Grade).

9.6. Supplementary Examination

- A student who gets 'F' grade in a course shall be permitted to register for the supplementary examination in the following semester or in the subsequent semesters.
- A student who gets 'F' grade in a course shall be given an option either to retain the previously awarded internal assessment mark or to improve it, and the higher mark out of these two options will be considered for the supplementary examination.
- A student who gets 'Ab' grade in a course is mandated to **repeat** the course and undergo all the stages of assessment in subsequent semesters.

9.7. Attendance Requirement

Student who has less than 70% attendance in any course shall not be permitted to participate in end semester examination and she / he shall be given 'Ab' Grade - failure due to lack of attendance. She / he shall be required to re-register and repeat that course as and when it is offered.

10. LETTER GRADES, GRADE POINTS, GRADE CARD

Performance of students in each paper will be expressed as marks as well as Letter Grades.

Table 7: Letter Grades and Grade Points

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very good)	8
B+ (Good)	7
B (Above average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (due to lack of attendance)	0

In case of fractions the marks shall be rounded off to nearest integer.

The class interval K will be calculated by the formula given below:

$$K = (X-50)/6$$

where X is the highest mark secured.

According to K value, one of the following grading schemes will be followed.

(i) If $K \geq 5$, then the grades shall be awarded as given in the following table.

Range of Marks in %	Letter Grade Points for	Grade Points for
X to (X-K) + 1	O	10
(X-K) to (X-2K) + 1	A+	9
(X-2K) to (X-3K) + 1	A	8
(X-3K) to (X-4K) + 1	B+	7
(X-4K) to (X-5K) + 1	B	6

(X-5K) to 50	C	5
40 – 49	P	4
Below 40	F	0
Absent (Lack of Attendance)	Ab	0

(ii) If K< 5, then the grades shall be awarded as given in the following table.

Range of Marks in %	**Letter Grade Points for**	**Grade Points for**
80-100	O	10
71-79	A+	9
66-70	A	8
61-65	B+	7
56-60	B	6
50-55	C	5
40-49	P	4
Below 40	F	0
Absent (lack of attendance)	Ab	0

The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester. The SGPA is based on the grades of the current term, while the Cumulative GPA (CGPA) is based on the grades in all courses taken after joining the programme of study.

10.1. Computation of SGPA and CGPA

The following procedure shall be followed to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e. $SGPA\ (Si) = \Sigma(Ci \times Gi) / \Sigma Ci$

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

10.1.1. Example for Computation of SGPA where candidate has not failed in any course.

Semester	Course	Credit	Letter Grade	Grade Point	Credit Point (Credit x Grade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	B	6	3 X 6 = 18
I	Course 4	3	O	10	3 X 10 = 30
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	B	6	4 X 6 = 24
		20			139
	SGPA				139/20=6.95

10.1.2. Example for Computation of SGPA where candidate has failed in one course.

Semester	Course	Credit	Letter Grade	Grade Point	Credit Point (Credit x Grade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	B	6	3 X 6 = 18
I	Course 4	3	O	10	3 X 10 = 30
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	F	0	4 X 0 = 00
		20			115
	SGPA				115/20=5.75

10.1.2. Example for Computation of SGPA where candidate has failed in two courses.

Semester	Course	Credit	Letter Grade	Grade point	Credit Point (Credit x Grade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	F	0	3 X 0 = 00
I	Course 4	3	B	6	3 X 6 = 18
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	F	0	4 X 0 = 00
		20			85
	SGPA				85/20=4.25

10.1.2. The CGPA shall also be calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

CGPA = Σ(Ci x Si) / Σ Ci, where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Example for Computation of CGPA

Semester 1	Semester 2	Semester 3	Semester 4
Credit 20 SGPA 6.9	Credit 20 SGPA 7.8	Credit 20 SGPA 5.6	Credit 20 SGPA 6.0
CGPA= (20 x 6.9 + 20 x 7.8 + 20 x 5.6 + 20 x 6.0)/80 = 6.6			

However, if any student fails more than once in the same subject, then while calculating CGPA, the credit and grade point related to the subject in which the student fails in multiple attempts will be restricted to one time only. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

10.2. Grade Card

The University shall issue a Grade card for the students, containing the marks and grades obtained by the student in the previous Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA).

The grade card shall list:

a. The title, semester and course code of the courses taken by the student.

b. The credits associated with the course.

c. The marks and grade secured by the student.

d. The total credits earned by the student in that semester

e. The SGPA of the student.

f. The total credits earned by the students till that semester.

g. The CPGA of the student.

11. DISTINCTION, RANK AND DIVISIONS

Distinction: On successful completion of the programme, students with a CGPA of 9.00 and above who passed all the courses in first attempt shall be awarded the degree in First Class with Distinction.

Table 8: Range of CGPA

Range of CGPA	Divisions
9.0 – 10	First Class with Distinction#
6.0 - 8.99	First Class
5.0 - 5.99	Second Class
4.0 - 4.99	Pass

Distinction will be awarded ONLY to those candidates who have cleared ALL subjects in the first attempt.

University Rank: University Rank in a programme will be awarded to the student who secures the highest CGPA in a batch and passed all the courses in first attempt.

Divisions: The Table 8 summarizes the range of CGPA and their respective divisions.

12. BRIDGE COURSE

A two-week bridge course will be conducted at the beginning of the first semester to introduce students to various facets of digital technologies. This foundational course is designed to facilitate effective learning in the domain of data analytics, particularly for students entering the program from diverse academic backgrounds.

13. COURSE CODE

- **Course code :** 7 Characters: 4 Alphabets and 3 Digits.
- **Alphabets :** 1st and 2nd Alphabets: Department Code (CS – Computer Science)
  3rd and 4th Alphabets: Programme Category (DA - Data Analytics)
- **Digits :** 1st Digit: Level - 6
  2nd and 3rd Digits: semester wise serial number of the course
  (01-50 odd semester, 51-99 even semester)

Ex: Odd Semester course- CSDA601; Even Semester course – CSDA651

M.Sc. Computer Science (Data Analytics)
CURRICULUM

FIRST SEMESTER							
S.No.	Course Code	Title of the Course	H/S	Credits	Hours/Week		
					L	T	P
1	CSDA601	Design and Analysis of Algorithms	H	3	3		
2	CSDA602	Probability and Statistics	H	3	3		
3	CSDA603	Data Engineering	H	4	3	1	
4	CSDA604	Artificial Intelligence and Machine Learning	H	3	3		
5		Elective 1	S	3	3		
6	CSDA605	Lab 1 - Design and Analysis of Algorithms Lab	H	2			2
7	CSDA606	Lab 2 – AI and ML Lab	H	2			2
			Total	20			

SECOND SEMESTER							
S.No.	Course Code	Title of the Course	H/S	Credits	Hours/Week		
					L	T	P
1	CSDA651	Advanced Database Systems	H	4	3		2
2	CSDA652	Web Analytics	H	3	3		
3	CSDA653	Data Visualization	H	3	3		
4		Elective 2	S	3	3		
5		Elective 3	S	3	3		
6	CSDA654	Lab 3 – Web Analytics Lab	H	2			2
7	CSDA655	Lab 4 – Data Visualization Lab	H	2			2
			Total	20			

THIRD SEMESTER (Coursework)							
S.No.	Course Code	Title of the Course	H/S	Credits	Hours/Week		
					L	T	P
1	CSDA607	Deep Learning	H	3	3		
2	CSDA608	Business Analytics	H	4	3	1	
3	CSDA609	Big Data Analytics	H	3	3		
4		Elective 4	S	3	3		
5		Elective 5	S	3	3		
6	CSDA610	Lab 5 – Deep Learning Lab	H	2			2
7	CSDA611	Lab 6 – Big Data Analytics Lab	H	2			2
			Total	20			

THIRD SEMESTER (Course work + Research)							
S.No.	Course Code	Title of the Course	H/S	Credits	Hours/Week		
					L	T	P
1	CSDA607	Deep Learning	H	3	3		
2	CSDA608	Business Analytics	H	4	3	1	
3	CSDA609	Big Data Analytics	H	3	3		
4	CSDA612	Project Work Phase – I	H	6			
5	CSDA610	Lab 5 – Deep Learning Lab	H	2			2
6	CSDA611	Lab 6 – Big Data Analytics Lab	H	2			2
			Total	20			

THIRD SEMESTER (Research)							
S.No.	Course Code	Title of the Course	H/S	Credits	Hours/Week		
					L	T	P
1	CSDA613	Research Methodology	H	4			4
2	CSDA614	Research Project Work - Phase I	H	8			8
3	CSDA615	Publication Ethics	H	3			3
4	CSDA616	Directed Study – I (Project Reporting and Presentation tools)	H	2			2
	CSDA617	Directed Study – II	H	3			3
			Total	20			

FOURTH SEMESTER (Coursework)							
S.No.	Course Code	Title of the Course	H/S	Credits	Hours/Week		
					L	T	P
1		Elective-6	S	4	3		2
2		Elective-7	S	4	3		2
3		Elective-8	S	4	3		2
4	CSDA656	Academic Project Work	H	8			8
Total				20			

FOURTH SEMESTER (Course Work + Research)							
S.No.	Course Code	Title of the Course	H/S	Credits	Hours/Week		
					L	T	P
1	CSDA657	Project Seminar & Viva voce	H	8			8
2	CSDA658	Project Work Phase II	H	8			8
3	CSDA659	Directed Study	H	4			4
			Total	20			

FOURTH SEMESTER (Research)							
S.No.	Course Code	Title of the Course	H/S	Credits	Hours/Week		
					L	T	P
1	CSDA660	Research Project Work Phase II	H	10	-	-	-
2	CSDA661	Dissertation and Viva Voce	H	10	-	-	-
			Total	20			

List of Electives			
S.No.	**Sem**	**Course Code**	**Title of the Course**
1.	I	CSDA631	DevOps
2.	I	CSDA632	Python Programming
3.	I	CSDA633	Data Warehousing and Mining
4.	II	CSDA671	Social Network Analytics
5.	II	CSDA672	Full Stack Development
6.	II	CSDA673	IoT and Predictive Analytics
7.	II	CSDA674	Accessibility Analytics
8.	II	CSDA675	Optimization Techniques for Analytics
9.	II	CSDA676	Financial and Risk Analytics
10.	II	CSDA677	Linear Algebra
11.	III	CSDA634	Time Series Data Analysis
12.	III	CSDA635	Generative AI
13.	III	CSDA636	Prompt Engineering
14.	III	CSDA637	Digital Forensics
15.	III	CSDA638	AI and Ethics
16.	III	CSDA639	Natural Language Processing
17	III	CSDA640	Robotics
18	III	CSDA641	Explainable AI
19.	IV	CSDA678	Large Language Models
20.	IV	CSDA679	Computer Vision
21.	IV	CSDA680	Agentic AI
22.	IV	CSDA681	Federated Learning
23.	IV	CSDA682	Recommender Systems

24.	IV	CSDA683	Big data security
25.	IV	CSDA684	Reinforcement learning
26	IV	CSDA685	Digital Twins
27	IV	CSDA686	Cloud Computing

SYLLABUS

Semester I

Year	I	Course Code: CSDA601	Credits	3
Sem.	I	Course Title: DESIGN AND ANALYSIS OF ALGORITHMS	Hours	45
			Category	A

Course Prerequisites, if any	• Basic Knowledge in Computing	
Internal Assessment Marks: 40	**End Semester Marks:** 60	**Duration of ESA:** 03 hrs.

Course Outcomes

1. Understand and apply fundamental algorithm analysis techniques to evaluate the efficiency of recursive and non-recursive algorithms.
2. Analyze and implement classical algorithm design strategies such as Brute Force, Divide-and-conquer to solve problems like sorting and searching.
3. Develop efficient solutions using Greedy and Dynamic Programming techniques.
4. Design and analyze recursive and combinatorial algorithms using Backtracking and Branch-and-Bound techniques
5. Demonstrate understanding of computational complexity concepts, including NP-completeness.

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	2	--	--	2	--	2	--	2	2	--	--
CO2	3	--	1	1	1	--	--	--	--	--	--	2	--	--
CO3	3	--	1	1	1	--	--	--	--	--	--	2	--	--
CO4	3	--	1	1	1	--	--	--	--	--	--	2	--	--
CO5	3	--	1	1	1	--	2	--	--	--	--	2	--	--

Unit No.	Course Contents	Hours
Unit I	**Introduction** Notation of Algorithm - Analysis of Algorithm Efficiency - Asymptotic Notations and Basic Efficiency classes - Mathematical Analysis of Non-Recursive and recursive Algorithms - Empirical Analysis of Algorithms	9
Unit II	**Divide and Conquer** Brute Force and Divide and conquer - Binary Search – Finding the maximum and minimum – merge sort - quick sort- Strassen's matrix multiplication. Decrease-and-Conquer and Transform-and-Conquer: Insertion sort -Depth First Search - Topological sorting - Gaussian Elimination -Balanced Search Trees - Heap Sort - Horner's Rule.	9
Unit III	**Greedy Method** General method - Knapsack problem - Job Sequencing - Spanning Trees - Prims's Algorithm and Kruskal's Algorithm- Optimal Merge Patterns -Single Source Shortest Paths - Huffman Trees.	9

Unit IV	**Dynamic Programming & Backtracking** General method - Principle of Optimality - Multistage Graphs - 0/1 Knapsack - Travelling Salesman Problem- Backtracking: General Method - 8-Queen Problem - Sum of Subsets - Hamiltonian Cycles - Travelling Salesman Problem.	9
Unit V	**Branch Bound** Introduction FIFO Solution -LC Branch and Bound -Rat in Maze –Traveling Salesman Problem. NP Completeness and Approximation Algorithm: Introduction - Polynomial Time -NP Completeness and Reducibility -Approximation Algorithms.	9
Recommended Learning Resources		
Print Resources	**TEXT BOOKS:** 1. S.Sridar, "Design and Analysis of Algorithms", Oxford University Press, 2015. 2. Horowitz, E. and Sahani, S, "Fundamentals of Computer Algorithms", Universities press, 2008. **REFERENCE BOOKS:** **1.** Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein. Introduction to Algorithms, MIT Press, 2022.	
Syllabus Design: Dr.K.S.Kuppusamy, Associate Professor, PUDoCS		

Year	I	Course Code: CSDA602	Credits	3
Sem.	I	Course Title: PROBABILITY AND STATISTICS	Hours	45
			Category	A

Course Prerequisites, if any	• *Basic understanding of mathematical concepts*
Internal Assessment Marks: 40	**End Semester Marks:** 60 / **Duration of ESA:** 03 hrs.

Course Outcomes

1. *Apply combinatorial techniques and principles of counting to solve problems involving permutations and combinations.*
2. *Understand and use classical, relative frequency, and axiomatic definitions of probability, including Bayes' Theorem and conditional probability*
3. *Analyze discrete and continuous random variables using probability functions, expectation, variance, and generating functions*
4. *Identify and apply appropriate probability distributions to model real-world phenomena and compute reliability in systems*
5. *Examine joint, marginal, and conditional distributions, and evaluate relationships using correlation and regression*

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	--	2	--	--	--	2	--	--	--	3	--	--	--
CO2	3	--	2	--	--	--	--	--	--	--	3	--	--	--
CO3	3	--	2	--	--	--	--	--	--	--	3	--	--	--
CO4	3	--	2	--	--	--	--	--	--	1	3	--	--	--
CO5	3	--	2	--	--	--	--	--	--	--	3	--	--	--

Unit No.	Course Contents	Hours
Unit I	**Introduction** Combinatorial methods- Principles of counting – Permutation – Combination – Binomial theorem- problems.	8
Unit II	**Probability** Probability: Classical - relative frequency and axiomatic definitions of probability - addition rule and conditional probability - multiplication rule - total probability - Bayes' Theorem and independence – problems.	9
Unit III	**Random Variables** Random Variables: Discrete - continuous and mixed random variables - probability mass - probability density and cumulative distribution functions - mathematical expectation – Variance- moments - probability and moment generating function - median and quantiles - Markov inequality.	10
Unit IV	**Special Distributions** Special Distributions: Discrete uniform – binomial – geometric - negative binomial – hypergeometric – Poisson - continuous uniform – exponential – gamma – Weibull – Pareto – beta – normal – lognormal - inverse Gaussian – Cauchy - double exponential distributions - reliability and hazard rate - reliability of series and parallel systems - problems.	9

Unit V	**Joint Distributions** Joint Distributions: Joint - marginal and conditional distributions - product moments - correlation and regression - independence of random variables - bivariate normal distribution - problems.	9
Recommended Learning Resources		
Print Resources	**TEXT BOOK:** 1. *Gupta, S.C. and Kapoor, V.K. : Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 2014.* **REFERENCE BOOK:** 1. *Sujit K. Sahu, Introduction to Probability, Statistics & R, Springer, 2024.*	
Syllabus Design: Dr.K.S.Kuppusamy, Associate Professor, PUDoCS		

Year	I	Course Code: CSDA603	Credits	4
Sem.	I	Course Title: DATA ENGINEERING	Hours	60
			Category	A

Course Prerequisites, if any	• Basic Understanding of data handling.	
Internal Assessment Marks: 40	**End Semester Marks:** 60	**Duration of ESA:** 03 hrs.

Course Outcomes

1. Understand the data engineering lifecycle and key activities such as data generation, storage, ingestion, transformation.
2. Apply principles of good data architecture and compare different architectural patterns
3. Identify various data sources and storage systems, and explain practical aspects of data generation and storage trends
4. Analyze ingestion methods and transformation techniques used in preparing data for analytics
5. Evaluate data serving strategies for analytics, including file exchange, databases, streaming, and query federation

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	--	1	2	2	--	1	--	2	--	1	3	--	--
CO2	3	--	1	2	2	--	1	--	2	--	1	3	--	--
CO3	3	--	1	2	2	--	1	--	2	--	1	3	--	--
CO4	3	--	1	2	3	--	1	--	2	--	1	3	--	--
CO5	3	--	1	2	2	--	1	--	2	--	1	3	--	--

Unit No.	Course Contents	Hours
Unit I	**Introduction** Data Engineering: Definition – Skills and activities. Data Engineering Life Cycle: Generation – Storage – Ingestion Transformation – Serving data. Major undercurrents across Data Engineering: Security – Data Management – Data Architecture – Orchestration.	12
Unit II	**Data Architecture** Principles of Good Data Architecture – Major Architecture Concepts: Domains and Services – Tight vs Loose coupling – User access – Event drive architecture. Types of Data Architecture: Warehouse – Lake – Modern Data Stack – Lamda Architecture – Kappa Architecture – Data Mesh.	12
Unit III	**Data Generation** Sources of Data – Source Systems – Practical Details: Databases – APIs - Data Sharing. Storage: Data Storage Systems – Data Engineering storage abstractions – Trends in storage.	12
Unit IV	**Ingestion** Key considerations for Ingestion phase – Batch Ingestion – Ways to Ingest data. Queries – Modelling – Transformation.	12

Unit V	**Serving Data for Analytics** Ways to serve Data for analytics: File exchange – Databases – Streaming – Query Federation.	12
Recommended Learning Resources		
Print Resources	**TEXT BOOKS:** ***1.*** Joe Reis, Matt Housley. Fundamentals of Data Engineering, O'Reilly, 2022. *2.* Zhaolong Liu, Data Engineering Fundamentals: Building scalable data solutions with ETL pipelines and strategic data architecture design, BPB Publications, 2025.	
Syllabus Design: Dr.K.S.Kuppusamy, Associate Professor, PUDoCS		

Year	I	Course Code: CSDA604	Credits	3
Sem.	I	Course Title: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	Hours	45
			Category	A

Course Prerequisites, if any	• Basic Python programming, data structures, algorithms, statistics, linear algebra, and probability.	
Internal Assessment Marks: 40	**End Semester Marks:** 60	**Duration of ESA:** 03 hrs.

Course Outcomes

1. Understand basic AI concepts and applications in data analytics
2. Learn problem-solving and search techniques in AI
3. Explore machine learning algorithms for classification and clustering
4. Develop skills in neural network models
5. Explore natural language processing and AI ethics

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	--	--	2	1	--	--	--	2	2	3	--	--	--
CO2	3	--	3	3	1	--	--	--	1	--	3	2	--	3
CO3	3	3	--	3	2	--	--	--	--	--	3	--	--	3
CO4	3	--	--	3	2	--	--	--	--	--	3	--	--	3
CO5	3	--	--	2	1	--	--	--	--	--	3	--	--	3

Unit No.	Course Contents	Hours
Unit I	**Introduction to Artificial Intelligence** Definition and scope of AI – History and evolution – Applications in data analytics – Intelligent agents – Problem solving and state-space representation – Uninformed search: BFS, DFS – Informed search: A* algorithm.	9
Unit II	**Knowledge Representation and Reasoning** Propositional and predicate logic – Rule-based systems – Semantic networks – Ontologies – Forward and backward chaining.	9
Unit III	**Machine Learning Techniques** Introduction to machine learning – Supervised learning: regression, decision trees, SVM – Unsupervised learning: K-means clustering – Dimensionality reduction: PCA – Model evaluation metrics: accuracy, precision, recall.	9
Unit IV	**Neural Networks** Basics of neural networks – Perceptron and backpropagation – Activation functions – Introduction to TensorFlow and PyTorch.	9
Unit V	**Advanced Topics and Applications** Natural Language Processing (NLP): tokenization, sentiment analysis – Reinforcement learning basics – Transfer learning – Explainable AI – Ethical issues in AI – Applications in business and big data analytics.	9

Recommended Learning Resources

Print Resources

TEXT BOOKS:

1. Stuart Russell & Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 2022.
2. Sebastian Raschka & Vahid Mirjalili, “Python Machine Learning", Packt Publishing, , 2017.
3. François Chollet, "Deep Learning with Python", Manning Publications,2021.

Syllabus Design: Dr. T. Vengattaraman, Associate Professor, PUDoCS.

Year	I	Course Code: CSDA605	Credits	2
Sem.	I	Course Title : DESIGN AND ANALYSIS OF ALGORITHMS LAB	Hours	30
			Category	B

Internal Assessment Marks: 40	End Semester Marks: 60	Duration of ESA: 03 hrs.

Skills to be acquired:

- Implement divide and conquer algorithms like binary search, merge sort, and quicksort.
- Design and apply greedy algorithms for optimization problems like knapsack and job scheduling
- Build dynamic programming solutions for complex problems like TSP and multistage graphs.
- Implement graph algorithms including DFS, topological sorting, and minimum spanning trees.
- Apply branch and bound techniques to optimize search algorithms and solve NP-hard problems.

Lab Software Requirements:

- Open-source IDEs and compilers.

Course Outcomes:

1. To analyze time and space complexity of algorithms using asymptotic notations Build and evaluate machine learning and clustering models.
2. Understand and acquire skills to implement sorting algorithms
3. Understand and implement divide and conquer technique in building algorithms.
4. To solve optimization problems using greedy method and dynamic programming techniques.
5. Apply backtracking and branch and bound methods to solve complex computational problems.

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	2	--	--	2	--	2	--	2	2	--	--
CO2	3	--	1	1	1	--	--	--	--	--	--	2	--	--
CO3	3	--	1	1	1	--	--	--	--	--	--	2	--	--
CO4	3	--	1	1	1	--	--	--	--	--	--	2	--	--
CO5	3	--	1	1	1	--	2	--	--	--	--	2	--	--

List of Exercises:

1. Implement binary search algorithm and analyze its time complexity using mathematical analysis for best, worst, and average cases.
2. Write a program to find maximum and minimum elements in an array using divide and conquer approach and compare with brute force method.
3. Implement Strassen's matrix multiplication algorithm for 4x4 matrices and compare its performance with traditional matrix multiplication.
4. Create a program to perform topological sorting on a directed acyclic graph using depth-first search.
5. Solve the job sequencing problem with deadlines using greedy method to maximize profit.
6. Implement Prim's algorithm to find the minimum spanning tree of a weighted undirected graph.
7. Write a program to solve the traveling salesman problem using dynamic programming approach.
8. Implement the sum of subsets problem using backtracking technique to find all possible combinations.
9. Solve the traveling salesman problem using branch and bound method with FIFO (First In First Out) approach.
10. Implement an approximation algorithm for the vertex cover problem and analyze its approximation ratio.

Syllabus Design: Dr. K.S. Kuppusamy , Associate Professor, PUDoCS.

Year	I	Course Code: CSDA606	Credits	2
Sem.	I	Course Title : AI and ML LAB	Hours	30
			Category	B

Internal Assessment Marks: 40	End Semester Marks: 60	Duration of ESA: 03 hrs.

Skills to be acquired:

- Implement fundamental AI algorithms like BFS, DFS, and A*.
- Build rule-based systems and perform logical inference.
- Develop machine learning models and apply dimensionality reduction.
- Train neural networks and apply NLP techniques.

Lab Software Requirements:

- Python 3.x with libraries: NumPy, Pandas, scikit-learn, Matplotlib.
- TensorFlow or Keras for deep learning models.
- NLTK or spaCy for NLP tasks.
- Jupyter Notebook or any Python IDE (VS Code, PyCharm).

Course Outcomes:

1. Apply search algorithms and expert systems for AI problem-solving.
2. Build and evaluate machine learning and clustering models.
3. Design and train neural networks and perform text analytics.
4. Implement Machine learning models for decision-making tasks.
5. Acquire skills to handle AI frameworks.

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	--	--	2	1	--	--	--	2	2	3	--	--	--
CO2	3	2	3	3	1	--	--	--	1	--	3	2	--	3
CO3	3	3	--	3	2	--	--	--	--	--	3	3	--	3
CO4	3	3	--	3	2	--	--	--	--	--	3	2	--	3
CO5	3	3	--	2	1	--	--	--	--	--	3	3	--	3

List of Exercises:

1. Write a Python program to implement Breadth-First Search (BFS) & Depth-First Search (DFS).
2. Solve a pathfinding problem using the A* algorithm.
3. Design a simple rule-based expert system using if-then rules.
4. Create a knowledge base and perform logical inference using propositional logic.
5. Build and evaluate a Decision Tree classifier using a sample dataset.
6. Apply K-Means clustering to group data into clusters.
7. Perform Principal Component Analysis (PCA) on a dataset and visualize the results.
8. Implement a SVM for classification.
9. Train a basic Neural Network using TensorFlow for classification.
10. Perform sentiment analysis on text data using NLP techniques.

Syllabus Design: Dr. T. Vengattaraman , Associate Professor, PUDoCS.

Semester II

Year	I	Course Code: CSDA651	Credits	4
Sem.	II	Course Title : ADVANCED DATABASE SYSTEMS	Hours	75
			Category	C

Course Prerequisites, if any	• Basic Knowledge in data handling
Internal Assessment Marks: 40	**End Semester Marks:** 60
	Duration of ESA (Theory) : 03 hrs. **Duration of ESA (Practical) :** 03 hrs.

Course Outcomes

1. Apply SQL effectively for data definition, manipulation, querying, and optimization, including understanding of constraints, normalization, and ACID properties.
2. Analyze and implement architectures of parallel and distributed databases, focusing on storage, query processing, and optimization techniques.
3. Design and model object-relational and object-oriented databases using structured data types, inheritance, and reference mechanisms.
4. Explore data warehousing and mining techniques, including OLAP operations, multidimensional queries, and the fundamentals of Big Data and the Hadoop ecosystem.
5. Understand and work with next-generation databases, including NoSQL, document databases (JSON/XML), in-memory databases, and concepts like sharding, replication, and the CAP theorem

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	--	--	2	--	--	--	--	2	2	3	--	--	--
CO2	3	--	3	3	1	--	--	--	1	--	3	2	--	--
CO3	3	2	--	3	2	--	--	--	--	--	3	--	--	--
CO4	3	--	--	3	2	--	--	--	--	--	3	--	--	--
CO5	3	--	--	2	1	--	--	--	--	--	3	--	--	--

Unit No.	Course Contents	Hours
	Theory Component	
Unit I	**SQL** Introduction- Database Revolution - Review of the Relational Model - Structured Query Language (SQL)- Data Types and Constraints in MySQL- SQL for Data Definition -SQL for Data Manipulation -SQL for Data Query -Data updation and Deletion –- Query Evolution and Query Optimization - Higher Normal Forms – ACID Properties -	9
Unit II	**Parallel and Distributed Databases** Architectures for Parallel Databases – Parallelizing Individual Operations – Parallel Query Optimization - Types of Distributed Databases – Architectures - Storage Aspects – Query Processing.	9
Unit III	**Object – Database systems** Structured data Types – Operations on Structured Data – Inheritance – Objects, OIDs, and Reference Types – Database Design for an ORDBMS – query Optimization – OODBMS – Comparison.	9
Unit IV	**Data Warehousing, Mining and Big Data** OLAP – Multidimensional Queries – implementation Techniques – Introduction to Data Mining – KDD – Mining for Rules - Big Data Revolution- Big data characteristics- Introduction to Hadoop Ecosystem.	9

Unit V	**Next Generation Databases** JSON Document Databases, XML and XML Databases, In-Memory Databases, Distributed non - relational storage systems-NoSQL Databases - Sharding and Replication-Consistency-The CAP Theorem-NoSQL Data Models.	9

Practical Component

1. **SQL Basics and Query Optimization**
   - Practice creating tables with constraints (primary key, foreign key, unique, etc.)
   - Write and execute SQL queries for insertion, updating, deletion, and complex retrieval using JOIN, GROUP BY, HAVING, and subqueries.
   - Analyze and improve performance of queries using EXPLAIN and indexing.
2. **Parallel and Distributed Query Execution**
   - Simulate parallel execution of SQL queries using multi-threaded approaches or frameworks (e.g., PostgreSQL with parallel query plans).
   - Set up a basic distributed database architecture using tools like MySQL Cluster or Apache Cassandra and perform distributed queries.
3. **Object-Oriented Database Design and Querying**
   - Create an object-relational schema using PostgreSQL with user-defined types, inheritance, and object identifiers.
   - Perform queries using structured and inherited data types.
4. **Data Warehousing and Mining**
   - Design a star/snowflake schema for a sample data warehouse.
   - Load data into the warehouse and perform OLAP operations like roll-up, drill-down, and slicing.
   - Use a simple data mining tool (e.g., Weka or Orange) to perform rule mining or clustering.
5. **NoSQL Database Operations**
   - Install and use a NoSQL database (e.g., MongoDB).
   - Perform CRUD operations on JSON documents.
   - Demonstrate sharding, replication, and evaluate consistency using different NoSQL models (document, key-value, column-family).

Recommended Learning Resources

Print Resources	**TEXT BOOKS:** 1. Guy Harrison, Next-Generation Databases. Apress, 2016. 2. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill, 2002. **REFERENCE BOOKS:** 1. Dan Sullivan. NoSQL for Mere Mortals. Addison-Wesley Professional, 2015.

Syllabus Design: Dr. Pothula Sujatha, Professor, PUDocs

Year	I	Course Code: CSDA652	Credits	3
Sem.	II	Course Title : WEB ANALYTICS	Hours	45
			Category	A

Course Prerequisites, if any	• Introductory knowledge in web terminologies
Internal Assessment Marks: 40	**End Semester Marks:** 60 / **Duration of ESA:** 03 hrs.
Course Outcomes	1. Understand web analytics fundamentals and their applications. 2. Master tools like Google Analytics, Tag Manager, and Looker Studio. 3. Develop skills in data-driven decision-making for websites and apps. 4. Apply ethical, privacy-compliant analytics. *5.* Perform case-based analysis for different industries

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1	--	--	--	--	1	3	1	3	2
CO2	3	3	2	1	2	--	--	--	--	1	3	1	3	3
CO3	3	3	1	1	2	--	--	--	--	1	3	1	3	3
CO4	3	2	1	1	2	--	--	--	--	3	2	1	3	2
CO5	3	3	1	1	3	--	--	--	--	1	3	1	3	3

Unit No.	Course Contents	Hours
Unit I	**Foundations of Web Analytics** Introduction- Channels & Traffic Sources-Understanding Data Types: Clickstream, Behavioural, Transactional-Foundational Metrics: Traffic, Engagement, Conversion, Retention-KPI Development Frameworks	9
Unit II	**Tools & Techniques for Data Collection** Clickstream Analysis: Data Collection & Reporting - Google Analytics 4 Essentials: Properties, Events, Goals - Google Tag Manager: Variables, Triggers, Tags - Behaviour Analysis: User Journeys, Flow Visualization, Heatmaps - App and Mobile Analytics Basics	9
Unit III	**Testing, Attribution & Optimization** Experimentation Techniques: A/B Testing, Multivariate Testing - Attribution Models: Last Click, Linear, Time Decay, Data-Driven Models - Multi-Channel Funnels - Conversion Rate Optimization	9
Unit IV	**Privacy, Governance & Reporting** Data Privacy Regulations: GDPR, CCPA, Data Governance - Ethical Data Collection & Usage - Dashboards and Reporting: Data Storytelling Techniques - Google Looker Studio - Dashboard Creation & Visualization	9
Unit V	**Applications, Case Studies & Careers** Case Studies: eCommerce, SaaS, Media Analytics - Cross-Platform Analytics - Web + Mobile Integration - Career Paths in Web Analytics: Roles & Certifications - Future Trends: AI in Analytics, Predictive Web Analytics	9

Recommended Learning Resources

Print Resources

TEXT BOOKS:

1. Avinash Kaushik, Web Analytics 2.0: The Art of Online Accountability & Science of Customer Centricity, Wiley, 2017.
2. Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc, 2010.

	REFERENCE BOOKS: 1. A. Karim Feroz, Gohar F. Khan, Marshall Sponder, Digital Analytics for Marketing, 2024. 2. Adriot Media, Mastering Google Analytics 4: A Comprehensive Guide, Instabooks.ai, 2024.
Syllabus Design: Dr. Sukhvinder Singh, Assistant Professor, PUDocs	

Year	I	Course Code: CSDA653 Course Title : DATA VISUALIZATION	Credits	3
Sem.	II		Hours	45
			Category	A

Course Prerequisites, if any	• Basic understanding of data handling	
Internal Assessment Marks: 40	**End Semester Marks:** 60	**Duration of ESA:** 03 hrs.

Course Outcomes

1. Apply fundamental data visualization principles effectively, including mapping data to visual aesthetics, coordinate systems, color theory.
2. Analyze and select appropriate visualization types based on data characteristics and storytelling objectives, while avoiding common design pitfalls.
3. Design and implement static data visualizations using Matplotlib and Pandas plotting capabilities
4. Develop advanced statistical data visualizations using Seaborn library, particularly for categorical data analysis
5. Create contextually appropriate visualizations that balance data accuracy with clear audience communication.

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	--	--	--	1	--	--	2	--	--	--	3	3	3
CO2	3	3	--	--	2	--	--	--	--	--	--	3	--	--
CO3	3	3	--	--	2	--	--	--	--	--	--	3	--	--
CO4	3	3	--	--	2	--	--	--	--	--	--	3	--	--
CO5	3	3	--	--	2	2	--	--	--	--	--	3	--	--

Unit No.	Course Contents	Hours
Unit I	**Introduction** From Data to Visualization – Definition – Mapping data on to aesthetics - Use of Data Visualization – Elements of Data Visualization – Importance of Data Visualization.	9
Unit II	**Visualization Basics** The power of visual storytelling – Good Examples of Data visualization – Benefits. Coordinate Systems and Axes – Color Scales. - Different types of charts and graphs used in Data visualization – Selecting right data visualization elements – Grouping – Software tools and libraries for Data visualization.	9
Unit III	**Directory of Visualizations** Amounts – Distributions – Proportions - xy relationships - Geospatial Data – Uncertainty. Common Pitfalls of Color use– Multipanel figures – Balancing Data and the Context	9
Unit IV	**Matplotlib and Pandas based plotting** Introduction to Matplotlib – Plotting functions – subplot functions – coloring – Building line plots – Bar plots – Scatter plots – Histogram – Pie charts.	9

	Pandas for plotting – Various plots with pandas data – A case study with pandas based plotting.	
Unit V	**Seaborn** Seaborn for visualization – Features – Benefits – Plotting with seaborn – Categorical data plotting with seaborn – Case studies using seaborn.	9
Recommended Learning Resources		
Print Resources	**TEXT BOOK:** *1.* Kalilur Rahmman, Python Data Visualization Essentials Guide, BPB publications, 2021. *2.* Claus O. Wilke, Fundamentals of Data Visualization, O'Reilly Media, 2019. **REFERENCE BOOK:** *1.* Cole Nussbaumer Knaflic, Storytelling With Data: A Data Visualization Guide For Business Professionals, Wiley publications, 2015.	
Syllabus design: Dr.K.S.Kuppusamy, Associate Professor, PUDoCS		

Year	I	Course Code: CSDA654 Course Title Web Analytics Lab	Credits	2
Sem.	II		Hours	30
			Category	B
Internal Assessment Marks: 40	End Semester Marks: 60		Duration of ESA: 03 hrs.	

Skills to be acquired:

- Ability to install and configure web analytics tools like Google Analytics and Matomo.
- Competence in interpreting web traffic data and behavior patterns.
- Skill in segmenting audiences and defining key metrics (KPIs).
- Understanding of user behavior flows and conversion funnels.
- Proficiency in dashboard creation, event tracking, and A/B testing.
- Data-driven decision-making based on user insights.

Lab Software Requirements:

- Google Analytics (GA4 – free online tool)
- Matomo Analytics (Open-source, self-hosted tool)
- Google Tag Manager
- Microsoft Excel / Google Sheets
- Power BI / Tableau (optional for dashboard visualization)
- Web browser (Chrome/Firefox)
- Basic website setup (can use WordPress or static HTML pages)

Course Outcome:

1. Understand the foundational concepts of web analytics and their applications.
2. Configure and use popular web analytics platforms to collect and analyze data.
3. Interpret user behaviour and traffic metrics to derive actionable insights.
4. Design and execute event tracking, goal conversions, and custom dashboards.
5. Apply web analytics tools to support business decisions and optimize UX.

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	3	-	-	-	-
CO2		3	-	2	-	-	-	-	-	-	3	-	2	-
CO3	2	3	-		-	-	-	-	-	2	3	-	-	-
CO4	2	2	3	3	-	-	-	-	-	2	2	3	3	-
CO5	2	2	2	2	-	-	-	-	-	2	2	2	2	-

List of Exercises:

1. Introduction to Google Analytics – Setting up an account and tracking a sample website
2. Understanding traffic sources and user segmentation
3. Configuring custom events and goals using Google Tag Manager
4. Analysing user behavior flow and identifying drop-off points
5. Comparative analysis using A/B testing with Google Optimize
6. Dashboards and reports: Creating custom reports in GA4
7. Real-time data analysis and anomaly detection
8. Setting up Matomo Analytics for local website tracking
9. Using filters and segments to analyze user cohorts and journeys
10. Case study: Deriving insights from a campaign performance dataset and suggesting improvements

Syllabus design: Dr. Sukhvinder Singh, Assistant Professor, PUDoCS

Year	I	Course Code: CSDA655	Credits	2
Sem.	II	Course Title : **Data Visualization Lab**	Hours	30
			Category	B

Internal Assessment Marks: 40	End Semester Marks: 60	Duration of ESA: 03 hrs.

Skills to be acquired:

- *Ability to convert raw data into effective visualization*

Lab Software Requirements:

- *Open Source Data visualization tools.*

Course Outcome:

1. *Understanding visual story telling through various charts.*
2. Analyse various chart types and choosing the optimal one suitable to the context.
3. Building interactive visualization.
4. Creating multipanel charts with effective visualization of data.
5. Creating effective visualization with seaborn

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	--	--	--	1	--	--	2	--	--	--	3	3	3
CO2	3	3	--	--	2	--	--	--	--	--	--	3	--	--
CO3	3	3	--	--	2	--	--	--	--	--	--	3	--	--
CO4	3	3	--	--	2	--	--	--	--	--	--	3	--	--
CO5	3	3	--	--	2	2	--	--	--	--	--	3	--	--

List of Exercises

Introduction & Visualization Basics (3 exercises)

1. **Visual Storytelling Dashboard** - Create a multi-panel infographic transforming raw sales data into compelling visual narratives using different chart types, implementing proper color scales, coordinate systems, and aesthetic mappings to demonstrate the journey from data to insight.
2. **Chart Selection Matrix** - Develop an interactive guide analyzing the same dataset (student performance metrics) through 6 different visualization types (bar, line, scatter, pie, histogram, box plot), documenting when and why each chart type is most effective with grouping strategies.
3. **Tool Comparison Portfolio** - Build identical visualizations using 3 different tools/libraries (Excel, Tableau Public, Python), comparing features, benefits, and limitations while creating bar charts, scatter plots, and trend lines from a common dataset.

Directory of Visualizations (4 exercises)

4. **Distribution Explorer** - Design visualizations showcasing different data amounts using bar charts and dot plots, then create distribution analyses using histograms, density plots, and box plots on population demographics data with proper uncertainty indicators.
5. **Proportion & Relationship Analyzer** - Build comprehensive proportion visualizations using pie charts, donut charts, and stacked bars for market share data, combined with xy relationship analysis through scatter plots and correlation matrices for sales vs. advertising spend.
6. **Geospatial Intelligence Dashboard** - Create an interactive map-based visualization showing regional sales performance, population density, or climate data using choropleth maps, bubble maps, and heat maps with proper geographic coordinate systems.

7. **Multipanel Figure Workshop** - Develop a complex multipanel visualization balancing data density with context, demonstrating proper color usage principles, avoiding common color pitfalls, and creating cohesive visual narratives across multiple subplots.

Matplotlib & Pandas Plotting (2 exercises)

8. **Matplotlib Mastery Project** - Build a comprehensive analytics report using matplotlib's plotting functions, subplot arrangements, custom coloring schemes, and all major plot types (line, bar, scatter, histogram, pie) to analyze time-series financial data with proper axes labeling and legends.
9. **Pandas Visualization Suite** - Create an end-to-end data analysis workflow using pandas plotting capabilities directly on DataFrame objects, implementing groupby visualizations, pivot table charts, and multi-index plotting for customer segmentation analysis.

Seaborn (1 exercise)

10. **Seaborn Statistical Storytelling** - Develop advanced statistical visualizations using seaborn's specialized functions for categorical data analysis (violin plots, swarm plots, box plots), regression analysis with confidence intervals, and correlation heatmaps, culminating in a complete exploratory data analysis case study on iris or tips dataset.

Syllabus Design: Dr. K S Kuppusamy, Associate Professor, PUDoCS.

Electives: Semester I

Year	I	Course Code: CSDA631	Credits	3
Sem.	I	Course Title: **DevOps**	Hours	45
			Category	A

Course Prerequisites, if any	• Students should have completed prior coursework or demonstrated proficiency in the following areas: fundamentals of computer science, building simple software applications
Internal Assessment Marks: 40	**End Semester Marks:** 60 / **Duration of ESA:** 03 hrs.
Course Outcomes	1. Understand the evolution, principles, and business value of DevOps 2. Learn the automation workflows of DevOps 3. Master infrastructure automation tools and techniques 4. Implement observability, monitoring, and security practices 5. Apply learning to real-world scenarios and future trends

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	--	--	2	3	2	--	--	1	2	--	2	--	1
CO2	3	--	--	3	3	2	--	--	--	1	--	3	--	2
CO3	3	--	--	3	3	2	--	--	--	1	--	3	--	2
CO4	3	--	--	3	3	2	--	--	--	3	--	3	--	2
CO5	3	--	--	3	3	3	--	--	--	2	--	3	--	3

Unit No.	Course Contents	Hours
Unit I	**Introduction to DevOps** Definition – History – Evolution - DevOps Culture & Mindset - CALMS framework - Agile vs. DevOps - Lean Principles in DevOps - The DevOps lifecycle: Plan, Develop, Build, Test, Release, Deploy, Operate, Monitor - Case Studies: DevOps transformations in leading companies	9
Unit II	**Continuous Integration & Continuous Delivery** Version Control Systems (Git, GitHub, GitLab) - CI Tools: Jenkins, GitLab CI - Building CI pipelines - Automated Testing in CI/CD - Continuous Delivery and Deployment Concepts - Containerization with Docker - Docker Compose for multi-container applications - Introduction to Kubernetes	9
Unit III	**Infrastructure as Code & Automation** Infrastructure as Code Concepts - Tools: Terraform, Ansible - Automating provisioning with Terraform - Configuration management with Ansible - Cloud Services: AWS, Azure basics for DevOps - Kubernetes Deep Dive	9
Unit IV	**Monitoring, Logging, and Security in DevOps** Importance - Tools: Prometheus, Grafana, ELK Stack - Site Reliability Engineering Principles - Incident management and post-mortem analysis - DevSecOps: Integrating Security into DevOps - Secure CI/CD pipelines - Compliance and governance in DevOps	9
Unit V	**Advanced Topics, Case Studies & Capstone Project** DevOps Metrics and KPIs - Advanced CI/CD patterns - Chaos Engineering: Introduction to resilience testing, Container - orchestration: Helm, Service Mesh - DevOps in Multi-cloud Environments - Industry case studies - Capstone Project: End-to-End DevOps pipeline for real application	9

Recommended Learning Resources	
Print Resources	**TEXT BOOKS:** *1.* Gene Kim, Jez Humble,Patrick, Debois, John Willis, The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations, IT Revolution Press, 2023. *2.* Joakim Verona, Michael Duffy, Paul Swartout, Learning DevOps: Continuously Deliver Better Software (2nd Edition)**,** Packt Publishing, 2022. *3.* Niall Richard Murphy, Betsy Beyer, Chris Jones, Jennifer Petoff, Site Reliability Engineering: How Google Runs Production Systems**,** O'Reilly Media, 2024. **REFERENCE BOOKS:** *1.* Nicole Forsgren, Jez Humble, Gene Kim, Accelerate: The Science of Lean Software and DevOps: Building and Scaling High Performing Technology Organizations, IT Revolution Press, 2023. *2.* Joakim Verona, Michael Duffy, Paul Swartout, Learning DevOps: Continuously Deliver Better Software, Packt Publishing, 2022.
Syllabus Design: Dr. Sukhvinder Singh, Assistant Professor, PUDoCS	

Year	I	Course Code: CSDA632	Credits	3
Sem.	I	Course Title: PYTHON PROGRAMMING	Hours	45
			Category	A

Course Prerequisites, if any	• Basic Knowledge in Programming Concepts
Internal Assessment Marks: 40	**End Semester Marks:** 60 / **Duration of ESA:** 03 hrs.
Course Outcomes	1. Understand the basics of writing Python code 2. Implement programs using lists, tuples and dictionaries 3. Understand the use of control structures 4. Ability to write programs using packages 5. Understand file manipulation

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	1	--	1	--	--	--	--	3	--	2
CO2	3	3	2	--	1	--	1	--	--	--	--	3	--	2
CO3	3	3	3	--	1	--	1	--	--	--	--	3	--	2
CO4	3	3	2	--	2	1	2	--	--	--	--	3	--	2
CO5	3	3	2	--	2	--	2	--	--	--	--	3	--	2

Unit No.	Course Contents	Hours
Unit I	**Introduction, Data types** Introduction to Python – Advantages of using Python – Executing Python Programs – Python's Core data types – Numeric Types – String Fundamentals.	9
Unit II	**Lists, Tuples, Dictionaries** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension.	9
Unit III	**Control Flow, Functions, Modules** Python Statements: Assignments – Expressions – If condition – While and For Loops. Functions: Definition, Calls – Scopes – Arguments – Recursive Functions– Functional Programming tools. Classes and Object Oriented programming with Python - Modules and Packages: Purpose, using packages– Exception Handling with Python.	9
Unit IV	**Packages** Packages: NumPy, Pandas, Scikit learn - Machine learning with Python – Cleaning up, Wrangling, Analysis, Visualization - Matplotlib package – Plotting Graphs.	9
Unit V	**File and Exception Handling** Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions	9

Recommended Learning Resources

Print Resources

TEXT BOOKS:

1. Mark Lutz, "Learning Python", O'Reilly, 2013.
2. Daniel Liang, "Introduction to programming using Python", Pearson, 2021.

	3. Wes Mc Kinney, “Python for Data Analysis”, O’Reilly Media, 2012. **REFERENCE BOOKS:** 1. Tim Hall and J-P Stacey, “Python 3 for Absolute Beginners”, Apress, 2009. 2. Mark Summerfield, “Programming in Python 3: A Complete Introduction to the Python Language”, Pearson Education, 2018.
Syllabus Design: Dr.V.Uma, Associate Professor, PUDoCS	

Year	I	Course Code: CSDA633	Credits	3
Sem.	I	Course Title: DATA WAREHOUSING AND MINING	Hours	45
			Category	A

Course Prerequisites, if any	• Basic Knowledge in Statistics and databases
Internal Assessment Marks: 40	**End Semester Marks:** 60 / **Duration of ESA:** 03 hrs.

Course Outcomes

1. Understand warehousing architectures and tools
2. Understand KDD process for finding interesting patterns
3. Remove Redundancy and incomplete data from the dataset using preprocessing
4. Characterize the kinds of patterns that can be discovered by ARM
5. Develop a DM application for data analysis using various tools.

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	--	2	1	1	--	--	2	1	3	1	2	2
CO2	3	2	--	2	1	1	--	--	2	1	3	1	2	2
CO3	3	2	--	2	1	1	--	--	2	1	3	1	2	2
CO4	3	2	--	2	1	1	--	--	2	1	3	1	2	2
CO5	3	2	--	2	1	1	--	--	2	1	3	1	2	2

Unit No.	Course Contents	Hours
Unit I	**Data Warehousing** Introduction – data warehousing Components – building a data warehouse – DB vs DW – architecture – schema design – data extraction – cleanup and transformation tools – Multi-dimensional data model – data cubes – snowflakes and Fact constellation – OLAP operations	9
Unit II	**Data Mining** Introduction – definition and functionalities – classification of DM systems – DM task Primitives – integration of a data mining systems with a DB and DW – issues in DM – KDD process – Data Preprocessing.	9
Unit III	**Association Rule Mining** Introduction – Mining of single dimensional Boolean Association rules, Multilevel association rules and Multidimensional association rules, correlation analysis, constraint-based association mining.	9
Unit IV	**Classification and Clustering** Classification by decision tree, Bayesian Classification, classification by back propagation, associative classification, prediction -Cluster Analysis – clustering using partitioning methods, Hierarchical Methods, Density based Methods, Grid based Methods and model-based Methods – algorithms for outlier analysis	9
Unit V	**Advance Mining** Introduction to Spatial and Temporal Mining – Web Mining – Text Mining with related Algorithms – case studies	9

Recommended Learning Resources	
Print Resources	**TEXT BOOKS:** 1. *Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining & OLAP", TataMcGraw Hill, 2017.* 2. *Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 2011.* **REFERENCE BOOKS:** 1. *Arun K. Pujari, "'Data Mining Techniques", University press, 2001.* 2. *K. Gupta, "Introduction to Data Mining with Case Studies", Easter Economy Edition, PHI, 2006.*
Syllabus Design: Dr. Pothula Sujatha, Professor, PuDoCS	

Electives: Semester II

Year	I	Course Code: CSDA671 Course Title: SOCIAL NETWORK ANALYTICS	Credits	3
Sem.	II		Hours	45
			Category	A

Course Prerequisites, if any	• Basic understanding of graphs, linear algebra, probability, and algorithms. • Basic programming knowledge, preferably in Python, for implementing network analysis techniques.
Internal Assessment Marks: 40	**End Semester Marks:** 60 / **Duration of ESA:** 03 hrs.
Course Outcomes	1. Understand social media mining concepts and apply graph basics to represent networks. 2. Analyze network measures like centrality, similarity, and transitivity. 3. Evaluate network models to explain real-world network structures. 4. Apply methods to detect communities and understand information diffusion. *5.* Analyze influence, homophily, and apply recommendation techniques.

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2	--	--	--	2	2	2	2	--	3	2
CO2	3	2	1	1	--	--	--	2	2	2	2	--	3	2
CO3	3	2	1	1	--	--	--	2	2	2	2	--	3	2
CO4	3	3	1	1	--	--	--	2	2	2	1	--	3	2
CO5	3	3	1	1	--	--	--	3	2	2	1	--	3	2

Unit No.	Course Contents	Hours
Unit I	**Introduction** Social Media Mining - New Challenges for Mining - Graph Essentials: Graph basics - Graph Representation - Types of Graphs - Connectivity in Graphs - Special Graphs - Graph Algorithms.	9
Unit II	**Network Measures** Centrality - Degree Centrality - Eigenvector Centrality - Katz Centrality – PageRank - Betweenness Centrality - Closeness Centrality - Group Centrality - Transitivity and Reciprocity - Balance and Status – Similarity - Structural Equivalence - Regular Equivalence.	9
Unit III	**Network Models** Properties of Real-World Networks - Degree Distribution - Clustering Coefficient - Average Path Length - Random Graphs - Evolution - Properties - Small-World Model - Preferential Attachment Model.	9
Unit IV	**Communities and Interactions** Community Analysis: Community Detection - Community Evolution - Community Evaluation. Information Diffusion in Social Media : Herd Behaviour - Information Cascades - Diffusion of Innovations - Epidemics.	9
Unit V	**Applications** Influence and Homophily **-** Measuring Assortativity - Measuring and Modelling Influence - Measuring and Modelling Homophily - Distinguishing Influence and Homophily - Shuffle Test - Edge-Reversal Test - Randomization Test - Recommendation in Social Media. Case study: Classification and Analysis of Facebook Metrics Dataset Using Supervised Classifiers	9

Recommended Learning Resources	
Print Resources	**TEXT BOOKS:** 1. Zafarani, Reza, Mohammad Ali Abbasi, and Huan Liu, "Social Media Mining: An Introduction", Cambridge University Press, 2015. **REFERENCE BOOKS:** 1. Nilanjan Dey Samarjeet Borah Rosalina Babo Amira Ashour, "Social Network Analytics – Computational Research Methods and Techniques", Academic Press, 2018. 2. Cioffi-Revilla, Claudio, "Introduction to Computational Social Science", Springer, 2014.
Syllabus Design: Dr. M. Sathya, Assistant Professor, PUDoCS	

Year	I	Course Code: CSDA672 Course Title: FULL STACK DEVELOPMENT	Credits	3
Sem.	II		Hours	45
			Category	A

Course Prerequisites, if any	• Basic Understanding of Computer Programming
Internal Assessment Marks: 40	**End Semester Marks:** 60 / **Duration of ESA:** 03 hrs.

Course Outcomes

1. *Analyze web architecture fundamentals including protocols, components, domain name systems, and the evolution of web technologies and applications.*
2. *Develop interactive client-side applications using HTML5, CSS styling techniques, JavaScript DOM manipulation, and modern frameworks for dynamic user experiences.*
3. *Build full-stack applications using the MERN stack (MongoDB, Express.js, React.js, Node.js) with component-based architecture and state management.*
4. *Implement backend services and APIs using Express.js routing, request handling, and both RESTful and GraphQL approaches for efficient data communication.*
5. *Manage MongoDB database operations including CRUD operations, query language implementation, and apply modularization techniques with build tools like Webpack*

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	--	--	1	1	--	--	--	--	--	--	--	--	--
CO2	3	2	--	3	2	--	--	--	--	--	--	1	--	--
CO3	3	2	--	3	2	--	--	--	--	--	--	1	--	--
CO4	3	2	--	3	2	--	--	--	--	--	--	--	--	--
CO5	3	--	--	3	2	--	--	--	--	--	2	2	--	--

Unit No.	Course Contents	Hours
Unit I	**Web Foundations** Evolution – Applications – Protocols – Components of Web – Domain Name Systems.	8
Unit II	**Client Side Scripting** HTML – Structure – Tags – HTML 5 Components – CSS – Benefits – Types – Styling rules. Javascript : Introduction – DOM – Event Handling – Case study with frameworks –case study.	9
Unit III	**MERN Components** Setting up the environment –MERN: MongoDB – Express – React - Node JS - Building simple apps - React components – React state	10
Unit IV	**Express and GraphQL** Routing – Request matching – Route parameters – Handler functions – REST API – GraphQL.	9
Unit V	**Mongo DB:** Documents – Collections – Databases – Query language – MongoDB CURD operations. MongoDB Node.js Driver, Schema Initialization, Reading from MongoDB, Writing to MongoDB. **Modularization and Webpack:** Backend modules – Frontend modules – Transform and bundle.	9

Recommended Learning Resources	
Print Resources	**TEXT BOOKS:** 1. Vasan Subramanian, Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Apress, 2019. 2. Godbole, Khate, Web Technologies, McGraw Hill Education, 2017. **REFERENCE BOOKS:** 1. M. Srinivasan, Web Technology: Theory and Practice Pearson India, 2012. 2. K. Yuen, V. Lau., Practical Web Technologies Pearson, 2003. 3. John Paul Mueller, Security for Web Developers, O'Reilly Media, 2015.
Syllabus Design: Dr. K S Kuppusamy, Associate Professor, PUDoCS	

Year	I	Course Code: CSDA673	Credits	3
Sem.	II	Course Title: Financial and Risk Analytics	Hours	45
			Category	A

Course Prerequisites, if any	• Student should have Basic Programming, Mathematics, Machine Learning, Data Analysis, and understanding of Data Types
Internal Assessment Marks: 40	**End Semester Marks:** 60 / **Duration of ESA:** 03 hrs.
Course Outcomes	1. Understand and classify major types of financial risks. 2. Apply quantitative risk measurement techniques. 3. Analyze the structure and functions of financial institutions 4. Evaluate the impact of modern challenges *5.* Design integrated risk management strategies

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	--	--	2	--	--	--	--	3	2	3	2
CO2	3	2	3	--	--	1	--	--	--	--	3	3	3	2
CO3	3	1	3	--	--	3	--	--	--	--	2	2	3	2
CO4	3	1	3	--	--	2	--	--	--	--	2	2	3	2
CO5	3	1	3	--	--	2	--	--	--	--	2	3	3	3

Unit No.	Course Contents	Hours
Unit I	**Foundations of Financial Risk and Institutions** Introduction - Importance and Objectives - Types of Financial Risks - Risk vs. Uncertainty - Financial Institutions Overview - Regulatory Environment - Risk Management by Central Authorities	9
Unit II	**Market Risk and Measurement Techniques** Fundamentals - Value at Risk - Stress Testing and Scenario Analysis - Measuring Volatility - Historical Simulation, Delta-Normal Method - Model Risk Management - Governance Frameworks for Models	9
Unit III	**Credit Risk and Liquidity Risk** Credit Risk Management - Credit Scoring and Rating Systems - Credit Derivatives and Credit Default Swaps - Counterparty Risk - Liquidity Risk - Types: Funding vs. Market Liquidity Risk - Measuring and Managing Liquidity Risk - Collateral Management	9
Unit IV	**Operational, Cyber, and Climate Risks** Definition, Framework, and Mitigation - Cyber Risk - Risks from Digital Transformation - Cyber Risk Regulations - Climate Risk - ESG Risk Management - Integrating Climate Risk in Financial Models	9
Unit V	**Risk Management Best Practices & Regulatory Compliance** Enterprise Risk Management - Integrating Risks Across the Enterprise - Financial Regulation Overview - Stress Tests and Reporting Requirements - Future Trends in Risk Management - AI & Machine Learning in Risk Analytics - RegTech innovations	9

Recommended Learning Resources

Print Resources

TEXT BOOKS:

1. John C. Hull, Risk Management and Financial Institutions, Wiley, 2023.

REFERENCE BOOKS:

2. Angelo Corelli, *Understanding Financial Risk Management,* Emerald Publishing, 2024.

Syllabus Design: Dr. Sukhvinder Singh, Assistant Professor, PUDoCS

Year	I	Course Code: CSDA674 Course Title: ACCESSIBILITY ANALYTICS	Credits	3
Sem.	II		Hours	45
			Category	A

Course Prerequisites, if any	• Basic Understanding of User Interface Design.

Internal Assessment Marks: 40	End Semester Marks: 60	Duration of ESA: 03 hrs.

Course Outcomes

1. Understand the principles of web accessibility, including universal design, types of disabilities, assistive technologies, and the need for inclusive web design.
2. Apply Web Content Accessibility Guidelines (WCAG) to evaluate and enhance web content based on the principles of perceivability, operability, understandability, and robustness.
3. Compare and utilize various accessibility analysis tools, both open-source and commercial, for identifying and resolving accessibility issues.
4. Conduct comprehensive accessibility evaluations using personas, heuristic methods, usability testing, and design walkthroughs to ensure standards compliance.
5. Analyze and improve mobile web accessibility, considering specific challenges such as screen size, contrast, touch interaction, and keyboard navigation, using specialized tools and WCAG mapping techniques.

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	--	2	2	1	3	--	--	--	3	2	1	3	2
CO2	3	--	2	1	2	1	--	--	--	3	1	--	3	2
CO3	2	--	2	1	2	1	--	--	--	2	1	--	3	2
CO4	3	--	2	1	3	2	--	--	--	3	1	--	3	3
CO5	3	--	2	1	2	2	--	--	--	3	1	--	3	2

Unit No.	Course Contents	Hours
Unit I	**Introduction** Web accessibility - Definitions – Universal Design – Disabilities and Accessibility Requirements – Introduction to Accessible web design – Accessibility Myths – Assistive Technologies.	8
Unit II	**Accessibility analytics Guidelines** Basics of Web Content Accessibility Guidelines – Principles : Perceivable – Operable – Understandable – Robust – Various Levels of Accessibility – WCAG standards evaluation tools and Comparative analysis.	9
Unit III	**Accessibility Analysis tools** Introduction to web accessibility analysis tools: Open Source vs. commercial – Features of accessibility analysis tools.	10
Unit IV	**Personalized Analytics** Personas and Scenarios - Comprehensive Accessibility Evaluation – Standards Review – Heuristic Evaluation – Design Walkthroughs – Screening Techniques – Usability Testing.	9
Unit V	**Mobile Accessibility Analytics** Mobile Accessibility analysis : Success criterion and components – Mapping WCAG to Mobile devices : Screen size factors – Contrast – Keyboard control for touchscreen devices – touch target size and spacing – device manipulation gestures – Tools for analysing mobile accessibility..	9

Recommended Learning Resources	
Print Resources	**TEXT BOOKS:** 1. Manuel Matuzovic, Web Accessibility Cookbook, O'Reilly Media, 2024. 2. Colin Shanley, Cracking Accessibility on Mobile Devices: The definitive field guide to accessibility and digital inclusion for business managers and project teams, RS Books Publishers, 2016.
Syllabus Design: Dr. K S Kuppusamy, Associate Professor, PUDoCS.	

Year	I	Course Code: CSDA675	Credits	3
Sem.	II	Course Title: OPTIMIZATION TECHNIQUES FOR ANALYTICS	Hours	45
			Category	A

Course Prerequisites, if any	• Basic knowledge of linear algebra, calculus, and probability. • Familiarity with Python programming and data analysis techniques.
Internal Assessment Marks: 40	**End Semester Marks:** 60 — **Duration of ESA:** 03 hrs.
Course Outcomes	1. Describe basic optimization concepts and methods like least squares, SVM, and convex functions. 2. Use descent methods to solve convex and smooth optimization problems. 3. Analyze momentum and stochastic gradient methods in machine learning. 4. Apply first-order methods to constrained and non-smooth optimization. 5. Develop dual optimization algorithms and apply them to real-world problems.

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	--	2	2	--	--	2	--	--	--	3	1	--	--
CO2	3	--	3	3	--	--	2	--	--	--	3	1	--	--
CO3	3	--	3	2	--	--	2	--	--	--	3	1	--	--
CO4	3	--	3	3	--	--	2	--	--	--	2	1	--	--
CO5	3	--	3	3	--	--	3	--	--	--	2	1	--	--

Unit No.	Course Contents	Hours
Unit I	**Introduction** Data Analysis and Optimization - Least Squares - Matrix Factorization Problems - SVM - LR - Deep Learning - Foundations of Smooth Optimization - A Taxonomy of Solutions to Optimization Problems - Taylor's Theorem - Characterizing Minima of Smooth Functions - Convex Sets and Functions - Strongly Convex Functions.	9
Unit II	**Descent Methods** Descent Directions - Steepest-Descent Method - General Case - Convex Case - Strongly Convex Case - Comparison between Rates - Descent Methods: Convergence - Line-Search Methods - Convergence to Approximate Second-Order Necessary Points - Mirror Descent - The KL and PL Properties.	9
Unit III	**Gradient Methods Using Momentum** Differential Equations - Nesterov's Method: Convex Quadratics - Convergence for Strongly Convex Functions and Weakly Convex Functions - Conjugate Gradient Methods - Lower Bounds on Convergence Rates - Stochastic Gradient : Noisy Gradients - Incremental Gradient Method - Classification and Perceptron - Empirical Risk Minimization - Randomness and Step-length - Convergence Analysis - Epochs - Mini-batching. **Coordinate Descent** Coordinate Descent in Machine Learning - Coordinate Descent for Smooth Convex Functions - Block-Coordinate Descent.	9
Unit IV	**First-Order Methods for Constrained Optimization** Optimality Conditions - Euclidean Projection - Projected Gradient Algorithm - Conditional Gradient (Frank–Wolfe) Method	9

	Non-smooth Functions and Sub-gradients Sub-gradients and Subdifferentials - Subdifferential and Directional Derivatives - Calculus of Subdifferentials - Convex Sets and Convex Constrained Optimization - Optimality Conditions for Composite Non-smooth Functions - Non-smooth Optimization Methods.	
Unit V	**Duality and Algorithms** Quadratic Penalty Function - Lagrangians and Duality - First-Order Optimality Conditions - Strong Duality - Dual Algorithms - Applications of Dual Algorithms: Consensus Optimization - Utility Maximization - Linear and Quadratic Programming. **Differentiation and Adjoints** Chain Rule for a Nested Composition of Vector Functions - Method of Adjoints - Adjoints in Deep Learning - Automatic Differentiation - Derivations via Lagrangian and Implicit Function Theorem.	9
Recommended Learning Resources		
Print Resources	**TEXT BOOKS:** 1. Stephen J. Wright, Benjamin Recht, “Optimization for Data Analysis”, Cambridge University Press, 2022. **REFERENCE BOOKS:** 1. Richard W. Cottle and Mukund N. Thapa, "Linear and Nonlinear Optimization", ISBN, Springer, 2017. 2. Gerard Cornuejols and Reha Tutuncu, "Optimization Methods in Finance”, Cambridge University Press, 2013.	
Syllabus Design: Dr. M. Sathya, Assistant Professor, PUDoCS		

Year	I	Course Code: CSDA675	Credits	3
Sem.	II	Course Title: IOT AND PREDICTIVE ANALYTICS	Hours	45
			Category	A

Course Prerequisites, if any	• Basic knowledge of programming, statistics, machine learning, databases, and computer networks.
Internal Assessment Marks: 40	**End Semester Marks:** 60 / **Duration of ESA:** 03 hrs.

Course Outcomes

1. Understand IoT architecture, components, and communication protocols.
2. Collect, store, and preprocess IoT data for analytics.
3. Apply predictive models for analysis and forecasting.
4. Perform predictive analytics on IoT data for real-world use cases.
5. Evaluate IoT platforms and explore future trends.

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	--	--	2	--	--	--	--	--	--	2	1	3	2
CO2	3	--	--	1	--	1	--	--	--	--	2	--	3	2
CO3	2	--	--	1	--	1	--	--	--	--	2	--	3	2
CO4	3	--	--	1	--	2	--	--	--	--	2	--	3	3
CO5	3	--	--	1	--	2	--	--	--	--	2	--	3	2

Unit No.	Course Contents	Hours
Unit I	**Introduction to IoT** Definition and Evolution of IoT – IoT Ecosystem – IoT Architecture – Physical and Logical Design – IoT Enabling Technologies – Sensors and Actuators – Communication Protocols (Zigbee – Bluetooth – MQTT – HTTP – CoAP) – IoT Applications in Data Analytics	9
Unit II	**IoT Data Acquisition and Management** Data Collection from IoT Devices – Streaming Data and Time-Series – Edge vs. Cloud Computing – Data Storage Solutions (InfluxDB – MongoDB – AWS IoT Core) – Real-Time Data Processing – Sensor Data Characteristics – Preprocessing IoT Data for Analytics	9
Unit III	**Introduction to Predictive Analytics:** Definition and Importance – Types of Predictive Models – Supervised Learning Techniques – Linear and Logistic Regression – Decision Trees – Random Forests – Time Series Forecasting – Model Evaluation: MAE – RMSE – R^2 – Cross-Validation	9
Unit IV	**Predictive Analytics on IoT Data** Data Integration from IoT Sources – Feature Engineering for Sensor Data – Predictive Maintenance – Anomaly Detection – Forecasting with IoT Data (ARIMA – LSTM – Prophet) – Visualization and Dashboarding – Case Studies in Smart Cities, Healthcare, and Industry 4.0	9
Unit V	**IoT Platforms and Future Trends:** Overview of IoT Platforms (ThingSpeak – AWS IoT – Google Cloud IoT – Azure IoT Hub) – Security and Privacy in IoT Data – Ethics in Predictive Analytics – Federated Learning for IoT – Edge AI – Role of AI/ML in Future IoT Systems – Research Directions	9

Recommended Learning Resources	
Print Resources	**Text Books:** 1. Arshdeep Bahga & Vijay Madisetti, Internet of Things: A Hands-On Approach, Techno Series, 2023. 2. Eric Siegel, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Wiley, 2016.
Syllabus design: Dr. T. Vengattaraman, Associate Professor, PUDoCS	

Year	I	Course Code: CSDA676	Credits	3
Sem.	II	Course Title: LINEAR ALGEBRA	Hours	45
			Category	A

Course Prerequisites, if any	• Basic understanding of algebra and functions. • Knowledge of solving equations, polynomials, and graphing.
Internal Assessment Marks: 40	**End Semester Marks:** 60 / **Duration of ESA:** 03 hrs.

Course Outcomes

1. Solve linear systems using matrix methods and understand their geometric meaning.
2. Comprehend vector spaces and subspaces.
3. Analyze linear maps, matrix forms, and perform change of basis and projections.
4. Use determinants and eigen concepts to study matrix similarity and diagonalization.
5. Apply least squares and matrix factorizations.

CO, PO & PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	--	3	--	--	--	--	--	--	--	3	--	--	--
CO2	3	--	3	--	--	--	--	--	--	--	3	--	--	--
CO3	3	--	3	--	--	--	--	--	--	--	3	--	--	--
CO4	3	--	2	--	--	--	--	--	--	--	3	--	--	--
CO5	3	--	3	--	--	--	--	--	--	--	3	--	--	--

Unit No.	Course Contents	Hours
Unit I	**Linear Systems** Solving Linear Systems - Gauss's Method - Describing the Solution Set - Linear Geometry - Vectors in Space - Length and Angle Measures - Reduced Echelon Form - Gauss-Jordan Reduction - The Linear Combination Lemma.	9
Unit II	**Vector Spaces** Definition - Subspaces and Spanning Sets - Linear Independence - Basis and Dimension - Vector Spaces and Linear Systems - Combining Subspaces - Dimensional Analysis.	9
Unit III	**Maps Between Spaces** Isomorphisms - Dimension Characterizes Isomorphism - Homomorphisms - Range Space and Null Space - Computing Linear Maps - Representing Linear Maps with Matrices - Matrix Operations - Sums and Scalar Products - Matrix Multiplication - Mechanics of Matrix Multiplication - Inverses - Changing Representations of Vectors - Changing Map Representations - Projection.	9
Unit IV	**Determinants** Definition - Exploration - Properties of Determinants - The Permutation Expansion - Determinants Exist - Geometry of Determinants - Determinants as Size Functions - Laplace's Formula - Laplace's Expansion.	9
Unit V	**Similarity** Complex Vector Spaces - Polynomial Factoring and Complex Numbers - Complex Representations - Definition - Diagonalizability - Eigenvalues and Eigenvectors - Self-Composition - Strings - Polynomials of Maps and Matrices - Jordan Canonical Form. **Least Squares and Factorisations** Least Squares - LU Factorisation – QR Factorisation - Singular Value.	9

Recommended Learning Resources	
Print Resources	**TEXT BOOKS:** 1. Jim Hefferon, “Linear Algebra”, Orthogonal Publishing L3c, 2020. **REFERENCE BOOKS:** 1. Serge Lang, “Introduction to Linear Algebra", First Edition, Springer Verlag, 1986. 2. David Lay, Steven Lay, Judi McDonald, “Linear Algebra and Its Applications”, Pearson Education Limited, 2022.
Syllabus Design: Dr. M. Sathya, Assistant Professor, PUDoCS	