PONDICHERRY UNIVERSITY
(A CENTRAL UNIVERSITY)

B.Sc. Artificial Intelligence and Machine Learning (Honors)

B.Sc. Artificial Intelligence and Machine Learning (Honors with Research)

REGULATIONS, CURRICULUM & SYLLABUS
(For Affiliated Colleges)

(Under the National Education Policy 2020)

Effective from the Academic Year 2023 - 2024

Revised in June 2024

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TABLE OF CONTENTS

1. PREAMBLE AND PROGRAMME OUTCOMES

1.1 Preamble

Welcome to the undergraduate course on Artificial Intelligence and Machine Learning. This course offers an exciting and dynamic exploration of the cutting-edge field that is revolutionizing the way we interact with technology and understand the world around us.

Artificial Intelligence and Machine Learning are at the forefront of technological innovation, and this course is designed to equip you with the knowledge and skills necessary to understand, develop, and apply these transformative technologies.

This course is a comprehensive and in-depth introduction to the theory, practice, and application of Artificial Intelligence (AI) and Machine Learning (ML). In an era characterized by unprecedented data availability and computational power, the study of AI and ML has become essential for understanding how machines can learn, adapt, and make intelligent decisions.

1.2 Programme Outcomes

After the completion of this program, the students will be able to:

1. **Understand the foundations of AI and ML**: Students will delve into the fundamental concepts that underpin AI and ML, including algorithms, data visualization, and mathematical prerequisites.

2. **Understand the basics of ML**: Gain a deep understanding of supervised and unsupervised learning, feature engineering, model selection, and the mathematics behind common ML algorithms.

3. **Apply the Deep Learning Concepts**: Explore neural networks, convolutional and recurrent networks, and discover the principles that enable the students to excel in tasks like image recognition, natural language processing, and beyond.

4. **Understand the scope of AI & ML**: Investigate the myriad ways in which AI and ML are used in practice, including autonomous vehicles, healthcare, finance, recommendation systems, and more.

5. **Analyze the Ethical and Legal Issues in AI**: Analyze the ethical and legal implications and challenges associated with AI and ML, including issues related to bias, fairness, transparency, and accountability.

6. **Evaluate the emerging tools in AI**: The students will be able to evaluate the modern AI tools in solving their problems. They would be able to stay abreast of the latest developments, research, and trends in AI and ML, as the field continuously evolves.

7. **Create solutions for real-world problems**: Hone critical thinking and problem-solving abilities through practical assignments and projects that tackle real-world challenges. Students will learn to build predictive models using popular programming languages, libraries, and frameworks.

Upon completion of the Bachelor of Science (B.Sc.) programme in Artificial Intelligence and Machine Learning, students will demonstrate the following outcomes at:

UG Certificate Level

- Acquire foundational knowledge in Artificial Intelligence and Machine Learning.
- Demonstrate basic skills in data visualisation.

UG Diploma Level

- Develop intermediate-level knowledge and skills in AI & ML.
- Apply ML concepts for problem-solving.

UG Degree Level

- Attain advanced knowledge and skills in AI & ML.
- Demonstrate proficiency in ML based problem-solving and programming.

UG Degree with Honors (or) Honors with Research

- Demonstrate proficiency in Machine learning model building and fine tuning.
- Apply ML algorithms to solve complex real world problems.
- Exhibit effective communication skills in conveying technical concepts orally and in writing.
- Engage in collaborative projects and demonstrate the ability to work effectively in a team.
- Considering ethical aspects in applying AI for professional and societal contexts.
- Possess a comprehensive understanding in recent trends in AI & ML.

This course offers the student a unique opportunity to explore the frontiers of technology and be part of a global community of learners and innovators.

Whether the student aspires to be a researcher, developer, entrepreneur, or simply want to gain a deeper understanding of AI and ML, this course will provide the student with the foundation needed to excel in the chosen path.

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: A credit is the number of hours of instruction required per week for the given subject in a given semester of 16-18 weeks. One credit is equivalent to 15 hours of teaching (lecture or tutorial) or 30 hours of practice/field work/community engagement and service per Semester.

B. Academic Year: Means the year starting on 1st day of July and ends on the 30th day of June in the succeeding year.

C. Residence time: Means the time a student spends for attending classes in the College/Institution (either Online/Offline) as a full-time student and enrolled in any Academic program of the Institution.

D. Semester: Means 18 weeks (90 Working days) of teaching-learning sessions of which two weeks shall be set apart for examinations and evaluation.

E. Grade: Means a letter grade assigned to a student in a Course for his/her 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, and F=0, Ab=0.

F. Grade Point Average (GPA): Means an average of the Grades secured by a student in all courses in a given academic session duly weighted by the number of credits associated to each of the courses.

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

H. A common Course: Means the set of courses that all students who are admitted to any Program of the University are required to study these courses include, Languages (English-Modern Indian Languages), NEP specific courses-viz. Understanding India, Environmental sciences/Education, Health and wellbeing/Yoga, Digital & Technological solutions.

I. Major Discipline: Means the core subjects mandatory for the program, Major discipline may be a single discipline or interdisciplinary/ multidisciplinary courses. eg. B.Sc. (Physics) or B.Sc. (Physics, Maths and Chemistry).

J. Minor Discipline: Means courses which are specific to specialization in Computer Science.

K. 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.

L. Exit option: Means the option exercised by the students, to leave the Programme at the end of any given Academic year.

M. Lateral entry: Means a student being admitted into an ongoing Programme of the University otherwise than in the 1st year of the programme.

N. Vocational Studies/Education: This refers to set of activities for participation in an approved project or practical or lab, practices of application of scientific theories, studio activities involving students in creative artistic activities, workshop-based activities, field-based shop-floor learning, and Community engagement services, etc. (These courses are expected to enable students to incorporate the learned skills in daily life and start up entrepreneurship.)

O. Skill-based learning/project: This refers to activities designed to understand the different socio-economic contexts, first-hand understanding of the policies, regulations, organizational structures, processes, and programmes that guide the development process.

P. Work-based internship: Means structured internships with Software Companies, Research and Higher Educational Institution Laboratories, Corporate offices, etc. which will further improve employability.

3. DURATION, ELIGIBILITY & AWARD OF UG DEGREE/ DIPLOMA/ CERTIFICATE

3.1. Duration of the Programme

The duration of the UG programme is 4 years or 8 semesters. Students who desire to undergo a Three-year UG Programme will be allowed to exit after completion of the 3rd year. If a student wants to leave after the completion of the first or second year, the student will be given a UG Certificate or UG Diploma, respectively, provided they secure the prescribed number of credits (as given in the Table 1).

3.2. Eligibility

Senior Secondary School Leaving Certificate or Higher Secondary (12th Grade) Certificate obtained after successful completion of Grade 12 or equivalent stage of education corresponding to Level-4 (Levels in NHEQF). **For detailed eligibility, refer the Admissions and Lateral Entry Section.**

3.3. Awarding of UG Certificate, UG Diploma and Degrees Nomenclature

Four years B.Sc. Degree Programme shall have options for earning a Certificate / Diploma / UG Degree / UG Degree (Honors) / UG Degree (Honors with Research) based on the exit option exercised by the candidates.

3.3.1. UG Certificate

Students who opt to exit after completion of the first year (2 Semesters) and have earned a minimum of 40 credits will be awarded a UG certificate in Data Visualisation if, in addition, they complete work based vocational course / internship of 4 credits during the summer vacation of the first year.

3.3.2. UG Diploma

Students who opt to exit after completion of the second year (4 Semesters) and have earned a minimum of 80 credits will be awarded the UG diploma in Artificial Intelligence and Machine Learning if, in addition, they complete work based vocational course / internship of 4 credits during the summer vacation of the second year.

3.3.3. Three-year UG Degree

Students who wish to discontinue after the 3-year (6 Semesters) UG programme will be awarded a UG Degree in Artificial Intelligence and Machine Learning after successful completion of three years, earning a minimum of 120 credits and satisfying the minimum credit requirements as mentioned in the Table1.

3.3.4. Four-year UG Degree (Honors)

A four-year UG Honors degree in the Artificial Intelligence and Machine Learning will be awarded to those who complete a four-year (8 Semesters) degree programme, earning a minimum of 160 credits and have satisfied the credit requirements as mentioned in Table1 below.

3.3.5. Four-year UG Degree (Honors with Research)

Students who secure a minimum of 7.5 CGPA in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a faculty member of the University.

The research project/dissertation will be in the major discipline of Artificial Intelligence and Machine Learning. The students who secure a minimum of 160 credits, including 12 credits from a research project/dissertation, will be awarded UG Degree in Artificial Intelligence and Machine Learning (Honors with Research).

3.3.6. Programme overview

As per the guidelines of NEP, students are mandated to complete 120 credits to complete a basic Bachelor's Degree in 3 years. With an additional 40 credits of course work one can pursue 4th Year Honors or Honors with Research Degree. The UG Programme will consist of the following categories of courses and the minimum credit requirements for 3-year UG and 4-year UG (Honors) or UG (Honors with Research) programmes are given in the Table 1.

Table 1: Breakup of Credits and Courses – Minimum Requirements

S.No.	Component	3 Year UG	4 Year UG (Honors/ Honors with research)
1	Major Disciplinary - Computer Science	60 Credits (15 Courses of 4 credits)	80 Credits (20 Courses of 4 credits)
2	Minor Disciplinary – Specialization Courses	24 Credits (6 Courses of 4 Credits)	32 Credits (8 Courses of 4 credits)
3	Multi-Disciplinary Courses	9 Credits (3 courses of 3 credits)	9 Credits (3 courses of 3 credits)
4	Ability Enhancement Courses	8 Credits (4 courses of 2 credits)	8 Credits (4 courses of 2 credits)
5	Skill Enhancement Course – On the chosen Specialization	9 Credits (3 courses of 3 credits)	9 Credits (3courses of 3 credits)
6	Value-added courses	8 Credits (4 courses of 2 credits)	8 Credits (4 courses of 2 credits)
7	Summer internship	4 Credits (Included in Major courses of 60 credits)	4 Credits (Included in Major courses of 80 credits)
8	Community engagement and service	2 Credits (1 Field based Course)	2 Credits (1 Field based Course)
9	Research Dissertation Project	-	12 Credits
	Total	**120**	**160**

Note: Honors students not undertaking research will do 3 courses for 12 credits in lieu of a Research Project / Dissertation.

3.3.7. Degree and Nomenclature

Candidates who complete Eight semesters and earn a minimum of 160 credits and have satisfied the credit requirements as mentioned in the Table 1 will be awarded either of the following degrees.

- B.Sc. Artificial Intelligence and Machine Learning *
- B.Sc. Artificial Intelligence and Machine Learning (Honors) #
- B.Sc. Artificial Intelligence and Machine Learning (Honors with Research) ##

* for candidates who wish to exit at the end of third year with 120 credits earned and satisfied the other minimum requirements given in 3.3.9.

for candidates who complete 3 theory courses (MJD 21, MJD 22, and MJD 23) instead of the research project work in the Eighth Semester

for candidates who complete a research project work in the Eighth Semester

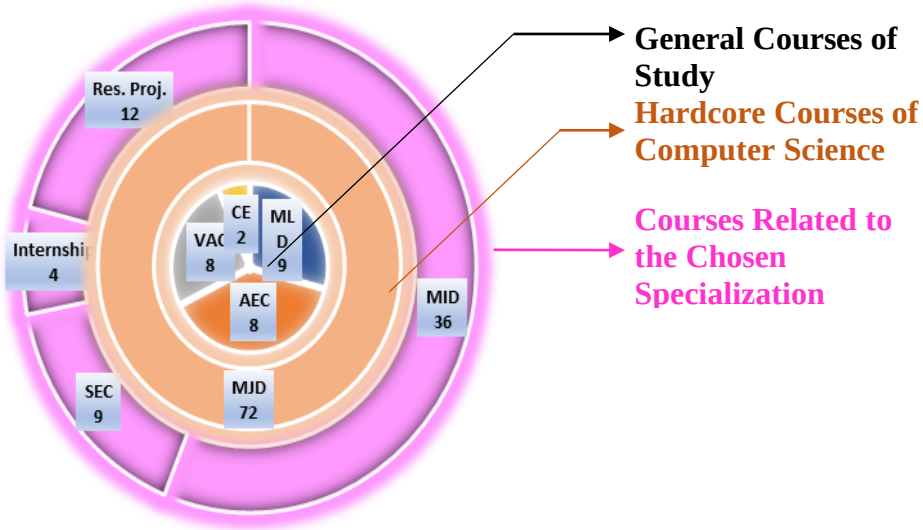
3.3.8. Degree with Specialization

Out of the above said 160 credits (Table1) the candidates shall earn 103 credits (83 credits out of 120 credits in the case of 3 year UG) from the Hardcore courses (Major Disciplinary, Multi-disciplinary, Ability Enhancement, Value added Courses and Community Engagement and Service) and the remaining 57 credits (37 credits in the case of 3 year UG) shall be earned from the subjects they choose to study from the list of softcore courses. These 57 credits shall be earned through studying the specialization courses in Minor Disciplinary – Specialization Courses, Skill Enhancement Courses in all the semesters and the Research Project or the Courses the candidates choose to study in the Eighth Semester. The Programme Structure is detailed in the Figure 1.

3.3.9. Exit Options and Nomenclature of Certificate, Diploma

Candidates can exercise the following exit options and obtain the said certificate or diploma or degree, if the minimum required credits are earned and other conditions are met. Students exercising the option of exit at the end of 2nd semester or 4th semester need to have completed an internship for atleast 8 weeks along with the necessary credit requirements to qualify for the relevant certificate or diploma. In any case, every student, whenever exit (or complete the 4 year programme), should have completed atleast one internship for a minimum period of 8 weeks.

Figure 1: Programme Structure with credit breakup



Exit after 2nd Semester: Certificate in Data Visualisation will be awarded for candidates who exit the course at the end of 2nd semester and earned a minimum of 40 credits and have completed a Summer Internship of 4 credits for a minimum period of 8 weeks, during the summer vacation post 2nd semester.

Exit after 4th Semester: Diploma in Artificial Intelligence and Machine Learning will be awarded for candidates who exit the course at the end of 4th semester and earned a minimum of 80 credits and have completed a Summer Internship of 4 credits for a minimum period of 8 weeks, during the summer vacation post 4th semester.

Exit after 6th Semester: UG Degree in Artificial Intelligence and Machine Learning (B.Sc. (AI & ML)) will be awarded for candidates who exit the course at the end of 6th semester and earned a minimum of 120 credits and have completed a Summer Internship of 4 credits for a minimum period of 8 weeks, during the summer vacation post 4th semester.

Exit after	Credits and other requirements	Awards
2nd Semester	Min: 40 Credits & Internship	Certificate in Data Visualisation
4th Semester	Min: 80 Credits & Internship	Diploma in Artificial Intelligence and Machine Learning
6th Semester	Min: 120 Credits & Internship	B.Sc. Artificial Intelligence and Machine Learning

4. STRUCTURE OF THE UNDERGRADUATE PROGRAMME

This B.Sc Honors programme offered in the affiliated colleges shall confirm to the structure specified hereunder. As per the decided programme mandate, the students to complete 120 credits to complete a basic Bachelor's Degree in 3 years. With an additional 40 credits of course work one can pursue 4th Year Honors or Honors with Research Degree. The UG Programme will consist of the categories of courses and the minimum credit requirements for 3-year UG and 4-year UG(Honors) or UG (Honors with Research) programmes as given in the Table1 at Section 3.3.6.

4.1. Types of Courses

Hardcore Courses	Softcore Courses (Specialization specific)
Major Disciplinary – AI & ML Multi-Disciplinary Courses Ability Enhancement Courses Value Added Courses Community Engagement and Service	Minor Disciplinary Skill Enhancement Courses Summer Internship Research Dissertation Project

4.2. Description of Courses

The following are the types of courses in this programme:

4.2.1. Major Discipline: 60 Credits - 3 Year UG, & 72 Credits - 4 Year UG

Major discipline here means AI and ML. Students should secure the prescribed number of credits (not less than 50% of the total credits) through core courses in the major discipline. The major discipline would provide the opportunity for a student to pursue in-depth study of a particular subject or discipline. A student may choose to change the major discipline within the broad discipline at the end of the second semester provided all the prerequisites of the respective degree programme are fulfilled.

4.2.2. Minor Discipline/Specialization: 24 Credits -3 Year UG, & 40 Credits - 4 Year UG

Minor discipline helps a student to gain a broader understanding beyond the major discipline. Student pursuing B.Sc (AI & ML) programme should obtain the required 40 credits for a 4 year UG (24 credits for 3 Year UG) along with the Skill Enhancement Courses chosen from the AI & ML specialization. 12 credits of these courses shall be allotted to vocational courses.

4.2.3. Multidisciplinary courses (MD): 9 Credits

All undergraduate students are mandated to pursue 9 credits worth of courses in such Multi-disciplinary areas/Courses out of 9/10 NEP defined subjects. Colleges may identify any 3 multiple disciplinary streams listed below based on availability of resources and manpower.

a) Natural Sciences	b) Physical Sciences
c) Mathematics & Statistics	d) Computer Science/Applications
e) Data Analysis	f) Social Sciences
g) Humanities	h) Commerce & Management
i) Library Science	j) Media Sciences, etc.

Students are expected to learn basic/introductory courses designed by other departments for this purpose. Colleges may list any 3 introductory courses (one each in Natural Sciences, Physical Sciences, and Humanities) for uniform adoption of all UG students.

4.2.4. Ability Enhancement Courses (AEC): 8 credits

All Undergraduate (UG) students are mandated to complete at least 8 Credits worth of Courses which focus on Communication and Linguistic skills, Critical reading, and writing skills. These courses are expected to enhance the ability in articulation and presentation of

their thoughts at workplace. Colleges may design these ability enhancement courses tuned to the requirements of given major discipline. For example a course in Business Communication is more appropriate in place of literature/prose/poetry.

Ability Enhancement Course	
I. English Language a. English Language & Literature - 1 and 2 b. Functional English - 1 and 2 c. Communicative English - 1 and 2	**II. Indian Language (two courses)** a. Indian Language & Literature - 1 and 2 b. Functional Language - 1 and 2 c. Communicative Language - 1 and 2

4.2.5. Skill Enhancement Courses (SEC): 9 credits

These courses are aimed at imparting practical skills, hands-on training, soft skills, and other skills to enhance the employability of students. Courses are designed as per the students' needs with the available resources. Students can choose these courses from the list of courses offered in the chosen specialization as said in 4.2.2. Colleges may also outsource the Skill Enhancement Courses to AICTE approved agencies for conducting short term Training Workshops, Skill India initiatives of GOI and approved Trades by Skill development of corporation are to be considered.

4.2.6. Value-Added Courses (VAC) Common to All UG Students: 8 credits

Under NEP, the UGC has proposed for 6 to 8 credits worth of common courses which are likely to add value to overall knowledge base of the students. These courses include:

a) Understanding India
b) Environmental Sciences/Education, Higher Order Thinking
c) Digital and Technological solutions
d) Health, Wellness, Yoga Education, Sports & Fitness, Universal Human values

The course structure and coverage of topics are suggested by UGC in its draft documents, colleges/UG Boards of Studies may design the methodology for conducting these value-added courses.

4.2.7. Summer Internship: 4 Credits

All students will undergo Internships / Apprenticeships in a firm, industry, or organization or Training in labs with faculty and researchers in their own or other Higher Education Institutions / Research institutions during the summer term. Students will be provided with opportunities for internships to actively engage with the practical side of their learning. Such

Summer Internship is to be conducted in between 4th Semester and 5th semester. A review report and award of grade based on Work based learning by students is to be recorded during the 5th Semester. Students who exercise the option of exit at the end of 1st year or 2nd year need to do the internships as specified in the respective section.

4.2.8. Community Engagement and Service: 2 Credits

The curricular component of 'Community Engagement and Service' seeks to expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems. This can be part of summer term activity or part of a major or minor course. Community Engagement shall be conducted for a minimum of 2 weeks.

4.2.9. Research Project / Dissertation: 12 Credits

Students choosing a 4 Year Bachelor's degree (Honors with Research) are required to take up research projects under the guidance of a faculty member. The students are expected to complete the Research Project in the eighth semester.

4.2.10. Audit courses: 0 credits

Audit courses offered do not carry any credits. Evaluation will be based on continuous assessment. Students may be given a Pass or Fail (P/F) based on the assessment that may consist of class tests, homework assignments, and/or any other innovative assessment methodology suitable to the expected learning outcome, as determined by the faculty in charge of the course of study.

4.3. Levels of the Courses

Course codes are based on the academic rigor. The first four letters of the course code indicate the department/Centre, followed by the academic rigor level code in digits (For e.g., CSAI 201). The coding structure follows:

4.3.1. 0-99: Pre-requisite courses

It is required to undertake an introductory course which will be a pass or fail course with no credits. It will replace the existing informal way of offering bridge courses that are conducted in some of the colleges/ universities.

4.3.2. 100-199: Foundation or introductory courses

These are courses which are intended for students to gain an understanding and basic knowledge about the subjects and help decide the subject or discipline of interest. These courses generally would focus on foundational theories, concepts, perspectives, principles, methods, and procedures of critical thinking in order to provide a broad basis for taking up more advanced courses.

4.3.3. 200-299: Intermediate-level courses including subject-specific courses

These courses are intended to meet the credit requirements for minor or major areas of learning. These courses can be part of a major and can be pre-requisite courses for advanced-level major courses.

4.3.4. 300-399: Higher-level Courses

These courses are required for majoring in a disciplinary/interdisciplinary area of study for the award of a degree.

4.3.5. 400-499: Advanced Courses

These courses which would include lecture courses with practicum, seminar-based course, term papers, research methodology, advanced laboratory experiments/software training, research projects, hands-on-training, internship/apprenticeship projects at the undergraduate level or first year post-graduate theoretical and practical courses.

4.4. 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 practicum or lab work, community engagement and services, and fieldwork in a semester mean two-hour engagement per week.

The Faculty to Student Ratio in all the practical / laboratory classes shall be maintained at 1:25.

In a semester of 15 weeks duration, a one-credit practicum in a course is equivalent to 30 hours of engagement. A one-credit of Seminar or Internship or Studio activities or Field practice/projects /community engagement and service means two-hour engagements per week. Accordingly, in a semester of 15 weeks duration, one credit in these courses is equivalent to 30 hours of engagement.

4.4.1. Pedagogical Styles

In order to achieve the expected Learning outcomes, UGC Framework has specified different Pedagogical approaches for different courses at undergraduate level. These approaches include:

a) Lecture course

b) Tutorial course

c) Practice cum or laboratory courses

d) Seminar Course

e) Internship course

f) Studio activity-based course

g) Field practicing

h) Project work courses

i) Community engagement and service course

The details of these different types of Pedagogical methods are as follows:

Table2: Pedagogical Approaches

COURSE TYPES	APPROACH
Lecture Courses	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 Courses	Problem solving Exercise classes guided discussion, supplementary readings vocational training, etc.
Practical / Lab work	Practical Lab activity with Theoretical support Mini projects, Activity based engagement, Program executions, Data processing and presentation exercise.
Seminar Course	A course requiring student to design and participate in discussions, Group Discussions, Elocution and Debate, Oral Communication Paper presentations, Poster Presentation, Role play participation, Quiz competitions, Business plan preparation/presentation, etc.

COURSE TYPES	APPROACH
Internship course	Courses requiring students to *Learn by Doing* in the workplace external to the educational Institutions. 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	Students need to study and analyze the recent research publications from indexed/peer reviewed journals in their area of specialization. Outcome of the study and analysis need to be presented as a thesis or research report with necessary experimental results.

4.5. Semester-wise Break: for courses of 3 year UG and 4 Year UG(Hons) Degree programmes

Incorporating the focus of NEP in terms of different categories of courses and award of Certificates, Diplomas and Degrees during different stages of 4 year Degree programmes, a template for Semester-wise course work was designed by the UGC and presented in para 5.3 of "Curriculum Framework". Salient features of it are as follows:

- All courses shall carry specified number of credits.
- Every Semester shall have a minimum of 20 credits worth of courses.
- Credits for a course shall be decided on the basis of number of Contact hours of the teaching in a classroom.
- One credit means one hour of Teaching in case of Theory subject and at least 2 hours of conducting Practical in hours case of Lab subjects.
- All Major and Minor disciplinary Courses shall have 4 credits with 6 hours of work load (including 2 hours of tutorials)
- Language courses, ability enhancement, skill enhancement and value added common course also will have 2 hours of hands on training.
- Progress of Learning is measured in terms of credits earned by the students on successful completion of course.
- Students can exercise his/her choice for exiting the course at the end of every Academic year.

- Graduate attributes listed by UGC shall be the focus of Teaching-Learning process.

- Semester I and II shall focus on introductory courses/subjects in Major/Minor disciplines and shall focus on providing knowledge in Multidisciplinary areas, skill enhancement and ability enhancement courses.

- Semester III and IV shall focus on Core disciplinary courses with a focus on building strong foundation in the given Discipline.

- Semester V and VI shall focus on providing in-depth knowledge and skills required for taking up a career in the given discipline.

- Semester VII and VIII shall focus on Advanced knowledge and shall direct the students to take up socially relevant projects/Research works on newer applications of the knowledge.

5. ADMISSION ELIGIBILITY, LATERAL ENTRY

5.1 Admission Eligibility

The candidates for admission to this programme shall be required to have passed 10+2 / 10+3 system of examinations or equivalent with Mathematics / Business Mathematics / Computer Science / Computer Applications / Informatics Practices / or Equivalent as one of the subjects of study.

Students shall be admitted to this programme based on admissions criteria fixed by the University / Government of Puducherry from time to time.

5.2 Admissions by Lateral Entry

In this programme, where admission was carried out adopting approved procedures in preceding years, subject to availability, lateral entry admission shall be permitted, subject to:

Candidates seeking entry at the second, third and fourth year, should meet the necessary eligibility criteria with respect to the certificate / diploma / degree they possess, with necessary minimum credits banked in the Academic Bank of Credits (ABC). Such students who get admitted in later years, 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.

- Lateral entry shall be permissible only in the beginning of years 2, 3, 4 of the Under Graduate / Honors programme; provided that the students seeking lateral entry shall have obtained the minimum pass marks / grades fixed by the University in their previous academic years.

6. EVALUATION

All Credit courses are evaluated for 100 marks. Internal Assessment component is for 25 marks and the End Semester University exam is for 75 marks. In case of Practicals, Project work etc., it is 50:50 marks for Internal and End-Semester Exams.

6.1. Category of Courses

There are three category of courses as shown in 6.2. Category A, theory courses with lecture hours and tutorials are evaluated for an Internal assessment component of 25 Marks and End Semester University Exam for 75 Marks.

Category A	Theory Courses with Lecture hours and hours allotted for Tutorials wherever required.
Category B	Practical Courses with only Practical hours or Laboratory hours. Laboratory Courses, Internships, Research Project Works and other courses allotted only with practical hours in the curriculum shall be under this category.
Category C	Theory & Practice combined Courses where Lecture and Practical hours allotted.

6.2. Learning Assessment

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

IA: 25 Marks
EA: 75 Marks</td><td>25 Marks

<table><tr><th>Evaluation Component</th><th>Marks</th></tr><tr><td>I. Mid Semester Exam (one)</td><td>20</td></tr><tr><td>II. Percentage of Attendance</td><td>05</td></tr><tr><td>Total</td><td>25</td></tr></table></td><td>75 Marks

(Evaluation Details given in Table 3)</td></tr>
<tr><td>Category B

IA: 50 Marks
EA: 50 Marks</td><td>50 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>15</td></tr><tr><td>III. Model Practical Exam</td><td>15</td></tr><tr><td>IV. Percentage of Attendance</td><td>05</td></tr><tr><td>Total</td><td>50</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)</td><td>30</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>50</td></tr></table></td><td>50 Marks

(Evaluation Details given in Table 3)</td></tr>
<tr><td>Category C

IA: 25 Marks
EA: 75 Marks</td><td>25 Marks

<table><tr><th>Evaluation Component</th><th>Marks</th></tr><tr><td>I. Mid Semester Exam (one) - Theory</td><td>10</td></tr><tr><td>II. Observation Book, Record Book</td><td>10</td></tr><tr><td>III. Percentage of Attendance</td><td>05</td></tr><tr><td>Total</td><td>25</td></tr></table></td><td>75 Marks

(Evaluation Details given in Table 3)</td></tr>
</table>

6.3. Marks for Attendance

Attendance %	Marks
Below 75%	0
75% - 80%	1
81% - 85%	2
86% - 90%	3
91% - 95%	4
96% - 100%	5

6.4. Internal Test Scheme

Principal of the College schedules the Mid-Semester Exam for all courses during 8/9th week of start of classes. All faculty members are expected to conduct this Mid-Semester exam for 1½ hour duration and evaluate, upload the marks to Controller of Examinations of University. Colleges need to preserve the answer books of Mid-Semester exams until declaration of results by the University.

6.5. End Semester University Exam

Controller of Examinations (COE) of Pondicherry University schedules the End-Semester exams for all three category of courses. **For Category C courses, theory and practical exams will be conducted separately by the Controller of Examinations of Pondicherry University.**

A detailed Exam Time Table shall be circulated to all Colleges atleast 15 days before the start of exams mostly during 15/16th week of the Semester. Question Papers shall be set externally based on BOS approved syllabus. All students who have a minimum of 70% attendance are eligible to attend the end-semester exams. The breakup of end semester marks is as given below.

6.6. Break up of end semester marks
(All End Semester Exams shall be conducted by the Pondicherry University)

The question paper shall be set as per the Bloom's Taxonomy. Table3 below gives the details of evaluation methods for Category A, B and C courses. Various levels along with their 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.

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.

Table3: End Semester Assessment examination details for all three categories of courses

Course Components	Marks	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 5 Marks each (25 Marks) *(Knowledge: 1, Comprehension: 2, Application: 1, Analysis:3)* Sec C: 2 Either/OR choice questions of 15 Marks each (30 Marks) *(Application: 2 Analysis:2* **Questions from all units of Syllabus equally distributed.**	75 Marks	3 Hours
Category B. Skill Enhancement / Practical Courses Based on Practical Exams conducted by COE of University **Internship / Research Project Work:** Presentation of the work / Report / Viva-voce exams conducted by COE of the University	50 Marks	3 Hours --
Category C. Theory Subjects with Practical Components: **i. Theory Component:** Sec A: 5 Questions of 2 Marks each (10 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.** **ii. Practical Component:** Based on Practical Exams conducted by COE of University **The examination shall be conducted for 50 Marks and reduced to 25 Marks.** **Total Marks: 75 (Theory: 50 Marks + Practical: 25 Marks)**	50 Marks 25 Marks	3 Hours 3 Hours

7. CONSOLIDATION OF MARKS, PASSING MINIMUM AND ARREAR EXAM

Controller of Examinations of the University consolidates the Internal Assessment marks uploaded by the Colleges and marks secured by students in end-semester examination. The total marks will be converted into letter grades as shown in the table section 8.1.

7.1. Passing Minimum

As per NEP Regulations, the passing minimum is 50% marks (IA + End semester put together). However, Pondicherry University considers 40% marks as pass during first 3 years of study and students who secured less than 50 will be awarded 'P' (Pass Grade).

7.2. Arrear Exam

A student who failed to secure 50% marks in aggregate is declared as Failed. Failed students are eligible to take up supplementary examination by registering to the failed course in the following Semester. All other candidates who failed due to shortage of attendance, those who are seeking to improve the grade shall repeat the course.

8. LETTER GRADES AND RANGE OF MARKS

Total Marks secured by a student in each subject shall be converted into a letter grade. UGC Framework has suggested a Country wide uniform letter grades for all UG courses.

8.1. Letter Grades

The following Table shows the seven letter grades and corresponding meaning and the grade points for calculation of CGPA.

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 (Absent)	0

In order to work out the above letter grades, the marks secured by a student (Total of Internal Assessment and End Semester Assessment) would be categorized for relative grading.

8.2. Range of Marks for each letter grades

The ranges of marks for each grade would be worked as follows:

Highest marks in the given subject	X
Cut of marks for grading purpose	50 Marks
Passing mark (for 3 year UG)	40 Marks
Number of grades G (Excl. P grade)	Grades: O, A+, A, B+, B, C, Hence, **G = 6**
Range of marks	K
K = (x – 50) / G	

The following table gives the range of marks and letter grades. According to K value, one of the following grading scheme will be followed.

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

Range of Marks in %	Letter Grade Points	Grade Points
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	Grade Points
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

9. CALCULATION OF SGPA & CGPA

Semester Grade Point Average (SGPA) is calculated by taking a weighted average of all grade points secured by a candidate from all subjects registered by him/her in the given Semester. The weights being the number of credits that each subject carries.

Cumulative Grade Point Average (CGPA) shall be calculated as the weighted average of credits that course carries and the value of Grade points averaged for all subjects.

9.1. Procedure of 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) = Σ(Ci x Gi) / ΣCi, 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.

9.2. 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

9.3. 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

9.4. 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

The CGPA shall also be calculated in similar way as shown in examples (i), (ii) and (iii) of SGPA for all subjects taken by the students in all the semesters. 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. In case of audit courses offered, the students may be given (P) or (F) grade without any credits. This may be indicated in the mark sheet. Audit courses will not be considered towards the calculation of CGPA.

10. DECLARATION OF RESULTS

Controller of Examinations (COE) of the University shall declare the results of given UG programme following the CGPA secured by students by the end of 6th Semester and 8th Semester.

Pass Classes:

Range of CGPA	Result
9.0 – 10.0	First Class with distinction
6.0 – 8.99	First Class
5.0 – 5.99	Second Class
4.0 – 4.99	Pass Class

11. MINIMUM CREDIT REQUIREMENTS

S.No.	Components	3-year UG			4-year UG (Honors / Honors With research)		
		Credits	Courses	Cr/Course	Credits	Courses	Cr/Course
1	Major Disciplinary/ Interdisciplinary Courses	56	14	4	76	19	4
2	Minor Disciplinary/ Interdisciplinary Courses	24	6	4	32	8	4
3	Multi-Disciplinary Courses	9	3	3	9	3	3
4	Ability Enhancement Courses	8	4	2	8	4	2
5	Skill Enhancement Courses	9	3	3	9	3	3
6	Value-added courses	8	4	2	8	4	2
7	Summer Internship (MJD 11)	4	1	4	4	1	4
8	Community Engagement and Service	2	1	2	2	1	2
9	Research Project/Dissertation	--	--	--	12	Project or 3 Courses[##]	
Total		**120**			**160**		

[##]**Note:** Honors students not undertaking research will do 3 courses for 12 credits in lieu of a research project/Dissertation.

- MJD: Major Disciplinary (Compulsory – Hardcore Subjects)
- MID: Minor Disciplinary (Specialization Specific – Softcore Subjects)
- MLD: Multi-Disciplinary
- AEC: Ability Enhancement Courses
- SEC: Skill Enhancement Courses
- VAC: Value Added Courses

12. COURSE CODE

- Course code : 7 Characters: 4 Alphabets and 3 Digits. Ex: ABCD123
- Alphabets : 1st and 2nd Alphabets: Major domain
  3rd and 4th Alphabets: Specialization
- Digits : 1st Digit: Levels (100, 200, 300, 400…)
  2nd and 3rd Digits: Serial number of the courses in the given year

Example: CSAI312: Computer Science Artificial Intelligence, Level - 300, Serial number of the courses in the given year - (12)

B.Sc. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

13. CURRICULUM

FIRST SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 1	CSAI101	Digital Logic Fundamentals	H	4	3		2
2	MID 1	CSAI102	Data Visualization	S	4	3		2
3	MLD 1		One course from the MLD streams (Table 10)	H	3	4		
4	AEC 1		English I / Modern Indian Languages I	H	2	4		
5	SEC 1	CSAI103/ CSAI104	S.No. 1 or 2 from Table 7	S	3	2		2
6	VAC 1		Understanding India	H	2	4		0
7	VAC 2		Environmental Sciences/Education /Higher Order Thinking	H	2	4		0
				Total	20	30 Hours		

SECOND SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 2	CSAI105	Problem Solving & Programming Fundamentals	H	4	3		2
2	MID 2	CSAI106	Introduction to Artificial Intelligence	S	4	3		2
3	MLD 2		One course from the MLD streams except the stream chosen in MLD1 (Table 10)	H	3	4		
4	AEC 2		English I / Modern Indian Languages I	H	2	4		
5	SEC 2	CSAI107/ CSAI108	S.No. 3 or 4 from Table 7	S	3	2		2
6	VAC 3		Health & Wellness/Yoga Education/ Universal Human Values	H	2			4
7	VAC 4	CSVA101	Digital Technologies	H	2	4		
				Total	20	30 Hours		

THIRD SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 3	CSAI201	Object Oriented Programming	H	4	3		2
2	MJD 4	CSAI202	Data Structures	H	4	3		2
3	MID 3	CSAI203	AI and Ethics	S	4	3		2
4	MLD 3		One course from the MLD streams except the streams chosen in MLD1 and MLD2 (Table 10)	H	3	4		
5	AEC 3		English II / Modern Indian Languages II	H	2	4		
6	SEC 3	CSAI204/ CSAI205	S.No. 5 or 6 from Table 7	S	3	2		2
				Total	20	27 Hours		

FOURTH SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 5	CSAI206	Computer System Architecture	H	4	3		2
2	MJD 6	CSAI207	Design and Analysis of Algorithms	H	4	3		2
3	MJD 7	CSAI208	Database Management Systems	H	4	3		2
4	MID 4	CSAI209	Mathematical Foundations of Machine Learning	S	4	3		2
5	AEC 4		English II / Modern Indian Languages II	H	2	4		
6	Project	CSAI210	Community Engagement and Service	H	2			6
				Total	20	30 Hours		

FIFTH SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 8	CSAI301	Operating Systems	H	4	3		2
2	MJD 9	CSAI302	Mathematical Foundations of CS	H	4	4	1	
3	MJD 10	CSAI303	Computer Networks	H	4	3		2
4	MID 5	CSAI304	Artificial Neural Networks	S	4	3		2
5	MJD 11	CSAI305	Summer Internship	H	4			6
				Total	20	25 Hours		

SIXTH SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 12	CSAI306	Management Strategies & Concepts	H	4	5		
2	MJD 13	CSAI307	Software Engineering Theory and Practice	H	4	3		2
3	MJD 14	CSAI308	Distributed Systems	H	4	3		2
4	MJD 15	CSAI309	Operations Research	H	4	4	1	
5	MID 6	CSAI310/ CSAI311	Any one course from Table 1	S	4	3		2
				Total	20	25 Hours		

SEVENTH SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 16	CSAI401	Web Engineering	H	4	3		2
2	MJD 17	CSAI402	System Modelling & Simulation	H	4	3		2
3	MJD 18	CSAI403	Wireless Communication Networks	H	4	3		2
4	MID 7	CSAI404/ CSAI405	Any one course from Table 2	S	4	3		2
5	MID 8	CSAI406/ CSAI407	Any one course from Table 3	S	4	3		2
				Total	20	25 Hours		

EIGHTH SEMESTER - B.Sc. AI & ML (Honors)								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 19	CSAI408/ CSAI409	Any one course from Table 4	H	4	3		2
2	MJD 20	CSAI410/ CSAI411	Any one course from Table 5	H	4	3		2
3	MJD 21	CSAI412	Large Language Models	H	4	3		2
4	MJD 22	CSAI413	Prompt Engineering	H	4	3		2
5	MJD 23	CSAI414	Time Series Analysis	H	4	3		2
				Total	20	25 Hours		

EIGHTH SEMESTER - B.Sc. AI & ML (Honors with Research)								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 19	CSAI408/ CSAI409	Any one course from Table 4	H	4	3		2
2	MJD 20	CSAI410/ CSAI411	Any one course from Table 5	H	4	3		2
3	MJD 21	CSAI415	Research Project	H	4			5
4	MJD 22	CSAI416	Project Report	H	4			5
5	MJD 23	CSAI417	Project Viva-voce	H	4			5
				Total	20	25 Hours		

Table 1: MID 6 – SIXTH SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MID 6	CSAI310	Machine Learning in IoT	S	4	3		2
2	MID 6	CSAI311	Big Data Analytics	S	4	3		2

Table 2: MID 7 – SEVENTH SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MID 7	CSAI404	Reinforcement Learning	S	4	3		2
2	MID 7	CSAI405	Natural Language Processing	S	4	3		2

Table 3: MID 8 – SEVENTH SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MID 8	CSAI406	Deep Learning and Image Analytics	S	4	3		2
2	MID 8	CSAI407	Robotics	S	4	3		2

Table 4: MJD 19 – EIGHTH SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 19	CSAI408	Sequence Models	S	4	3		2
2	MJD 19	CSAI409	AI and Cybersecurity	S	4	3		2

Table 5: MJD 20 – EIGHTH SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 20	CSAI410	Generative AI	S	4	3		2
2	MJD 20	CSAI411	Explainable AI	S	4	3		2

Table 6: MJD 21 / MJD 22 / MJD 23 – EIGHTH SEMESTER								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 21	CSAI412	Large Language Models	H	4	3		2
2	MJD 22	CSAI413	Prompt Engineering	H	4	3		2
3	MJD 23	CSAI414	Time Series Analysis	H	4	3		2

Table 7: SEC 1 / SEC 2 / SEC 3 – I / II / III SEMESTERs								
S.No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	SEC 1	CSAI103	Python Programming	S	3	3		2
2	SEC 1	CSAI104	Building Interactive Dashboards	S	3	3		2
3	SEC 2	CSAI107	Data Wrangling with R	S	3	3		2
4	SEC 2	CSAI108	Logic Programming	S	3	3		2
5	SEC 3	CSAI204	Machine Learning Frameworks	S	3	3		2
6	SEC 3	CSAI205	Data Mining and Tools	S	3	3		2

Table 8: List of Major Disciplinary Courses				
S.No.	**Component**	**Course Code**	**Title of the Course**	**H/S**
1.	**MJD 1**	**CSAI101**	Digital Logic Fundamentals	**H**
2.	**MJD 2**	**CSAI1055**	Problem Solving & Programming Fundamentals	**H**
3.	**MJD 3**	**CSAI201**	Object Oriented Programming	**H**
4.	**MJD 4**	**CSAI202**	Data Structures	**H**
5.	**MJD 5**	**CSAI206**	Computer System Architecture	**H**
6.	**MJD 6**	**CSAI207**	Design and Analysis of Algorithms	**H**
7.	**MJD 7**	**CSAI208**	Database Management Systems	**H**
8.	**MJD 8**	**CSAI301**	Operating Systems	**H**
9.	**MJD 9**	**CSAI302**	Mathematical Foundations of Computer Science	**H**
10.	**MJD 10**	**CSAI303**	Computer Networks	**H**
11.	**MJD 11**	**CSAI305**	Summer Internship	**H**
12.	**MJD 12**	**CSAI306**	Management Strategies & Concepts	**H**
13.	**MJD 13**	**CSAI307**	Software Engineering Theory and Practice	**H**
14.	**MJD 14**	**CSAI308**	Distributed Systems	**H**
15.	**MJD 15**	**CSAI309**	Operations Research	**H**
16.	**MJD 16**	**CSAI401**	Web Engineering	**H**
17.	**MJD 17**	**CSAI402**	System Modelling & Simulation	**H**
18.	**MJD 18**	**CSAI403**	Wireless Communication Networks	**H**
19.	**MJD 19**	**CSAI408/ CSAI409**	Sequence Models / AI and Cybersecurity	**S**
20.	**MJD 20**	**CSAI410/ CSAI411**	Generative AI / Explainable AI	**S**

Table 9: List of Minor Disciplinary Courses				
S.No.	**Component**	**Course Code**	**Title of the Course**	**H/S**
1.	**MID 1**	**CSAI102**	Data Visualization	**S**
2.	**MID 2**	**CSAI106**	Introduction to Artificial Intelligence	**S**
3.	**MID 3**	**CSAI203**	AI and Ethics	**S**
4.	**MID 4**	**CSAI209**	Mathematical Foundations of Machine Learning	**S**
5.	**MID 5**	**CSAI304**	Artificial Neural Networks	**S**
6.	**MID 6**	**CSAI310/ CSAI311**	Machine Learning in IoT / Big Data Analytics	**S**
7.	**MID 7**	**CSAI404/ CSAI405**	Reinforcement Learning / Natural Language Processing	**S**
8.	**MID 8**	**CSAI406/ CSAI407**	Deep Learning and Image Analytics / Robotics	**S**

*Table 10: MLD 1 / MLD 2 / MLD 3 in Sem 1 / Sem 2 / Sem 3			
Streams	**Course Code**	**Title of the Course**	**H/S**
Natural Science		Biology	**H**
		Botany	**H**
		Zoology	**H**
		Biotechnology	**H**
		Biochemistry	**H**
Physical Sciences		Chemistry	**H**
		Physics	**H**
		Biophysics	**H**
		Astronomy	**H**
		Astrophysics	**H**
		Earth and Environmental Sciences	**H**
Mathematics & Statistics		STATA	**H**
		SPSS	**H**
		Tally	**H**
Computer Science	**COMS101**	Introduction to Python Programming	**H**
	COMS102	Foundations of Information Technology	**H**
Social Sciences		Political Sciences	**H**
		History	**H**
		Social work	**H**
		Sociology	**H**
Humanities		Anthropology	**H**
		Psychology	**H**
		Economics	**H**

Commerce & Management		Business Management	**H**
		Accountancy	**H**
		Finance	**H**
		Financial Institutions	**H**
Media Sciences		Journalism	**H**
		Mass Media	**H**
		Communication	**H**

*Courses will be announced after the approval of the respective boards.

Table 11: List of Ability Enhancement Courses

S.No.	Component	Course Code	Title of the Course	H/S
1.	**AEC 1**		English I / Modern Indian Languages I	**H**
2.	**AEC 2**		English I / Modern Indian Languages I	**H**
3.	**AEC 3**		English II / Modern Indian Languages II	**H**
4.	**AEC 4**		English II / Modern Indian Languages II	**H**

Table 12: List of Skill Enhancement Courses

S.No.	Component	Course Code	Title of the Course	H/S
1.	**SEC 1**	**CSAI103**	Python Programming	**S**
2.	**SEC 1**	**CSAI104**	Building Interactive Dashboards	**S**
3.	**SEC 2**	**CSAI107**	Data Wrangling with R	**S**
4.	**SEC 2**	**CSAI108**	Logic Programming	**S**
5.	**SEC 3**	**CSAI204**	Machine Learning Frameworks	**S**
6.	**SEC 3**	**CSAI205**	Data Mining and Tools	**S**

Table 13: List of Value-Added Courses				
S.No.	**Component**	**Course Code**	**Title of the Course**	**H/S**
1.	**VAC 1**		Understanding India	**H**
2.	**VAC 2**		Environmental Sciences / Education / Higher Order Thinking	**H**
3.	**VAC 3**		Health & Wellness / Yoga Education / Universal Human Values	**H**
4.	**VAC 4**		Digital Technologies	**H**

Table 14: Project (WP/ Internship)				
S.No.	**Component**	**Course Code**	**Title of the Course**	**H/S**
1.	**Project**	**CSAI210**	Community Engagement and Service	**H**

14. SYLLABUS

FIRST SEMESTER

<table>
<tr><td>Year</td><td>I</td><td colspan="2">Course Code: CSAI101</td><td>Credits</td><td>4</td></tr>
<tr><td rowspan="2">Sem.</td><td rowspan="2">I</td><td colspan="2" rowspan="2">Course Title: DIGITAL LOGIC FUNDAMENTALS</td><td>Hours</td><td>75</td></tr>
<tr><td>Category</td><td>C</td></tr>
<tr><td>Course Prerequisites, if any</td><td colspan="5">NIL</td></tr>
<tr><td>Internal Assessment Marks: 25</td><td colspan="2">End Semester Marks: 75</td><td colspan="3">Duration of ESA (Theory): 03 hrs.
Duration of ESA (Practical): 03 hrs.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">• Understand and describe the principles of digital systems and binary number operations
• Apply Karnaugh mapping to simplify Boolean expressions and optimize digital circuits
• Analyze and design basic combinational circuits using various digital components
• Synthesize and evaluate synchronous sequential circuits using storage elements and HDL
• Design and implement various types of registers and counters using HDL</td></tr>
<tr><td>Unit No.</td><td colspan="4">Course Content</td><td>Hours</td></tr>
<tr><td colspan="6">Theory Component</td></tr>
<tr><td>Unit I</td><td colspan="4">Introduction
Digital Systems – Binary Numbers – Conversions – Types – Codes – Storage and Registers – Binary Logic – Boolean Algebra – Theorems and Properties – Functions – Canonical and Standard Forms – Other Logic Operations – Digital Logic Gates – Integrated Circuits</td><td>9</td></tr>
<tr><td>Unit II</td><td colspan="4">Gate-Level Minimization
Map Method – Four-Variable K-Map – Product-of-Sums Simplification – Don’t-Care Conditions – NAND and NOR Implementation – Other Two-Level Implementations – Exclusive-OR Function – Hardware Description Language</td><td>9</td></tr>
<tr><td>Unit III</td><td colspan="4">Combinational Logic
Analysis Procedure – Design Procedure – Binary Adder–Subtractor – Decimal Adder – Binary Multiplier – Magnitude Comparator – Decoders – Encoders – Multiplexers – HDL Models of Combinational Circuits</td><td>9</td></tr>
<tr><td>Unit IV</td><td colspan="4">Synchronous Sequential Logic
Storage Elements – Latches – Flip-Flops – Analysis of Clocked Sequential Circuits - Synthesizable HDL Models of Sequential Circuits – State Reduction and Assignment – Design Procedure</td><td>9</td></tr>
<tr><td>Unit V</td><td colspan="4">Registers and Counters
Registers – Shift Registers – Ripple Counters – Synchronous Counters – Other Counters – HDL for Registers and Counters</td><td>9</td></tr>
<tr><td colspan="6">Practical Component</td></tr>
<tr><td></td><td colspan="4">1. Binary to Decimal and vice-versa
2. Decimal to Hexadecimal and Vice-Versa
3. Digital Logic Gates
4. Simplification of Boolean Functions
5. Combinational Logic Circuits
i. Code Converters
ii. Arithmetic (Adders,</td><td></td></tr>
</table>

Exercises	Subtractors, Multipliers, Comparators) iii. Data Handling (Multiplexers, Demultiplexers, Encoders & Decoders) 6. Combinational Logic Circuit Design 7. Binary Adder-Subtractor Simulation 8. Decimal Adder Simulation 9. Binary Multiplier Simulation 10. Sequential Circuit Storage Elements: Flip-Flop Simulation	30
Recommended Learning Resources		
Print Resources	1. M. Morris Mano, Michael D. Ciletti, "Digital design With an Introduction to the Verilog HDL", Pearson, Sixth Edition, 2018. 2. M. Rafiquzzaman, "Fundamentals of Digital Logic and Microcomputer Design", John Wiley & Sons, Inc., Fifth Edition, 2009.	
Syllabus design: Dr. M.Sathya, Assistant Professor, PUDoCS		

Year	I	**Course Code: CSAI102**	**Credits**	4
Sem.	I	**Course Title :DATA VISUALIZATION**	**Hours**	75
			Category	C
Course Prerequisites, if any	Basic understanding of Computers			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	● Understand the concepts of Data visualization. ● Understand the process of building effective visualization ● Apply the Python Libraries to build Visualization ● Analyze various visualization options to build optimal visualization. ● Create effective visualization.			

Unit No.	**Course Content**	**Hours**
	Theory Component	
Unit I	**Introduction** Introduction to Data Visualization – Definition – 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. - 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	**Matplotlib** Introduction to Matplotlib – Plotting functions – subplot functions – coloring – Building line plots – Bar plots – Scatter plots – Histogram – Pie charts.	9
Unit IV	**Pandas based plotting** Pandas for plotting – Various plots with pandas data – A case study with pandas based plotting.	9
Unit V	**Seaborn** Seaborn for visualization – Features – Benefits – Plotting with seaborn – Categorical data plotting with seaborn – Case studies using seaborn.	9

	Practical Component	
List of Exercises	1. Build a line plot using Matplotlib. 2. Build a Pie chart using MatplotLib. 3. Build histogram using Matplotlib. 4. Customize the charts built in the above exercises with various options. 5. Build a visualization with source data handling using Pandas. 6. Build any 3 types of charts using seaborn. 7. Perform Categorical data plotting with seaborn. 8. Case Study: Population growth plotting 9. Case Study: Happiness Index across various countries - an analysis. 10. Develop a visualization with multiple subplots.	30
Recommended Learning Resources		
Print Resources	**TEXT BOOK:** 1. Kalilur Rahmman, Python Data Visualization Essentials Guide, BPB publications, First Edition (2021), ISBN: 978-93-91030070. **REFERENCE BOOK:** 1. Cole Nussbaumer Knaflic, Storytelling With Data: A Data Visualization Guide For Business Professionals, Wiley publications , (2015), ISBN: 978-1119002253	
Syllabus design: Dr.K.S.Kuppusamy, Associate Professor, PUDoCS		

Year	I	**Course Code: CSAI103**	**Credits**	3
Sem.	I	**Course Title : PYTHON PROGRAMMING**	**Hours**	60
			Category	B
Course Prerequisites, if any	Basic Knowledge in Programming Concepts			
Internal Assessment Marks: 50	End Semester Marks: 50	Duration of ESA (Practical): 03 hrs.		
Course Outcomes	• Understand the basics of writing Python code • Implement programs using lists, tuples, and dictionaries • Understand the use of control structures • Implement programs using packages • Analyze the need for file manipulation and develop programs to implement it.			

Unit No.	**Course Content**	**Hours**
	Theory Component	
Unit I	**Introduction, Data types** Introduction to Python – Advantages of using Python – Executing Python Programs – Python's Core data types – Numeric Types – String Fundamentals.	6
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.	6
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.	6
Unit IV	**Packages** Packages: NumPy, Pandas, Scikit learn - Machine learning with Python – Cleaning up, Wrangling, Analysis, Visualization - Matplotlib package – Plotting Graphs.	6

Unit V	**File Handling** Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions	6
Practical Component		
List of Exercises	1. Exchange the values of two variables 2. Finding minimum among n variables 3. Perform Simple sorting 4. Generate Students' marks statement 5. Find square root, GCD, exponentiation 6. Perform linear search, binary search 7. Perform Matrix operations using NumPy 8. Perform Dataframe operations using Pandas 9. Use Matplotlib on dataset and visualize 10. Perform Word count, copy file operations	30
Recommended Learning Resources		
Print Resources	**TEXT BOOKS:** 1. Mark Lutz, "Learning Python", Fifth Edition, O'Reilly, 2013. 2. Daniel Liang, "Introduction to programming using Python", Pearson, First edition, 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, First Edition, 2009. 2. Magnus Lie Hetland, "Beginning Python: From Novice to Professional", Apress, Second Edition, 2005.	
Syllabus design: Dr V. Uma, Associate Professor, PUDoCS		

Year	I	**Course Code: CSAI104**	**Credits**	3
Sem.	I	**Course Title : BUILDING INTERACTIVE DASHBOARDS**	**Hours**	60
			Category	B
Course Prerequisites, if any	Basic Knowledge in spreadsheets			
Internal Assessment Marks: 50	End Semester Marks: 50	Duration of ESA (Practical): 03 hrs.		
Course Outcomes	• Understand the basics of dashboards. • Implement visualization using Excel. • Understand the use of Tableau in creating dashboards. • Visualize using PowerBI. • Analyze the visualization features in Looker Studio.			

Unit No.	**Course Content**	**Hours**
	Theory Component	
Unit I	**Introduction** Introduction to Dashboard - Design principles - Types - Data discovery and exploration - Data requirements for visualization - Big data lake - Pitfalls of data visualization	6
Unit II	**Building Interactive dashboards using Excel** Understanding spreadsheets - visualize data using Excel's powerful charting functions - Introduction to Pivot Tables - Using shapes to create infographics - organizing data for dashboards - creation of dashboards	6
Unit III	**Tableau** Getting started with Tableau- Creating basic charts - Creating common visualizations - Creating dashboard layouts - Using dashboard filters - Creating calculated fields and measures - Using Quick table calculations	6
Unit IV	**PowerBI** Introduction - Uploading data - Reports - Visual Interactions - Decorating, Saving, Pinning, Filtering a report	6
Unit V	**Looker Studio** Features - Benefits - Tables and charts - report generation - Dashboard generation	6

Practical Component		
List of Exercises	1. Perform simple data visualization of the given data using any visualization tool 2. Visualizing KPIs using various charts in Excel and create dashboard 3. Create marketing dashboard using Excel 4. Create sales dashboard using Tableau 5. Create Executive dashboard using Tableau 6. Perform finance data visualization and create a dashboard using PowerBI 7. Create Social media dashboard using PowerBI 8. Create interactive dashboard using Looker studio	30
Recommended Learning Resources		
Print Resources	**TEXT BOOKS:** 1.Cole Nussbaumer Knaflic, "Storytelling with Data: A Data Visualization Guide for Business Professionals", Wiley, 2015. 2. Sireesha Pulipati**,** "Data Storytelling with Google Looker Studio: A Hands-On Guide to Using Data Studio for Building Compelling and Effective Dashboards", Packt Publishing Limited,2022. 3. Dick Kusleika, "Data Visualization with Excel Dashboards and Reports", Wiley, 2021. 4. Alberto Ferrari & Marco Russo, "lntroducing Microsoft PowerBI", Microsoft, 2016. 5. Alexander Loth ,"Visual Analytics with Tableau", Wiley, 2019.	
Syllabus design: Dr V. Uma, Associate Professor, PUDoCS		

SECOND SEMESTER

Year	I	Course Code: CSAI105	Credits	4
Sem.	II	Course Title: PROBLEM SOLVING & PROGRAMMING FUNDAMENTALS	Hours	75
			Category	C
Course Prerequisites, if any	NIL			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.		
Course Outcomes	• Analyze problems and develop top-down designs. • Write, compile, and debug basic programs. • Implement logic with conditionals and loops. • Manipulate arrays of various dimensions. • Design and implement functions with recursion.			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction to Computer Problem-Solving** Problem-solving Aspect – Top-down Design – Implementation of Algorithms – Program Verification – Efficiency of Algorithms – Analysis of Algorithms	9
Unit II	**Basic programming constructs** Basic Data types (Numerical, String) – Variables – Expressions – I/O statements – Compile and Run – Debugging	9
Unit III	**Decision Making – Branching & Looping** Decision making – Relational Operators – Conditional statement, Looping Statements – Nested loops – Infinite loops – Switch Statements	9
Unit IV	**Array Techniques** Array Manipulation – Different operations – One dimensional Array – Two-dimensional Array – Multi-dimensional Array – Character – Arrays and Strings	9
Unit V	**Modular solutions** Introduction to Functions – Importance of Design of Functions – Arguments – Parameters – Return Values – Local and Global Scope – Recursion	9
	Practical Component	
Exercises	1. Program to array counting, array order reversal & find the maximum number in a set. 2. Program for removal of duplicates from an ordered array & to partition an array. 3. Program to find the k^{th} smallest element. 4. Program to exchange the values of two variables without using a third variable. 5. Program that takes a list of numbers as input and counts the total number of elements in the list. 6. Program to compute the factorial of a given integer. 7. Program to compute the sine of an angle (in degrees) using a series expansion. 8. Program to generate the Fibonacci sequence up to a specified limit. 9. Program that takes an integer as input and reverses its digits.	30

	10. Program that converts a number from one base to another (e.g., binary to decimal, decimal to binary).	
Recommended Learning Resources		
Print Resources	1. R. G. Dromey, "How to Solve it by Computer", Pearson Education India, Thirteen Edition, 2013. 2. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", Third Edition, O'Reilly Publishers, 2020.	
Syllabus design: Dr. M.Sathya, Assistant Professor, PUDoCS		

Year	I	**Course Code: CSAI106**	**Credits**	4
Sem.	II	**Course Title : INTRODUCTION TO ARTIFICIAL INTELLIGENCE**	**Hours**	75
			Category	C
Course Prerequisites, if any	Exposure to Algorithms, Data structure and Mathematical Logic.			
Internal Assessment Marks: 25	End Semester Marks: 75		Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.	
Course Outcomes	• Explore basic concepts of AI and understand the importance of agents. • Understand various search strategies. • Analyze knowledge representation and reasoning approaches. • Understand the importance of planning in real world scenarios. • Evaluate the architecture of expert systems.			
Unit No.	**Course Content**		**Hours**	
Theory Component				
Unit I	**Introduction** AI – Foundations of AI, Intelligent Agents – Agents and Environments – Good Behavior –Nature of Environments – Structure of Agents.		6	
Unit II	**Problem solving** Problem Solving Agents – Searching for solutions- Uninformed Search Strategies – Informed Search Strategies, Heuristic functions - Adversarial search - Local search algorithms and optimization problems – Searching with nondeterministic actions, Constraint satisfaction problems.		12	
Unit III	**Knowledge and reasoning** Logical Agents: Wumpus world - Propositional logic - First order logic: Inference, forward and backward chaining, Resolution		9	
Unit IV	**Planning** Classical planning – Algorithms – Approaches - Planning and acting in real world – Hierarchical planning – Multiagent planning		9	

Unit V	**Expert systems** Expert systems – Introduction – Difference between expert system and conventional programs– Expert system organization – Architecture of Expert system – Knowledge representation techniques- Knowledge acquisition techniques - Inference Engine- Explanation systems.	9
	Practical Component	
List of Exercises	1. Solve the Water Jug Problem using DFS, BFS blind search algorithms 2. Implement Mini-max adversarial search algorithm. 3. Find the optimal path between two cities using best first search and A* heuristic algorithms 4. Implement the Missionaries and cannibals problem using constraint satisfaction method. 5. Represent knowledge using Propositional Logic and perform inference. 6. Represent knowledge using Predicate Logic and perform inference. 7. Case study: Autonomous Vehicles 8. Case Study: Travelling Salesman Problem. 9. Case Study: Planning Delivery of packages 10. Develop an Expert System.	30
Recommended Learning Resources		
Print Resources	**TEXT BOOKS:** 1. Stuart J Russell and Peter Norvig, Artificial Intelligence – A Modern Approach, PHI Learning, Fourth Edition, 2022. 2. Patterson W D, Introduction to Artificial Intelligence and Expert Systems, PHI Learning, First Edition, 1995. **REFERENCE BOOKS:** 1. Elaine Rich and Kelvin Knight, Artificial Intelligence, TMH, Third Edition, 2009.	
Syllabus design: Dr V. Uma, Associate Professor, PUDoCS		

Year	I	**Course Code: CSAI107**	**Credits**	3
Sem.	II	**Course Title : DATA WRANGLING WITH R**	**Hours**	60
			Category	B
Course Prerequisites, if any	Basic computer programming skill			
Internal Assessment Marks: 50	End Semester Marks: 50	Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	• Understand the basics of R and data wrangling. • Implement programs using data structures in R. • Implement data importing, scraping and exporting. • Analyze basic data objects in R for writing functions, applying loops, and web scraping. • Create applications using the R packages used for data shaping and transforming.			
Unit No.	**Course Content**		**Hours**	
Theory Component				
Unit I	**Basics of R and Data Wrangling** Role of data wrangling-Introduction to R-Basics of R programming-Numbers-Character Strings-Regular Expressions-Factors-Dates		6	
Unit II	**Managing data structures in R** Data structure basics-Vectors-Lists-Matrices-Data frames-Dealing with missing values		6	
Unit III	**Importing, Scraping and Exporting Data with R** Importing data-Scraping data-Exporting data-Web scraping		6	
Unit IV	**Creating Efficient code in R** Functions-Built-in-functions-Function definition-Loop control statements-Simplifying code with %>%		6	
Unit V	**Shaping and transforming data with R** Summarising data- Reshaping data with tidyr-Transforming data with dplyr		6	
Practical Component				

List of Exercises	1. Perform arithmetic operations 2. Implement various string and date operations 3. Create a vector and find the numbers divisible by 2 4. Create a matrix and find the number of entries in each row which are greater than 4 5. Perform various operations on List 6. Create a data frame from a dataset and handle the missing values 7. Import data into R from different file formats and perform scraping 8. Perform web scraping 9. Write functions to find sum and difference of the arguments passed 10. Perform Exploratory data analysis and perform data cleaning	30
Recommended Learning Resources		
Print Resources	**TEXT BOOKS:** 1. Bradley C. Boehmke, "Data wrangling with R", Springer Cham, 2016. 2. Tilman M.Davies, "The Book of R: A First Course in Programming and Statistics", No Starch press, 2016. 3. Andrea de Vries, Joris Meys, "R programming for Dummies", 2nd edition, Wiley, 2016.	
Syllabus design: Dr V. Uma, Associate Professor, PUDoCS		

Year	I	**Course Code: CSAI108**	**Credits**	3
Sem.	II	**Course Title : LOGIC PROGRAMMING**	**Hours**	60
			Category	B
Course Prerequisites, if any	Basic Knowledge in Programming Concepts			
Internal Assessment Marks: 50	End Semester Marks: 50	Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	• Understand the basics of writing Prolog code. • Understand and explain principles of declarative specification, and its relation to file operations. • Implement well-crafted Prolog programs of moderate size and sophistication using loops. • Implement manipulation of databases using logic programming. • Understand and evaluate the string processing foundations of logic programming.			
Unit No.	**Course Content**		**Hours**	
	Theory Component			
Unit I	**Introduction, Clauses and Predicates** Introduction to Prolog – Clauses- Predicates - Loading clauses - Variables - Unification - Evaluating goals - Backtracking - Removing common variables		6	
Unit II	**Operators, Input and Output** Operators: Arithmetic, Equality, Logical. Input and Output: Outputting Terms - Inputting Terms - Input and Output Using Characters - Outputting Characters - Inputting Characters - Using Characters - Input and Output Using Files - File Output: Changing the Current Output Stream - File Input: Changing the Current Input Stream		6	
Unit III	**Loops** Looping a Fixed Number of Times - Looping Until a Condition Is Satisfied: Recursion - Using the 'repeat' Predicate - Backtracking with Failure: Searching the Prolog Database - Finding Multiple Solutions		6	

Unit IV	**Database and List processing** Changing the Database: Adding and Deleting Clauses - Adding Clauses - Deleting Clauses - Changing the Database: Example - Maintaining a Database of Facts Representing Data as Lists - Notation for Lists - Decomposing a List - Built-in Predicates: member - length - reverse - append - List Processing - Using findall/3 to Create a List	6
Unit V	**String Processing** Converting Strings of Characters To and From Lists - Joining Two Strings - Trimming a String - Inputting a String of Characters - Searching a String - Dividing a String into Its Component Parts	6
Practical Component		
List of Exercises	1.Execute simple programs in Prolog by representing facts and predicates. 2.Apply Unification on a set of facts 3.Execute simple programs in Prolog to read and write input. 4.Implement programs using various operators. 5.Execute simple programs in Prolog using loops 6.Implement programs using recursion 7.Execute simple programs in Prolog to perform list processing 8.Implement database operations 9.Execute simple programs in Prolog to perform string processing 10. Execute simple programs to perform searching	30
Recommended Learning Resources		
Print Resources	**TEXT BOOKS:** 1. Max Bramer, "Logic Programming with Prolog", Springer, 2005 2. J.M. Spivey, "An Introduction to Logic Programming Through Prolog", Prentice Hall, 1996. **REFERENCE BOOKS:** 1. J.W.Lloyd, "Foundations of Logic Programming", Springer Berlin Heidelberg, 2012.	
Syllabus design: Dr V. Uma, Associate Professor, PUDoCS		

Year	I	Course Code: CSVA101	Credits	2
Sem.	II	Course Title: DIGITAL TECHNOLOGIES	Hours	45
			Category	A

Course Prerequisites, if any	-NIL-	
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory) : 03 hrs.

Course Outcomes	• Get introduced to the digital systems and its building blocks. • Understand how the Digital Communication happens and to Learn the advantages and disadvantages including Cybersecurity. • Learn the day to day digital activities and the initiatives on Digital India. • Acquire knowledge on current Technologies and Trends in Digital Space. • Explore the applications on the state of the art in Digital Technologies.

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction**: Digital Systems - Information & Communication Technology - ICT Tools Computer Architecture – Software – Hardware - Operating System - Algorithms - Flowcharts.	7
Unit II	**Communication Systems:** Transmission Media - Computer Networks – Internet - Web Browsers - Search Engines - Messaging, Email - Social Media – Online Ethics. - **Cybersecurity:** Threats, Significance, Challenges, Precautions, Safety Measures. Cyber Crime Awareness.	7
Unit III	**Digital India & e-Governance:** Initiatives - Unified Payment Interface - Aadhar online services - Credit / Debit Cards - e-Wallets – Mobile and Internet Banking – NEFT / RTGS / IMPS - Online Payments & PoS – Digital Accessibility.	7
Unit IV	**Emerging Technologies & Applications: (Basic introduction only).** Overview of Artificial Intelligence, Cloud Computing, Big Data, Internet of Things, Virtual Reality, 5G, 3D Printing.	7
Unit V	**Case Studies:** Any one case study on the emerging technologies and report submission by the candidates.	7
	Practical Component	
Practice	1. Operating System Installation and configuration 2. Application Software Installation and configuration 3. Hardware understanding and minor troubleshooting 4. Networking, cabling, configuration	10
	Recommended Learning Resources	
Print Resources	1. Pramod Kumar, Anuradha Tomar, R. Sharmila, "Emerging Technologies in Computing - Theory, Practice, and Advances", Chapman and Hall / CRC, 1st Edition, 2021, eBook ISBN: 9781003121466. https://doi.org/10.1201/9781003121466. 2. V. Rajaraman, "Introduction to Information Technology", PHI, 3rd Edition, 2018, ISBN-10: 9387472299, ISBN-13: 978-9387472297. 3. E. Balagurusamy, "Fundamentals of Computers", Tata Mc GrawHill, 2nd Edition, 2011, ISBN: 9780071077880. 4. Behrouz A. Forouzan, "Data Communications and Networking", McGraw Hill, 4th Edition, 2007, ISBN 978-0-07-296775-3. 5. Rajkumar Buvya, James Broberg, and Andrzej Gosciniski, "Cloud Computing-Principals and Paradigms", Wiley, 2011, ISBN: 978-0-470-88799-8.	

	6. Stuart Russel and Peter Norvig, “Artificial Intelligence - A Modern Approach”, Pearson Education, 3rd Edition, 2010, ISBN- 13: 978-0-13 -604259-4. 7. Samuel Greengard, “Internet of Things”, The MIT Press, 2015, ISBN: 9780262328937, https://doi.org/10.7551/mitpress/10277.001.0001. 8. C.S.V. Murthy, “E- Commerce – Concept, Models &Strategies”, Himalaya Publishing House, 2015, ISBN: 8178662760. 9. Hurwith, Nugent Halper, Kaufman, “Big Data for Dummies”, Wiley & Sons, 1st Edition, 2013, ISBN-13: 978-1118504222.
Syllabus Design: Prof. S.K.V. Jayakumar, Professor, PUDoCS	

THIRD SEMESTER

Year	II	Course Code: CSAI201 Course Title: OBJECT ORIENTED PROGRAMMING	Credits	4
Sem.	III		Hours	75
			Category	C
Course Prerequisites, if any	Basic Programming knowledge			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.		
Course Outcomes	• Understand the principles of OOP and the concept of class and objects. • Apply the concept of Object initialization and overloading. • Understand the concept of inheritance and reusability. • Understand file operations and exception handling. • Apply OOP to design and implement solutions to real-world problems.			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Principles of Object Oriented Programming (OOP)** Object Oriented Programming Paradigm-Basic Concepts of OOP-Benefits of OOP - Application of OOP - Simple C++ program - Compiling and Linking	9
Unit II	**Classes and Objects** Specifying class - Member functions - Nesting of Member functions - Access specifier - Static Data members and functions - Arrays within a Class - Arrays of Objects - Objects as Arguments - Returning Objects - Friend Function	9
Unit III	**Object Initialization and Overloading** Types of Constructors - Dynamic Initialization of Objects - Destructors Operator overloading - function Overloading - Manipulation of Strings	9
Unit IV	**Inheritance** Derived Classes - Types of inheritance - Virtual Base Classes - Abstract Classes - Pointers to Derived Classes - Virtual base class - Method Overriding - Pure Virtual Functions	9
Unit V	**File operations and Exception handling** Classes for File Operations - File Modes - opening and closing a File - Basics of Exception Handling - Try-Catch block - Case Studies on Real Time Applications	9
	Practical Component	
List of Exercises	**1.** Write a Program to Read and Print Number Input From the User. 2. Write a simple program using a class and objects 3. Write a program to demonstrate the usage of a constructor and destructor in a class 4. Write a program to overload + operator to add two complex numbers. 5. Write a program to demonstrate the usage of function overloading. 6. Write a program to display employee information using multiple inheritance. 7. Write a program to demonstrate multilevel inheritance. 8. Write a program to copy a file from one location to another location.	30
	Recommended Learning Resources	
Print Resources	**Text Book:** 1. E Balagurusamy, "Object oriented Programming with C++", Seventh	

	edition, Tata McGraw Hill, 2020.
Syllabus Design: Dr. T. Vengattaraman, Associate Professor, PUDoCS	

Year	II	Course Code: CSAI202	Credits	4
Sem.	III	Course Title: DATA STRUCTURES	Hours	75
			Category	C
Course Prerequisites, if any	• Introductory knowledge about Computing			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.		
Course Outcomes	• Learn basic terminologies of linear and nonlinear data structures and algorithms • Understand the concept of polynomial addition and sparse matrices using arrays • Apply linked lists to solve problems related to stacks, queues, and sparse matrices • Understand the operations and traversals of binary trees • Apply graph algorithms to solve problems like topological sorting and finding minimum cost spanning trees			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction** Basic terminologies – Linear and Nonlinear data structures - Algorithm**:** Definition – Pseudo code – Analysis – Design Techniques	7
Unit II	**Arrays, Stacks & Queues** Representation – Polynomial Addition – Sparse Matrices – Multidimensional Arrays - Stacks and Queues **-** Stack ADT – Operations – Evaluation of Expressions – Queue ADT – Operations – Application – Multiple Stacks and Queues	11
Unit III	**Lists** Singly Linked Lists – Linked Stacks and Queues – Operations – Circularly Linked Lists – Equivalence Relations – Sparse Matrices – Doubly Linked Lists	9
Unit IV	**Trees** Basic Terminologies – Binary trees – Representation, Operations, Traversals, Types – Applications of Trees	9
Unit V	**Graphs** Basic Terminologies – Representation, Operations, Traversals – Applications - Shortest path problem, Topological sorting, Minimum Cost Spanning trees	9
	Practical Component	
Exercises	1. Searching Algorithms (with the number of key comparisons) - Sequential, Binary and Fibonacci search algorithms 2. Evaluation of arithmetic expression 3. Stack, Queue, Circular queue, priority queue 4. Singly Linked List, Doubly Linked List, Circular Linked List 5. Tree Traversal techniques 6. Graph Traversal techniques 7. Dijkstra's Algorithm to obtain the shortest paths	30

Recommended Learning Resources	
Print Resources	1. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Fundamentals of Data Structures in C", India University Press, Second Edition, 2008. 2. Debasis Samanta, "Classic Data Structures", Prentice-Hall of India, Pvt. Ltd., India, Seventeenth Printing, Second Edition, 2009. 3. Dinesh P Mehta & Sartaj Sahni, Handbook of Data Structures and Applications, Second Edition, Chapman and Hall, 2020.
Syllabus design: Dr. M.Sathya, Assistant Professor, PUDoCS	

<table>
<tr><td>Year</td><td>II</td><td colspan="2" rowspan="2">Course Code: CSAI203

Course Title: AI AND ETHICS</td><td>Credits</td><td>4</td></tr>
<tr><td>Sem.</td><td>III</td><td>Hours</td><td>75</td></tr>
<tr><td colspan="4"></td><td>Category</td><td>C</td></tr>
<tr><td>Course Prerequisites, if any</td><td colspan="5">Nil</td></tr>
<tr><td>Internal Assessment Marks : 25</td><td colspan="3">End Semester Marks : 75</td><td colspan="2">Duration of ESA (Theory): 03 hrs.
Duration of ESA (Practical): 03 hrs.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">● Introduce students to the ethical considerations surrounding artificial intelligence (AI).
● Explore the potential benefits and risks of AI in various domains.
● Develop critical thinking skills to analyze and evaluate AI technologies from an ethical perspective.
● Appraise the need for responsible development and deployment of AI aligned with ethical principles.
● Analyze the impact of ethical practices in building AI applications.</td></tr>
<tr><td>Unit No.</td><td colspan="3">Course Component</td><td colspan="2">Hours</td></tr>
<tr><td colspan="6">Theory Component</td></tr>
<tr><td>Unit I</td><td colspan="3">Introduction to AI Ethics
Introduction – Introduction to Artificial Intelligence – Overview for Law and Regulations – Impacts of AI – Ethics of AI – Approaches in AI Ethics.</td><td colspan="2">9</td></tr>
<tr><td>Unit II</td><td colspan="3">Rise of AI Ethics
AI Ethics – Common Themes and Varieties of Questions – Ethical Questions in AI – AI Ethics Now – AI Ethics Law – Case study: An Indigenous AI Report.</td><td colspan="2">9</td></tr>
<tr><td>Unit III</td><td colspan="3">Concepts and Issues
Moral frameworks of Justice in AI – Accountability in Computer Systems – Transparency – Responsibility – Concept of Handoff as a Model – Race and Gender – Autonomy – Troubleshooting AI .</td><td colspan="2">9</td></tr>
<tr><td>Unit IV</td><td colspan="3">Perspectives and Approaches
Perspectives on Ethics of AI – Computer Science - Engineering – Cognitive Science – Economics – Humanities – Philosophy – Anthropology – Trustworthy AI – Case study of AI for Social Good.</td><td colspan="2">9</td></tr>
<tr><td>Unit V</td><td colspan="3">Case Studies and Applications
Ethics of AI – Transport – Military – Biomedical research – Patient care and Public health – Law – Robot teaching – Algorithms and the Social Organization of work – Smart city Ethics.</td><td colspan="2">9</td></tr>
<tr><td colspan="6">Practical Component</td></tr>
<tr><td>List of Exercises</td><td colspan="3">1. Analyse the ethical impacts of AI based smartphone applications.
2. Analyse the ethical consequences of Generative AI.
3. Prepare a report on Computer Science perspective of Ethics in AI.
4. Prepare a report on Ethics in AI from a Cognitive science perspective.
5. Explore various “Bias and Fairness Audit” tools and use it to analyze the impact of any three AI tools.</td><td colspan="2">30</td></tr>
<tr><td colspan="6">Recommended Learning Resources</td></tr>
</table>

Print Resources	**Text books:** 1. Markus D. Dubber, Frank Pasquale, Sunit Das, The Oxford Handbook Of Ethics Of AI, Oxford University Press, 2021, ISBN: 019006739X; 2. Paula Boddington, AI Ethics: A Textbook, Artificial Intelligence: Foundations, Theory, and Algorithms, Springer, 2023, ISBN: 9811993815; **Reference books:** 1. Mark Coeckelbergh, AI Ethics, The MIT Press Essential Knowledge, The MIT Press, 2020, ISBN: 0262538199;
Syllabus design: Dr.K.S.Kuppusamy, Associate Professor, PUDoCS	

Year	II	Course Code: CSAI204	Credits	3
Sem.	III	Course Title: MACHINE LEARNING FRAMEWORKS	Hours	60
			Category	B
Course Prerequisites, if any	Basic understanding of programming.			
Internal Assessment Marks : 50	End Semester Marks : 50		Duration of ESA (Practical) : 03 hrs.	
Course Outcomes	● Understand the role of ML frameworks in applying ML algorithms. ● Gain hands-on experience with popular frameworks like TensorFlow and PyTorch. ● Build and evaluate basic ML models for regression, classification, and clustering tasks. ● Develop foundational skills for further exploration of ML and deep learning. ● Acquire skills to build end-to-end ML applications.			

Unit No.	Course Component	Hours
	Theory Component	
Unit I	**Introduction to Machine learning** Machine learning terminologies – Types of Machine learning – Libraries for data manipulation: Numpy and Pandas	6
Unit II	**Introduction to ML Frameworks** Definition and Importance of ML Frameworks – Types of ML Frameworks – Tensorflow – PyTorch – Scikit-learn – Keras – Challenges in ML Frameworks	6
Unit III	**Introduction to Scikit-learn** Installation and Setup – Basic Concepts in Scikit-learn – Data Preprocessing – Real world applications: Classification – Regression – Clustering – Dimensionality Reduction – Ensemble Learning using Scikit-learn	6
Unit IV	**Introduction to Tensorflow** Installation and Setup – Basic Concepts in Tensorflow – Data Preprocessing – Real world applications – Tensorflow Operations – Variables and Placeholders – Linear regression with Tensorflow	6
Unit V	**Introduction to PyTorch** Installation and Setup – Basic Concepts in PyTorch – Data Preprocessing – Real world applications – PyTorch Operations – Variables and Placeholders – Neural Networks with PyTorch	6
	Practical Component	
List of Exercises	1. Installing ML frameworks (Scikit-learn, Tensorflow, PyTorch) 2. Explore Scikit-learn datasets 3. Implement Linear regression using Scikit-learn 4. Implement a simple Multi-Layer Perceptron 5. Implement Binary Classification using Scikit Learn 6. Implement Multiclass Classification using Scikit Learn 7. Basic matrix manipulation using Tensorflow 8. Implement Linear Regression using Tensorflow 9. Implement Image Classification 10. Simple classifier using PyTorch	30

Recommended Learning Resources		
Print Resources	**Text books:** 1. Aurélien Géron, Hands-on Machine learning with Scikit-learn, Keras, and Tensorflow concepts, tools, and Techniques to Build Intelligent Systems, O'Reilly, 2019. 2. Sebastian Liu Yuxi (Hayden) Mirjalili Vahid Raschka, Machine learning with PyTorch and Scikit-Learn: Develop machine learning and deep learning models with scikit-learn and pytorch, Packt Publications, 2022. **Reference book:** 1. Hackeling, Gavin, Mastering machine learning with scikit-learn: learn to implement and evaluate machine learning solutions with scikit-learn, Packt Publications, 2017	
Syllabus design: Dr.K.S.Kuppusamy, Associate Professor, PUDoCS		

Year	II	**Course Code: CSAI205**	**Credits**	3
Sem.	III	**Course Title: DATA MINING AND TOOLS**	**Hours**	60
			Category	B
Course Prerequisites, if any	Nil			
Internal Assessment Marks: 50	End Semester Marks: 50	Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	• Understand basic concepts and techniques of Data Mining • Develop skills of using recent data mining software (Weka) for solving practical problems. • Understand the data preprocessing techniques • Apply and evaluate association rule mining techniques • Apply and analyze classification algorithms			

Unit No.	**Course Content**	**Hours**
	Theory Component	
Unit I	**INTRODUCTION TO DATA MINING AND WEKA** Need for data mining-Related technologies -Introduction to Weka- Perform basic data processing in Weka-Machine Learning, DBMS, OLAP, Statistics-Data Mining Goals-Stages of the Data Mining Process-Data Mining Techniques -Applications	6
Unit II	**DATA PREPROCESSING** Data cleaning -Data transformation-Data reduction-Discretization and generating concept hierarchies-Attribute-oriented analysis -Attribute generalization -Attribute relevance	6
Unit III	**DATA MINING KNOWLEDGE REPRESENTATION** Task relevant data -Background knowledge-Interestingness measures -Representing input data and output knowledge -Visualization techniques	6
Unit IV	**DATA MINING ALGORITHMS: ASSOCIATION RULES** Motivation and terminology -Basic idea: item sets-Generating item sets and rules efficiently -Correlation analysis	6
Unit V	**DATA MINING ALGORITHMS: CLASSIFICATION** Basic learning/mining tasks -Inferring rudimentary rules: -Decision trees - Naive Bayes approach- Ensemble approaches	6

Practical Component		
List of Exercises	Experiments with Weka 1.Installing Weka 3 Data Mining System. 2.Implement filters, discretization. 3.Perform visualization. 4.Using filters and statistics. 5.Mining association rules using Apriori algorithm. Use IRIS dataset and perform the following experiments. 6.Perform classification using Decision trees. 7.Perform classification using Naive Bayes approach 8.Implement Bagging approach.	30
Recommended Learning Resources		
Print Resources	1. Jiawei Han, MichelineKamber, Jian Pei, Data Mining Concepts and Techniques, Morgan Kaufman Publications, Fourth Edition, 2022. 2. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Second Edition, Morgan Kaufmann, 2005, ISBN: 0-12-088407-0. 3. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, Mining of Massive Datasets,Cambridge University Press, Second Edition, 2014.	
Syllabus design: Dr. V.Uma, Associate Professor, PUDoCS		

FOURTH SEMESTER

Year	II	Course Code: CSAI206 Course Title: COMPUTER SYSTEM ARCHITECTURE	Credits	4
Sem.	IV		Hours	75
			Category	C
Course Prerequisites, if any	Fundamentals of Computers			
Internal Assessment Marks: 25	End Semester Marks: 75		Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.	
Course Outcomes	• Understand the concept of digital electronics and logic circuits. • Working with binary and arithmetic operations. • Understand the organization of CPU and working principles. • Understand the Input-Output organization in a computer. • Understand the Memory organization in a computer.			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Digital Logic Circuits** Digital Computers - Logic Gates - Boolean Algebra - Map Simplification - Combinational - Circuits - Flip-Flops - Sequential Circuits - Digital Components	9
Unit II	**Data Representation and Transfer** Datatypes - Complements - Fixed - Point Representation - Floating Point Representation - Register Transfer - Bus and Memory Transfer - Arithmetic - Logic and Shift Micro-operations	9
Unit III	**CPU Organization** Register and Stack - Instruction Format - Addressing Modes - Data Transfer and Manipulation - Program Control - RISC - Basics of Pipelining	9
Unit IV	**Input-Output Organization** Peripheral devices - I/O Interface - Asynchronous data transfer - Modes of transfer - Priority Interrupt - DMA - Serial Communication	9
Unit V	**Memory Organization** Memory Hierarchy - Main Memory - Auxiliary Memory - Associative Memory - Cache Memory - Virtual Memory - Memory Management Hardware	9
	Practical Component	
List of Exercises	1. Simplify Boolean expressions using Karnaugh maps. 2. Design a combinational circuit. 3. Implementing Logical Left and Right Shifts 4. Understand different data types and how to calculate complements. 5. Evaluate performance improvement through instruction level parallelism. 6. Analyze the effect of cache performance on system performance. 7. Understand the impact of memory hierarchy on access time.	30
	Recommended Learning Resources	
Print Resources	1. Morris Mano, Computer System Architecture, Pearson Education, 2017.	

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

Year	II	Course Code: CSAI207	Credits	4
Sem.	IV	Course Title: DESIGN AND ANALYSIS OF ALGORITHMS	Hours	75
			Category	C

Course Prerequisites, if any	Basic Knowledge in Data Structures and Programming.	
Internal Assessment Marks: 25	**End Semester Marks:** 75	**Duration of ESA (Theory):** 03 hrs. **Duration of ESA (Practical):** 03 hrs.

Course Outcomes	• Analyze the efficiency of algorithms and compare their performance using appropriate metrics. • Understand the general approach of Brute Force and Divide and Conquer algorithms. • Understand the principles of the Greedy method in algorithm design. • Understand the principles of Dynamic Programming. • Understand the principles of Backtracking and Branch and bound strategies.

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction** Notation of Algorithm - Analysis of Algorithm Efficiency - Asymptotic Notations and Basic Efficiency classes - Mathematical Analysis of Non-Recursive and recursive Algorithms	9
Unit II	**Divide and Conquer** Brute Force and Divide and conquer - Binary Search – Finding the maximum and minimum – merge sort - quick sort-	9
Unit III	**Greedy Method** General method - Knapsack problem - Job Sequencing - Spanning Trees - Prims's Algorithm and Kruskal's Algorithm	9
Unit IV	**Dynamic Programming** General method - Principle of Optimality - Multistage Graphs - 0/1 Knapsack - Travelling Salesman Problem-	9
Unit V	**Backtracking & Branch Bound** Backtracking-General Method – 8 - Queen Problem - Sum of Subsets - Hamiltonian Cycles- Branch and Bound: Introduction FIFO Solution – LC Branch and Bound – 0/1 Knapsack	9
	Practical Component	
List of Exercises	1. Write recursive and iterative algorithms and analyze the time complexities using Big-O notation. 2. Implement and compare the efficiency of sorting algorithms (e.g., bubble sort, quicksort) on different input sizes. 3. Implement merge sort and analyze its time complexity with different input sizes. 4. Implement a greedy algorithm for the knapsack problem and analyze its efficiency. 5. Implement Prim's algorithm for finding the minimum cost spanning tree. 6. Implement Kruskal's algorithm for the same purpose and compare the results. 7. Solve the 0/1 knapsack problem using dynamic programming and analyze the time complexity. 8. Implement a backtracking solution for the subset sum problem and analyze its efficiency.	30

Recommended Learning Resources	
Print Resources	1. Horowitz, E. and Sahani, S, "Fundamentals of Computer Algorithms", Universities press, Second Edition, 2008. 2. S.Sridar, "Design and Analysis of Algorithms", Oxford University Press, 2014
Syllabus Design: Dr. T. Vengattaraman, Associate Professor, PUDoCS	

Year	II	**Course Code: CSAI208**	**Credits**	4
			Hours	75
Sem.	IV	**Course Title: DATABASE MANAGEMENT SYSTEMS**	**Category**	C
Course Prerequisites, if any	Knowledge of data structures and file-handling			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.		
Course Outcomes	• Understand the fundamentals of relational Model. • Design real time applications using database query language (SQL) • Familiarize with the different kinds of PL/SQL objects. • Understand the various database applications using the Relational model, ER model and EER model. • Construct and normalize conceptual data models.			

Unit No.	**Course Content**	**Hours**
	Theory Component	
Unit I	**Introduction to Relational model** Structure of relational database, Database schema, Keys, Schema diagram, Relational Query language, Relational Algebra.	9
Unit II	**Introduction to SQL** SQL data definition, basic structure of SQL Queries, set operations, null values, aggregate functions, nested subqueries	9
Unit III	**Intermediate and advanced SQL** Join expressions, views, transaction, integrity constraints, functions and procedures, triggers.	9
Unit IV	**Database design using ER model** The Entity-Relationship model, complex attributes, mapping cardinalities, primary key, removing redundant attributes in entity sets, reducing ER diagrams to relational schemas, extended ER features.	9
Unit V	**Relational database design** Decomposition using functional dependencies, normal forms, functional dependency theory, algorithms for decomposition using functional dependencies, decomposition using multivalued dependencies.	9
	Practical Component	
Exercises	1. Implement the DDL commands using SQL. 2. Implement the DML commands. 3. Implement the DDL constraints, DCL, and TCL commands. 4. Implement various built functions and aggregate functions. 5. Implement the various join operations. 6. Implement the various nested subqueries. 7. Creation and manipulation of Views. 8. Practice the basics of PL/SQL [control structures].	30

	9. Create the functions and procedures using PL/SQL. 10. Create the Triggers using PL/SQL.	
Recommended Learning Resources		
Print Resources	1. Abraham Silberschatz, Henry F. Korth and S.Sundarshan, "Database System Concepts ", Seventh Edition, McGraw Hill International Edition, 2021. 2. Brumm.B, "Beginning Oracle SQL for Oracle Database 18c: From Novice to Professional", First Edition, Apress, 2019. 3. Kevin Loney, Bob Bryla , "Oracle Database 12c The Complete Reference", First Edition, McGraw Hill, 2013.	
Syllabus design: Dr. S.L.Jayalakshmi, Assistant Professor, PUDoCS.		

Year	II	**Course Code: CSAI209**	**Credits**	4
Sem.	IV	**Course Title: MATHEMATICAL FOUNDATIONS OF MACHINE LEARNING**	**Hours**	75
			Category	C
Course Prerequisites, if any	Basic knowledge in Mathematics			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	• Learn concepts in linear algebra and use it as a platform for machine learning. • Understand techniques for analytical and numerical solutions of linear equations. • Learn concepts in multivariate calculus and vector calculus. • Analyze the importance of PCA and dimensionality reduction. • Explore the concepts of gradients.			

Unit No.	**Course Content**	**Hours**
	Theory Component	
Unit I	**INTRODUCTION** Solution of linear systems – systems of linear equations, matrices, solving systems of linear equations.	9
Unit II	**VECTORS** Vectors Spaces - linear independence, basis and rank, affine spaces, Norms, inner products, Lengths and distances, Angles and orthogonality, Orthonormal basis	9
Unit III	**MATRIX DECOMPOSITION** Methods - Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky decomposition, Eigen-decomposition and diagonalization, singular value decomposition, matrix approximation-Dimensionality reduction and PCA	9
Unit IV	**VECTOR CALCULUS** Introduction - Differentiation of univariate functions, Partial differentiation and gradients, Gradients of vector-valued functions , Gradients of matrices, Some useful identities for computing gradients, Backpropagation and automatic differentiation	9
Unit V	**CONTINUOUS OPTIMIZATION** Introduction - Optimization using gradient descent, Constrained optimization and Lagrange multipliers, Convex optimization	9 75
	Practical Component	

List of Exercises	1. Learn R/Python programming basics and Implement simple arithmetic and string operations. 2. Find a. Transpose of a vector b. Dot product of 2 vectors c. Sum of vectors d. Norm of a vector 3. Perform matrix operations. 4. Solve systems of linear equations. 5. Find Eigen values and Eigen vectors. 6. Perform PCA. 7. Perform Singular value decomposition 8. Perform gradient calculation	30
Recommended Learning Resources		
Print Resources	1. M.P. Diesenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020. 2. Charu C. Aggarwal, Linear Algebra and Optimization, Springer Nature Switzerland AG, 2020 3. K Hoffman and R Kunze, Linear Algebra, Pearson Education, 2nd Edition, 2005. 4. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India, 10th Edition, 2015	
Syllabus design: Dr. V.Uma, Associate Professor, PUDoCS		

FIFTH SEMESTER

Year	III	Course Code: CSAI301	Credits	4
			Hours	75
Sem.	V	Course Title: OPERATING SYSTEMS	Category	C

Course Prerequisites, if any	Knowledge of computers & computer organization.	
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs Duration of ESA (Practical): 03 hrs
Course Outcomes	• To understand the basic concepts of Operating System and Process. • To learn the various mechanisms of CPU scheduling, process synchronization and deadlocks. • To understand how the memory is utilized. • To analyze various File System methods and Disk scheduling algorithms. • Evaluate system structures in various operating systems, such as Linux and Windows and identifying similarities and differences.	

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Overview and Process management** Introduction: Operating System Structures - Operating systems services - System calls. Process Management**:** Process Concept – process scheduling-operation on processes-Inter process communications- Threads.	9
Unit II	**Scheduling algorithms and Process Synchronization** CPU Scheduling: Basic Concepts – Scheduling Algorithms. Process Synchronization**:** Critical Section problem – Semaphores - Classical problems of synchronization-Monitors. Deadlock: Deadlock Characterization-Deadlock Handling-Deadlock Prevention-Deadlock Avoidance- Deadlock Detection-Deadlock Recovery.	9
Unit III	**Memory Management** Main Memory: Contiguous Memory Allocation-Paging-Structure of the Page Table –Swapping. Virtual Memory: Demand Paging-Page Replacement-Thrashing.	9
Unit IV	**Storage Management** Mass Storage structure: Overview- HDD (Disk) Scheduling – storage management- RAID Structure. File Systems: File concepts – Access methods – Directory Structure – File Protection – File system Implementation- File-System Structure- File-System Operations- Allocation methods.	9
Unit V	**Case Studies** The Linux system: Design principles – kernel modules-process management- Scheduling- Memory Management-Linux File System. Windows Operating system: Systems components-Windows File System.	9
	Practical Component	
Exercises	1. Practice File handling utilities, Process utilities, Disk utilities, and Networking commands (ipconfig, ping, arp, route, netstat). 2. Write a program to implement various system call	30

	operations. 3. Write a program to demonstrate various File management operations. 4. Write a program to simulate CPU scheduling algorithms: FCFS, SJF, Round Robin, and priority. 5. Write a program to simulate Intra & Inter – Process Communication (IPC) techniques: Pipes, Messages Queues, and Shared Memory. 6. Write a program to simulate solutions to Classical Process Synchronization Problems: Dining Philosophers, Producer – Consumer, Readers – Writers. 7. Write a program to simulate Bankers Algorithm for Deadlock Avoidance. 8. Write a program to simulate Page Replacement Algorithms: FIFO, Optimal, LRU. 9. Write programs to simulate implementation of HDD Scheduling Algorithms: FCFS, SCAN, C-SCAN. 10. Case study on Linux and Windows Operating systems features and prepare a report on the same.	
Recommended Learning Resources		
Print Resources	1. Abraham Silberschatz, Peter B Galvin, G. Gagne, "Operating Systems Concepts", 10th Edition, Addison Wesley, 2018. 2. William Stallings, "Operating Systems: Internals and Design Principles", 10th Edition, Prentice Hall, 2021.	
Syllabus design: Dr. S.L.Jayalakshmi, Assistant Professor, PUDoCS		

Year	III	Course Code: CSAI302	Credits	4
Sem.	V	Course Title: MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE	Hours	75
			Category	A
Course Prerequisites, if any	• Basic knowledge in Mathematics			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA: 03 hrs.		
Course Outcomes	• Understand logical statement structures. • Apply operations in problem-solving. • Analyze integer representations and congruences. • Understand counting principles. • Evaluate combinatorial solutions.			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Logic and Proofs** Propositional Logic – Predicates and Quantifiers – Rules of Inference - Proofs – Methods and Strategy	15
Unit II	**Basic Structures** Sets – Functions – Sequences and Summations– Matrices Relations – properties – representation	15
Unit III	**Number Theory** Divisibility and Modular Arithmetic – Integer Representations and Algorithms – Primes and Greatest Common Divisors – Congruences	15
Unit IV	**Induction and Recursion** Mathematical Induction - Strong Induction and Well Ordering - Recursive Definitions and Structural Induction	15
Unit V	**Counting** Basics – Pigeonhole principle – Permutations and Combinations – Binomial Coefficients	15
	Practical Component	
	-	-
	Recommended Learning Resources	
Print Resources	1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Seventh Edition, McGraw Hill, Seventh Edition, 2017. 2. Trembley. J.P and Manohar. R., "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill, 2020.	
Syllabus design: Dr. M.Sathya, Assistant Professor, PUDoCS		

<table>
<tr><td>Year</td><td>III</td><td colspan="2">Course Code: CSAI303</td><td>Credits</td><td>4</td></tr>
<tr><td rowspan="2">Sem.</td><td rowspan="2">V</td><td colspan="2" rowspan="2">Course Title: COMPUTER NETWORKS</td><td>Hours</td><td>75</td></tr>
<tr><td>Category</td><td>C</td></tr>
<tr><td>Course Prerequisites, if any</td><td colspan="5">Fundamentals of computers</td></tr>
<tr><td>Internal Assessment Marks: 25</td><td colspan="2">End Semester Marks: 75</td><td colspan="3">Duration of ESA (Theory): 03 hrs.
Duration of ESA (Practical): 03 hrs.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">• Learn the basics of Network topology
• Learn about the various physical network media
• Understand the functionalities of all the network layers
• Familiarize the protocols of different layers
• Implement the various network protocols</td></tr>
<tr><td>Unit No.</td><td colspan="3">Course Content</td><td colspan="2">Hours</td></tr>
<tr><td colspan="6">Theory Component</td></tr>
<tr><td>Unit I</td><td colspan="3">Introduction
Introduction to Networks, Topology, Network Architecture, Reference Models, Transmission Media-Multiplexing, Switching</td><td colspan="2">9</td></tr>
<tr><td>Unit II</td><td colspan="3">Data link layer
Design Issues, Error Detection and Correction , Elementary Data, Link Protocols, Sliding window Protocols</td><td colspan="2">9</td></tr>
<tr><td>Unit III</td><td colspan="3">Network Layer
Design Issues, Routing , Logical Addressing, IP Working- IPV4 Vs IPV6, Address Mapping, delivery, Forwarding and routing</td><td colspan="2">9</td></tr>
<tr><td>Unit IV</td><td colspan="3">Transport Layer
The Transport Service, Service provided to the Upper Layers, Flow Control & Buffering, TCP Congestion Control, UDP , TCP Vs UDP</td><td colspan="2">9</td></tr>
<tr><td>Unit V</td><td colspan="3">Application layer
Domain Naming System, DNS Namespace, Resource Records, Name Servers , Electronic mail, Messages Formats, Message Transfer</td><td colspan="2">9</td></tr>
<tr><td colspan="6">Practical Component</td></tr>
<tr><td>Exercises</td><td colspan="3">1. Implementation of Basic Chat
2. Implementation of Multiple User Chat
3. Implementation of File Transmission
4. Implementation of Simple Mailing Application
5. Implementation of Client Server Application
6. Given IP address and subnet mask, Computation of (i)Subnet addresses (ii) Number of hosts in each subnet (iii IP addresses of hosts in each subnet
7. Implementation of Error Detection / Error Correction Techniques
8. Implementation of socket program Remote Procedure Call
9. Implementation of any 1 routing protocol
10. Implementation of congestion control protocol</td><td colspan="2">30</td></tr>
<tr><td colspan="6">Recommended Learning Resources</td></tr>
<tr><td>Print Resources</td><td colspan="5">1. Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks”, Fifth</td></tr>
</table>

	Edition, Prentice Hall publisher, 2022. 2. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers Inc., 2015. 3. James F. Kurose, Keith W. Ross,” Computer Networking - A Top-Down Approach Featuring the Internet”, Seventh Edition, Pearson Education, 2022.
Syllabus Design: Dr. G. Krishnapriya, Assistant Professor, PUDoCS	

Year	III	**Course Code: CSAI304** **Course Title: ARTIFICIAL NEURAL NETWORKS**	**Credits**	4
Sem.	V		**Hours**	75
			Category	C
Course Prerequisites, if any	Basic knowledge in Artificial Intelligence and Machine Learning			
Internal Assessment Marks: 25	End Semester Marks: 75		Duration of ESA (Theory): 03 hrs. Duration of ESA (Practicals): 03 hrs.	
Course Outcomes	• Understand various learning techniques in machine learning. • Understand linear regression and implement it on various datasets • Learn linear classification techniques and ensemble classifiers • Understand perceptron's and its architecture • Understand neural networks and its applications			

Unit No.	**Course Content**	**Hours**
	Theory Component	
Unit I	**INTRODUCTION** Machine Learning- Basic definitions- Types of learning: Unsupervised learning – Reinforcement Learning – Supervised Learning – hypothesis space and inductive bias – Probably Approximately Correct (PAC) Learning – Learning multiple classes – Model selection and Generalization - Evaluation and Cross validation.	9
Unit II	**REGRESSION AND CLASSIFICATION** Linear Regression - Least Squares -Under-fitting / Overfitting - Validation – Logistic Regression- Gradient Linear Models - Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbours - Tree based Methods – Decision Trees	9
Unit III	**ENSEMBLE METHODS & MLP** Bagging- Random forest - Boosting - GBDT- Stacking - Cascading - Multilayer Perceptrons: Introduction – Perceptron – Training a Perceptron – Learning Boolean Functions	9
Unit IV	**NEURAL NETWORKS** Neural Networks – Biological Motivation-– Feed Forward Network – Back Propagation - Activation and Loss Functions - from shallow networks to deep networks – vanishing gradient problem – hyperparameter tuning - batch normalization - regularization - dropout	9

Unit V	**APPLICATIONS** Stock Prediction - Handwriting digit classification - Disease prediction - Weather forecasting	9
Practical Component		
Exercises	1. Implementation of Linear Regression using stock price dataset in UCI ML repository. Using social network dataset in UCI ML repository. 2. Implement Logistic Regression. 3. Implement Decision Trees. Using Diabetes dataset in UCI ML repository. 4. Implement KNN. 5. Implement SVM. 6. Implement Random Forest. 7. Implement Neural Network. 8. Implement Handwritten digit classification using Neural Network.	30
Recommended Learning Resources		
Print Resources	1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC, 2nd Edition, 2014. 2. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2nd edition, 2020 3. Ethem Alpaydin, "Introduction to Machine Learning", 4th Edition, Adaptive Computation and Machine Learning Series, MIT Press, 4th edition, 2020 4. Tom M Mitchell, "Machine Learning", McGraw Hill Education, 2013.	
Syllabus design: Dr. V.Uma, Associate Professor, PUDoCS		

SIXTH SEMESTER

<table>
<tr><td rowspan="2">Year</td><td rowspan="2">III</td><td colspan="2" rowspan="2">Course Code: CSAI306
Course Title: MANAGEMENT STRATEGIES AND CONCEPTS</td><td>Credits</td><td>4</td></tr>
<tr><td>Hours</td><td>75</td></tr>
<tr><td>Sem.</td><td>VI</td><td>Category</td><td>A</td></tr>
<tr><td>Course Prerequisites, if any</td><td colspan="5">Nil</td></tr>
<tr><td>Internal Assessment Marks: 25</td><td colspan="2">End Semester Marks: 75</td><td colspan="3">Duration of ESA (Theory): 03 hrs.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">• Understand the fundamentals of Management Theories.
• Learn the management & communication Process Concepts
• Analyse the performance of decentralized and centralized organizational structures
• Analyse the different leadership styles and their effects on team performance and organizational culture.
• Evaluate the effectiveness of the strategies in enhancing productivity and efficiency.</td></tr>
<tr><td>Unit No.</td><td colspan="4">Course Content</td><td>Hours</td></tr>
<tr><td colspan="6">Theory Component</td></tr>
<tr><td>Unit I</td><td colspan="4">Management Theories
Science Theory and Practice - Management and Society: Social Responsibility and Ethics. The nature and purpose of planning - objectives – Strategies Policies and planning premises.</td><td>15</td></tr>
<tr><td>Unit II</td><td colspan="4">Decision Making
Process of decision making- organizing- Nature and purpose of organizing – Basics of departmentalization - Line/Staff Authority and Decentralization - Effective Organizing and organizational structure & culture.</td><td>15</td></tr>
<tr><td>Unit III</td><td colspan="4">Human Resource Management & Selection
Staffing-Manpower planning - Recruitment & Selection-Performance appraisal and career strategy - Organizational development.</td><td>15</td></tr>
<tr><td>Unit IV</td><td colspan="4">Managing the Human factor
Motivation - Leadership – Communication</td><td>15</td></tr>
<tr><td>Unit V</td><td colspan="4">The System & Process of Controlling
Control techniques and Information Technology - Productivity and Operations Management - Overall and Preventive Control - Towards a Unified - Global management theory.</td><td>15</td></tr>
<tr><td colspan="6">Recommended Learning Resources</td></tr>
<tr><td>Print Resources</td><td colspan="5">1. Herald Knootz and Heinz Weihrich, “Essentials of Management”, 11th edition, McGraw-Hill Publishing Company, 2020.
2. Fred R. David and Forest R. David, "Strategic Management: Concepts and Cases", Prentice Hall India Learning Private Limited, 16th Edition, 2020.</td></tr>
<tr><td colspan="6">Syllabus design: Dr. S.L.Jayalakshmi, Assistant Professor, PUDoCS</td></tr>
</table>

Year	III	Course Code: CSAI307 Course Title: SOFTWARE ENGINEERING THEORY AND PRACTICE	Credits	4
Sem.	VI		Hours	75
			Category	C
Course Prerequisites, if any	Basic knowledge in programming			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.		
Course Outcomes	• Understand the fundamental concepts of Software Engineering. • Analyze and document software requirements. • Apply appropriate software engineering design concepts to develop software. • Apply software metrics. • Understand software testing strategies.			
Unit No.	**Course Content**		**Hours**	
Theory Component				
Unit I	**Introduction to Software Engineering** The evolving role of software, Defining software engineering, Changing nature of software, Software myths, Role of software development, Software life cycle models, Build & fix model, Unified model, Selection of a life cycle model.		9	
Unit II	**Software Requirements** Analysis & Specifications, Requirements engineering, Types of requirements, Feasibility studies, Requirements elicitation, Requirement analysis, Requirement documentation, Requirement validation, Requirement management.		9	
Unit III	**Software Project Planning** Size estimation, Cost estimation, Models, Constructive cost model, Software risk management, Software design, Modularity, Strategy of design, Function oriented design, Object oriented design.		9	
Unit IV	**Software Metrics** Software & Metrics, Token count, Data structure metrics , Information flow metrics, Object oriented metrics, Use-Case metrics, Metrics analysis, Software reliability, Software reliability models, Capability maturity model.		9	
Unit V	**Testing Strategies** A strategic approach to software testing, Test strategies for		9	

	conventional software, Black-Box and White-Box testing, Validation testing, System testing, The art of Debugging.	
Practical Component		
Exercises	**Apply the phases of Software Development Life Cycle for the following applications and develop the same:** 1. Library Management System 2. Hospital Management System	30
Recommended Learning Resources		
Print Resources	1. Roger S. Pressman, Bruce Maxim, "Software Engineering, A Practitioner's Approach", 9th edition, McGraw Hill International Edition, 2023. 2. Ian Sommerville, "Software Engineering", 10th edition, Pearson Education, 2017.	
Syllabus Design: Dr. G. Krishnapriya, Assistant Professor, PUDoCS		

Year	III	Course Code: CSAI308	Credits	4
Sem.	VI	Course Title : DISTRIBUTED SYSTEMS	Hours	75
			Category	C

Course Prerequisites, if any	Basic knowledge in Operating Systems and Computer Networks	
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practicals): 03 hrs.

Course Outcomes

- Learn basic concepts of distributed Systems
- Understand state-of-the-art distributed system
- Design and develop Client/Server Applications.
- Setup fault tolerance and replication servers.
- Ability to design and implement CORBA and DCOM.

Theory Component

Unit No.	Course Content	Hours
Unit I	**INTRODUCTION** Definition – Goals – Hardware and Software Concepts – Client/Server Model Communication – Layered Protocols RPC – Remote Object Invocation – Message Oriented Communication.	9
Unit II	**CLIENT SERVER** Client Server and Naming Entity – Threads - Client Server – Code Migration – S/W Agents – Naming Entity – Location Mobile Entity.	9
Unit III	**SYNCHRONIZATION** Distributed Transactions Synchronization – Clock Synchronization – Logical Clocks – Global States – Election Algorithms – Mutual Exclusion – Distributed Transaction - Consistency and Replication–Data Centric Consistency–Fault Tolerance – Distributed Commit –Recovery	9
Unit IV	**DISTRIBUTED OBJECTS** Distributed Object Database System: CORBA – DCOM – GLOBE.	9
Unit V	**DISTRIBUTED FILE SYSTEM** Introduction - Distributed Document Base System – WWW – Distributed Coordination Based System – JINI.	9

Practical Component		
Exercises	1. Perform arithmetic operation using RMI. 2. Calculate simple and compound interest using RMI. 3. Implementation of ATM using RMI. 4. Implementation of Telephone Directory using RMI. 5. Implementation of Quiz Server using Servlets. 6. Implementation of Online Shopping System using servlets. 7. Implementation of Matrimonial System using servlets. 8. Implementation of servlet based Airline Reservation System. 9. Create a Word Document with text using DCOM and Visual Basic.	30
Recommended Learning Resources		
Print Resources	**TEXT BOOK(S):** 1. Andrew S. Tanenbaum, Maarten van Steer, Distributed Systems Principles and Paradigms, 3rd edition, Prentice Hall India, 2017. 2. George Couloursis, Jean Dollomore and Tim Kinderberg, Distributed Systems - Concepts and Design, Addison-Wesley, Fifth edition, 2011.	
Syllabus Design: Dr.T.Sivakumar, Assistant Professor, PUDoCS		

<table>
<tr><td>Year</td><td>III</td><td colspan="2">Course Code: CSAI309</td><td>Credits</td><td>4</td></tr>
<tr><td rowspan="2">Sem.</td><td rowspan="2">VI</td><td colspan="2" rowspan="2">Course Title: OPERATIONS RESEARCH</td><td>Hours</td><td>75</td></tr>
<tr><td>Category</td><td>A</td></tr>
<tr><td>Course Prerequisites, if any</td><td colspan="5">Basic Mathematical and Problem Solving Skills</td></tr>
<tr><td>Internal Assessment Marks: 25</td><td colspan="2">End Semester Marks: 75</td><td colspan="3">Duration of ESA (Theory): 03 hrs.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">• Understand and comprehend the basics of Linear Programing Problem (LPP).
• Learn LPP solving methods and explore duality in LPP.
• Solve assignment problem and its variants.
• Find feasible and optimal solutions for transportation problem.
• Perform critical path analysis and reviewing of a project.</td></tr>
<tr><td>Unit No.</td><td colspan="4">Course Content</td><td>Hours</td></tr>
<tr><td colspan="6">Theory Component</td></tr>
<tr><td>Unit I</td><td colspan="4">Introduction
Operation Research – Definition – Characteristics – Techniques – Applications. LPP – Introduction – Applications and components of LPP – Steps in solving LPP.</td><td>15</td></tr>
<tr><td>Unit II</td><td colspan="4">LPP
Mathematical formulation – Graphical method – Simplex method – Artificial variables – Big-M method - Two-phase method – Degeneracy and unbound solutions – Duality in LPP – Formulation – Relationship between primal and dual problems.</td><td>15</td></tr>
<tr><td>Unit III</td><td colspan="4">Assignment Model
Mathematical formulations - Hungarian Method – Variants of the Assignment problem.</td><td>15</td></tr>
<tr><td>Unit IV</td><td colspan="4">Transportation Problem
Mathematical formulation – Finding basic feasible solutions – NWCR, LCM and VAM – Optimal solution – MODI method.</td><td>15</td></tr>
<tr><td>Unit V</td><td colspan="4">Network Scheduling
Introduction – Basic components – Logical sequencing – Rules of network construction – Concurrent Activities – Critical Path Analysis -Activity Time and Floats – Project Evaluation and Review Technique (PERT) – Three Time Estimates – Critical Path Analysis of PERT network – Probability of completion of Project.</td><td>15</td></tr>
<tr><td colspan="6">Practical Component</td></tr>
<tr><td></td><td colspan="4">-</td><td></td></tr>
<tr><td colspan="6">Recommended Learning Resources</td></tr>
<tr><td>Print Resources</td><td colspan="5">1. Kanti Swarup, P.K. Gupta, Man Mohan, “Operations Research”, Sultan Chand & Sons, 20th Edition, 2023.
2. Taha H.A., “Operations Research: An Introduction”, Pearson Education, 10th Edition, 2019.</td></tr>
<tr><td colspan="6">Syllabus Design: Dr. G. Krishnapriya, Assistant Professor, PUDoCS
Dr. M. Nandhini, Professor, PUDoCS</td></tr>
</table>

Year	III	Course Code: CSAI310 Course Title: MACHINE LEARNING in IoT	Credits	4
Sem.	VI		Hours	75
			Category	C

Course Prerequisites, if any	Basic knowledge in AI and IoT, basics of probability & statistics	
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.
Course Outcomes	• Ability to develop small applications using IoT. • Learned the IoT Architecture. • Evaluate machine learning theory • Implement linear models • Implement and analyze clustering techniques	

Theory Component

Unit No.	Course Content	Hours
Unit I	**Introduction to IoT** Getting Started - Hardware requirements – Single Board Computer - Single Board Microcontroller - IoT Sensors	9
Unit II	**Overview of IoT and IIoT** Commercial uses of IoT – Industrial Internet of Things – Application of IIoT - IoT and IIoT differences.	9
Unit III	**Machine Learning with IoT** Using Python in Raspberry Pi – Handing sensor data Using Python in Arduino.	9
Unit IV	**Storing Sensor Data** Configure SQLite3 Database – create, insert data – Checking of data sanity.	9
Unit V	**Machine Learning in Sensor Data** Using machine learning models on sensor data – Machine learning Case studies in IoT.	9

Practical Component

List of Exercises	1. Develop a Human detection system using an IR sensor and write received data from Arduino to PC through Serial. 2. Develop an Intelligent Traffic Light system, which gets ultrasonic sensor readings for identifying trespassers with an understanding of Arduino Read and Write commands. 3. Get sensor readings from any IoT device and to import and export data using Pandas library functions. 4. Store sensor data in SQLite3 Database 5. Implement a ML model on sensor data.	30

Recommended Learning Resources

Print Resources	Puneeth Mathur, IoT Machine Learning Applications in Telecom, Energy, and Agriculture: With Raspberry Pi and Arduino Using Python, Apress, 2021.

Syllabus Design: Dr.T.Sivakumar, Assistant Professor, PUDoCS

Year	III	Course Code: CSAI311	Credits	4
Sem.	VI	Course Title: BIG DATA ANALYTICS	Hours	75
			Category	C
Course Prerequisites, if any	● Basic understanding of programming			
Internal Assessment Marks: 25	End Semester Marks: 75		Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.	
Course Outcomes	● Understand the Role of Big Data Technologies. ● Gain a working knowledge of Big Data Ecosystems. ● Implement and understand the basics of Hadoop and MapReduce. ● Develop foundational skills for further exploring Big Data technologies and tools. ● Understand Hive and Pig architectures.			

Unit No.	Course Component	Hours
	Theory Component	
Unit I	**Introduction to Big Data** Introduction to Big Data: Types of Digital Data-Characteristics of Data – Evolution of Big Data – Definition of Big Data – Challenges with Big Data – 3Vs of Big Data – Non Definitional traits of Big Data – Business Intelligence vs. Big Data – Data Warehouse and Hadoop environment – Coexistence.	9
Unit II	**Introduction to Big Data Analytics and NoSQL** Big Data Analytics: Classification of analytics – Data Science Terminologies in Big Data – CAP Theorem – BASE Concept. Introduction to NoSQL: Types of Databases – Advantages – NewSQL – SQL vs. NoSQL vs NewSQL.	9
Unit III	**Introduction to Hadoop Ecosystems** Introduction to Hadoop: Features – Advantages – Versions – Overview of Hadoop Ecosystems – Hadoop distributions – Hadoop vs. SQL – RDBMS vs. Hadoop – Hadoop Components – Architecture – HDFS – Map Reduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression.	9
Unit IV	**Introduction to NoSQL Database** No SQL databases: Mongo DB: Introduction – Features – Data types – Mongo DB Query language – CRUD operations – Arrays – Functions: Count – Sort – Limit – Skip – Aggregate – Map Reduce. Cursors – Indexes – Mongo Import – Mongo Export.	9
Unit V	**Introduction to Hive and Pig Architectures** Introduction to Hive – Architecture – data type – File format – HQL – SerDe – User-defined functions.	9
	Practical Component	
List of Exercises	1. Installing Big Data tools (Hadoop, Mongo DB, Hive, and Pig) 2. Explore Hadoop Commands 3. Explore Mongo DB Datasets 4. Implement a simple Hadoop program for word count 5. Implement a simple MapReduce program for finding the	30

	average length of words starting with each character. 6. Basic Mongo DB database creation. 7. Implement basic Mongo DB database manipulation commands.	
Recommended Learning Resources		
Print Resources	**Text books:** 1. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, 2019. 2. Tom White, "Hadoop: The Definitive Guide", O'Reilly Publications, 2011. **Reference books:** 1. Kyle Banker, "Mongo DB in Action", Manning Publications Company, 2012. 2. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, "Big Data for Dummies", John Wiley & Sons, Inc., 2013.	
Syllabus design: Dr.K.S.Kuppusamy, Associate Professor, PUDoCS		

SEVENTH SEMESTER

Year	IV	**Course Code: CSAI401**	**Credits**	4
Sem.	VII	**Course Title: WEB ENGINEERING**	**Hours**	75
			Category	C
Course Prerequisites, if any	• Basic understanding of programming concepts.			
Internal Assessment Marks : 25	**End Semester Marks :** 75		Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs	
Course Outcomes	• Understand the process of web publishing. • Acquire skills developing web pages using HTML. • Acquire skills to style the web pages using CSS. • Acquire skills to build server side web components. • Explore the mobile web development process.			

Theory Component		
Unit No.	**Course Content**	**Hours**
Unit I	**Introduction to World Wide Web** Introduction to web publishing - Web browsers - Web servers - Uniform Resource Locators - Using browser based developer tools.	9
Unit II	**Introduction to HTML and CSS** Structuring a web page with HTML - Basic elements - Lists - Links - Tables - Images - Forms. Using CSS to style a site - CSS for positioning - Integrating Multimedia elements.	9
Unit III	**Introduction to JavaScript** The structure - Operators - Variables - Control structures - Functions - Arrays - Objects - Validation.	9
Unit IV	**Introduction to PHP:** Setting up the server - PHP language basics - built-in functions - library functions - using includes - database connectivity - sending email - cookies and sessions-File uploads.	9
Unit V	**Mobile Web :** Mobile browsing needs - text on mobile web - design and page layout - links - images and multimedia - CSS for mobile - making use mobile features - Best practices.	9
Practical Component		
List of Exercises	1. Build your resume using simple static html. 2. Enrich your resume with CSS. 3. Implement an HTML Form with Javascript validation.	30

	4. Build a web application to demonstrate event handling in JavaScript. 5. Add a server side component to the task #3. 6. Build a server side data storage web application. 7. Build a web application to demonstrate session handling. 8. Build a web application to demonstrate cookies handling. 9. Implement mobile web application. 10. Implement file uploads in a web application.	
Recommended Learning Resource		
Print Resources	1. Laura Lemay, Rafe Coburn, Jennifer Kyrnin, "Sams Teach yourself HTML, CSS & Javascript Web Publishing, Pearson Education, 2016.	
Syllabus design: Dr.K.S.Kuppusamy, Associate Professor, PUDoCS		

Year	IV	**Course Code: CSAI402**	**Credits**	4
			Hours	75
Sem.	VII	**Course Title: SYSTEM MODELING AND SIMULATION**	**Category**	C
Course Prerequisites, if any	Basic knowledge in statistics			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.		
Course Outcomes	• Understand the fundamentals of modelling and simulation. • Learn about statistical models and input modelling. • Understand the techniques for random number generation. • Perform the simulation of dynamic systems. • Verify the simulation models.			

Theory Component

Unit No.	Course Content	Hours
Unit I	**Introduction** Simulation tools - Advantages and disadvantages of Simulation - Areas of application- Systems and system environment - Components of a system; Discrete and continuous systems - Model of a system; Types of Models - DESS - Simulation of queuing systems - General Principles.	9
Unit II	**Statistical Models in Simulation** Review of terminology and concepts - Useful statistical models - Discrete distributions - Continuous distributions - Poisson process - Empirical distributions - General Principles - Characteristics of queuing systems - Queuing notation - Long-run measures of performance of queuing systems - Steady-state behavior of M/G/1 queue - Networks of queues.	9
Unit III	**Random-Number Generation** Properties of random numbers - Generation of pseudo-random numbers - Techniques for generating random numbers - Tests for Random Numbers - Inverse transform technique Acceptance - Rejection technique.	9
Unit IV	**Input Modeling** Data Collection - Identifying the distribution with data - Parameter estimation - Goodness of Fit Tests - Fitting a non-stationary Poisson process - Selecting input models without data – Multivariate & Time - Series input models -Types of simulations with respect to output analysis - Stochastic nature of output data - Measures of performance and their estimation.	9
Unit V	**Simulation Models** Measures of performance and their estimation - Output analysis for terminating simulations - Output analysis for steady - state simulations- Verification, Calibration And Validation - Optimization, Model building, verification and validation - Verification of simulation models - Calibration and validation of models, Optimization via Simulation.	9

Practical Component

Exercises	1. Simulation of Random Number Generation. 2. Implement Chi-square goodness-of-fit test. 3. Implement One-sample Kolmogorov-Smirnov test 4. Implement test for Standard Normal Distribution	30

	5. Implement Monte-Carlo Simulation. 6. Simulation of Single Server Queuing System. 7. Simulation of Two-Server Queuing System. 8. Simulate and control a conveyor belt system 9. Implement Two-sample Kolmogorov-Smirnov test.	
Recommended Learning Resources		
Print Resources	1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, "Discrete-Event System Simulation", 5th Edition, Pearson Education, 2013. 2. Lawrence M. Leemis, Stephen K. Park " Discrete – Event Simulation: A First Course", Pearson Education, 2013.	
Syllabus Design: Dr. G. Krishnapriya, Assistant Professor, PUDoCS		

Year	IV	Course Code: CSAI403	Credits	4
Sem.	VII	Course Title: WIRELESS COMMUNICATION NETWORKS	Hours	75
			Category	C
Course Prerequisites, if any	Knowledge in computer networks.			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practicals): 03 hrs.		
Course Outcomes	● Understand basics of Wireless Communication Networks ● Understand the Satellite Communication concepts and compare various generations of communication. ● Explore IEEE 802.11 WLAN standard. ● Explore WAP and its applications. ● Understand wireless LANs technologies.			

Theory Component

Unit No.	Course Content	Hours
Unit I	**INTRODUCTION** Wireless Communication Technology- Antennas and Propagation- Antennas, Propagation Modes, Fading in the Mobile Environment. Signal Encoding Techniques- Signal Encoding Criteria, Digital Data- Analog Signals, Analog Data-Analog Signals, Analog Data-Digital Signals.	9
Unit II	**SATELLITE COMMUNICATIONS** Wireless Networking - Satellite Communications- Satellite Parameters and Configurations, Capacity Allocation-Frequency Division, Capacity Allocation-Time Division Cellular Wireless Networks- Principles of Cellular Networks, First-Generation Analog, Second-Generation - TDMA, CDMA, 3G Systems.	9
Unit III	**WIRELESS LAN STANDARDS** Evolution of IEEE 802.11- Introduction to IEEE 802.11 - General Description- Medium Access Control (MAC) for the IEEE 802.11 -WLANs Physical Layer for IEEE 802.11 - WLANs; Radio Systems -IR Systems Applications.	9
Unit IV	**MOBILE IP** Introduction, operation of Mobile IP, Mobile IP terminologies, Wireless Access Protocols: Introduction, Architecture overview, Wireless application environment.	9

Unit V	**WIRELESS LAN TECHNOLOGY** Wireless LAN- application, requirements, Technology: Infrared, spread spectrum, Narrowband microwave (radio), Introduction Bluetooth Technologies (Only Overview).	9
Practical Component		
List of Exercises	1. Study about different Wireless devices like Wi-Fi Dongler, Wireless Access Point, Antenna, Wi-Fi Router. 2. Configure a wireless LAN using CISCO Packet Tracer. 3. Develop a client server application using Wireless LAN. 4. Simulate BlueTooth Communication after pairing in CISCO Packet Tracer.	30
Recommended Learning Resources		
Print Resources	1. William Stallings, "Wireless Communications and Networks" 2nd edition, Pearson Prentice Hall, 2008.	
Syllabus Design: Dr.T.Sivakumar, Assistant Professor, PUDoCS		

Year	IV	Course Code: CSAI404	Credits	4
Sem.	VII	Course Title: REINFORCEMENT LEARNING	Hours	75
			Category	C

Course Prerequisites, if any	• Probability and Linear Algebra (Basics) • Programming Knowledge (preferably Python) • Machine Learning	
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.
Course Outcomes	• Understand basics of RL. • Understand RL Framework and Markov Decision Process. • Analyzing Dynamic Programming based RL. • Understand Monte Carlo. • Apply appropriate Reinforcement Learning method to solve a given blem.	

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**INTRODUCTION** Basics of probability and linear algebra – Reinforcement Learning (RL), Elements of Reinforcement Learning, Reinforcement Learning vs Supervised Learning, Approaches of solving Reinforcement Learning: Value based, policy based, model based, Exploration – Exploitation dilemma, Immediate Reinforcement Learning	9
Unit II	**BANDIT PROBLEMS** Bandit problems, Value-action based methods (sample average), Greedy method, €-greedy method, Incremental Implementation, Non-stationary problem, Optimistic Initial values, UCB algorithm	9
Unit III	**MARKOV DECISION PROCESS** Markov Property, Finite Markov Decision Process, policy, and value function, Reward models, Episodic & continuing tasks, Bellman's optimality operator, and Value iteration & policy iteration	9
Unit IV	**DYNAMIC PROGRAMMING** Policy evaluation, policy improvement, policy iteration, value iteration, Asynchronous Dynamic programming, Generalized Policy Iteration (GPI), bootstrap, full backup	9

Unit V	**MONTE CARLO METHOD** Advantages of Monte Carlo over Dynamic Programming, Monte Carlo Control, on-policy, off-policy, Incremental Monte Carlo, Issues/Assumptions in Monte Carlo Methods	9
Practical Component		
List of Exercises	1. Bandit Problem a. Implement Greedy and Epsilon greedy methods b. Comparison between Greedy and Epsilon Greedy Policy c. UCB: Upper Confidence Bound 2. Dynamic Programming and Monte Carlo Methods a. Implementation of Grid World using Dynamic Programming b. Gamblers Problem using Dynamic Programming c. Black Jack using Monte Carlo d. Race Track Problem	30
Recommended Learning Resources		
Print Resources	1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction," MIT Press, 2nd Edition, 2018. 2. Csaba Szepesvari, "Algorithms for Reinforcement Learning," Morgan & Claypool Publishers, 1st Edition, 2019. 3. Abhishek Nandy and Manisha Biswas, "Reinforcement Learning: With Open AI, TensorFlow and Keras using Python," Apress, 1st Edition, 2018. 4. Micheal Lanham, "Hands-On Reinforcement Learning for Games," Packt Publishing, 1st Edition, 2020.	
Syllabus design: Dr. V.Uma, Associate Professor, PUDoCS		

Year	IV	Course Code: CSAI405 Course Title: NATURAL LANGUAGE PROCESSING	Credits	4
			Hours	75
Sem.	VII		Category	C
Course Prerequisites, if any	Basic understanding of linguistics, syntax and semantics			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs Duration of ESA (Practical) : 03 hrs		
Course Outcomes	**Students will be able to** • Understand the theoretical foundations of NLP • Perform classification tasks using naive Bayes classifiers and logistic regression • Understand vector semantics and embeddings • Implement neural language models for any concerned applications • Understand the real-time applications of NLP.			
Unit No.	**Course Content**		**Hours**	
Theory Component				
UNIT I	**Regular Expressions, Text Normalization, Edit Distance** Regular Expressions - Words - Corpora - Word Tokenization - Word Normalization, Lemmatization and Stemming - Sentence Segmentation - Minimum Edit Distance.		9	
UNIT II	**N-gram Language Models** N-Grams - Evaluating Language Models – Sampling Sentences from a Language Model - Generalization and Zeros - Smoothing. **Sequence Labelling for Parts of Speech and Named Entities** English Word Classes - Part-of-Speech Tagging - Named Entities and Named Entity Tagging – HMM or Part-of-Speech Tagging - Conditional Random Fields (CRFs).		9	
UNIT III	**Naive Bayes, Text Classification and Sentiment** Naive Bayes Classifiers - Training the Naive Bayes Classifier - Optimizing for Sentiment Analysis - Naive Bayes as a Language Model – Evaluation - Test sets and Cross-validation.		9	
UNIT IV	**Vector Semantics and Embeddings** Lexical Semantics- Vector Semantics- Words and Vectors - Cosine for measuring similarity – TF-IDF – PMI – Applications of TF_IDF and PMI – Word2Vec		9	
UNIT V	**Neural Networks and Neural Language Models** Units - The XOR problem- FeedForward Neural Networks - Feedforward Networks for NLP: Classification - Training Neural Nets - Feedforward Neural Language Modeling - Training the Neural Language Model. **NLP Applications** Chatbots & Dialogue Systems – Design		9	
Practical Component				

List of Exercises	Implement the following 1. Separate the sentences and tokens of the given text document. 2. Remove all the stop words (‘a’ , ‘the’, ‘was’…) from the text 3. Perform stemming/convert each token to its root form in the given text and lemmatization on the given text 4. Correct the spelling errors in the text given. 5. Detect if a text is a positive or negative sentiment. 6. Find the dependencies of all the words in the given text. 7. Build a text classifier with available training data using textblob library in python 8. Design a simple chatbot for a domain of your choice	30
Recommended Learning Resources		
Print Resources	1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing - An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, 3rd Edition, Prentice Hall, 2024. *2.* Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, 1st Edition, O’Reilly Media, 2009.	
Prepared by: Dr. M.Nandhini, Professor, Dept. of Computer Science, PU		

Year	IV	**Course Code: CSAI406** **Course Title: DEEP LEARNING AND IMAGE ANALYTICS**	**Credits**	4
			Hours	75
Sem.	VII		**Category**	C
Course Prerequisites, if any	Machine Learning			
Internal Assessment Marks: 25	End Semester Marks: 75		Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs.	
Course Outcomes	● Understand the basic architecture and workings of neural networks ● Understand the fundamentals of deep neural networks ● Build the CNN model for image analytics ● Fine tune CNN deep learning architectures ● Learn real-time applications of Image Analytics.			

Unit No.	Course Content	Hours
	Theory Component	
UNIT I	**Foundations of Neural Networks and Deep Learning**: Neural Networks - Training Neural Networks - Activation Functions - Loss Functions – Hyper-parameters	9
UNIT II	**Fundamentals of Deep Networks**: Understanding Deep Learning- Common Architectural Principles of Deep Networks - Parameters- Layers - Activation Functions - Loss Functions - Optimization Algorithms - Hyperparameters - Building Blocks of Deep Networks	9
UNIT III	**CNN:** Convolutional Neural Networks- Architecture - Input, Convolutional, Pooling, fully connected Layers - Applications - CNN Variants - ResNet	9
UNIT IV	**Building Deep Networks:** Matching Deep Networks to the Right Problem - Modeling CSV Data with Multilayer Perceptron Networks - Predicting Handwritten Images Using CNNs -	9

UNIT V	**Tuning Deep Networks**: Working with Layer Count, Parameter Count, and Memory - Feed-Forward Multilayer Neural Networks - Controlling Layer and Parameter Counts - Weight Initialization Strategies- Using Activation Functions - Applying Loss Functions - Understanding Learning Rates - Applying Methods of Optimization - Controlling Epochs and Mini-Batch Size - Regularization - Max-Norm Regularization - Dropout- Dealing with Overfitting	9
	Practical Component	
List of Exercises	1. Implement a simple perceptron model and train it to perform binary classification on a given dataset. Use the sigmoid activation function and gradient descent for training. 2. Build a multilayer feed-forward neural network from scratch. Train the network using the backpropagation algorithm on a given dataset 3. Implement and train the CNN on the MNIST dataset for handwritten digit classification. 4. Fine-tune a pre-trained CNN model and perform image analytics.	30
Recommended Learning Resources		
Print Resources	1. Josh Patterson and Adam Gibson, "Deep Learning- a practitioner's approach", 1st Edition, O'Reilly Media, 2017. 2. Nikhil Buduma and Nicholas Locascio, "Fundamentals of Deep Learning: Designing Next Generation Machine Intelligence Algorithms", 1st Edition, O'Reilly Media, 2017.	
Syllabus design: Dr. V.Uma, Associate Professor, PUDoCS		

Year	IV	**Course Code: CSAI407** **Course Title: ROBOTICS**	**Credits**	4
			Hours	75
Sem.	VII		**Category**	C
Course Prerequisites, if any	Mathematical Foundations of Computer Science and Basics of Machine Learning			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practicals.): 03 hrs.		
Course Outcomes	● Learn about Agents and Sensors. ● Learn Knowledge representation, reasoning and planning. ● Perform designing of various robotic arms. ● Implement robot programs. ● Apply and design robots.			

Theory Component

Unit No.	**Course Content**	**Hours**
Unit I	**Agents, Paradigms, Sensors** Intelligent agents - Search overview - Adversarial search - Constraint satisfaction - Paradigms: Hierarchical, Reactive- Types of Sensors-Vision	9
Unit II	**Knowledge representation, reasoning and planning** Predicate logic-Fuzzy logic - Classical planning - Planning and acting in the real world - Navigation	9
Unit III	**Learning** Decision making - Learning from examples - Knowledge in learning - Learning probabilistic models - Reinforcement learning - Deep learning	9
Unit IV	**Robot Programming** Features of various programming methods, Robot Task planning: concept, different methods, robot learning, Mobile Robot: Introduction, obstacle Representatives, Motion Planning in fixed and Changing structure - Simple Programs.	9
Unit V	**Industrial Applications and Case Studies** Application of robots: Material handling - Machine loading and unloading – Assembly – Inspection –Recent developments in Robotics- Safety Considerations.	9

Practical Component		
List of Exercises	1. Programming a robot for performing various applications involving the Point-to-point motion of the manipulator's arm. 2. Programming a robot for performing various applications involving continuous path motion of the manipulator arm. 3. Interfacing a robot with a belt conveyor. 4. Developing a program for a robot to perform pick and place operations. 5. Programming of robot for material handling application 6. Programming of robot for processing application 7. Programming a robot for sorting operation	30
Recommended Learning Resources		
Print Resources	**TEXT BOOKS:** 1. Robin.R.Murphy, Introduction to AI Robotics, MIT press, 2 edition 2019. **2.** Stuart J Russell and Peter Norvig, Artificial Intelligence – A Modern Approach, Third Edition, PHI,2010.	
Syllabus Design: Dr.T.Sivakumar, Assistant Professor, PUDoCS		

EIGHTH SEMESTER

Year	IV	**Course Code: CSAI408**	**Credits**	4
Sem.	VIII	**Course Title : SEQUENCE MODELS**	**Hours**	75
			Category	C
Course Prerequisites, if any	Knowledge in deep learning concepts			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	● Understand the need for deep learning architectures ● Analyse the challenges in deep learning models ● Understand the importance of RNN ● Understand the architectures of LSTM and GRU ● Understand the need for sequence to sequence models and its applications			
Unit No.	**Course Content**		**Hours**	
Theory Component				
Unit I	**INTRODUCTION TO DEEP LEARNING** Fundamentals of Deep Learning - Learning Algorithms - Probabilistic modelling - Early Neural Networks - Deep Learning vs Machine Learning. Scalars - Vectors - Matrices - Higher Dimensional Tensors - Manipulating Tensors		9	
Unit II	**DEEP NEURAL NETWORKS** Architecture- Back propagation - Hyperparameter tuning - Optimisers - Vanishing and Exploding gradients- Bias Variance tradeoff - Regularisation - Batch normalisation		9	
Unit III	**RECURRENT NEURAL NETWORK** Architecture- Types - Computing gradients - Backpropagation through time - bidirectional RNN - challenges - applications		9	
Unit IV	**LSTM & GRU** Long Short-Term Memory (LSTM) - Architecture - variants - applications - Gated Recurrent Unit (GRU) - Architecture - variants - applications		9	
Unit V	**SEQUENCE TO SEQUENCE MODELS** Architecture - Attention mechanism - Deep recurrent networks - recursive neural networks – applications		9	

Practical Component		
List of Exercises	1. Handling Time Series Data - Image Data - Video Data using Deep Neural network 2. Apply RNN for image captioning 3. Apply LSTM for text generation 4. Apply GRU for sequence generation 5. Apply sequence models for sentiment classification 6. Apply LSTM for time series analysis 7. Apply GRU for weather forecasting	30
Recommended Learning Resources		
Print Resources	1. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer International Publishing AG, part of Springer Nature, 2018 2. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016 3. Delip Rao, Brian McMahan, Natural language processing with PyTorch: Build Intelligent Language Applications Using Deep Learning, O'Reilly, 2019	
Syllabus design: Dr. V.Uma, Associate Professor, PUDoCS		

Year	IV	Course Code: CSAI409	Credits	4
Sem	VIII	Course Title: AI AND CYBER SECURITY	Hours	75
			Category	C

Course Prerequisites, if any	Knowledge of Computer Networks and Cryptography	
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.
Course Outcomes	● Learned to protect out vital data from the hackers. ● Implement security standards in computer networks. ● Understand Cyber law and data privacy ● Understand cyber security management ● Apply ML models for cyber security	

Theory Component

Unit No.	Course Content	Hours
Unit I	**Introduction** Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., non-state actors, Cyber terrorism, Critical IT and National Critical Infrastructure, Cyberwarfare.	9
Unit II	**Cyber Crimes** Cybercrimes targeting Computer systems and Mobiles- spyware, viruses, Trojans, ransomware. Online scams and frauds- email scams, Phishing, Online job fraud, Debit/ credit card fraud, Online payment fraud, Darknet- illegal trades, drug trafficking, human trafficking, Cyber Police stations, Crime reporting procedure.	9
Unit III	**Cyber Law and Data Privacy** Cybercrime and IT Act 2000 and its amendments. Cybercrime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies. Data protection, Data privacy and data security, Personal Data Protection.	9
Unit IV	**Cyber Security Management** Cyber security Plan-cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals.	9
Unit V	**AI for Cyber security** AI for evolution - Types of ML - Applications - Role of ML models Detecting cybersecurity threats - Network Anomaly detection using ML models - Malware detection using ML models	9

Practical Component		
List of Exercises	1. Configure Firewall to protect your computer and Computer Network from hackers. 2. Establish a secure password policy manager in your organization. 3. Write a program to send the data securely using Java Cryptography Extension (JCE). 4. Install python libraries for AI and cybersecurity 5. Detecting spams with Naive Bayes classifier 6. Implement decision tree to detect malware 7. Perform anomaly detection using SVM classifier	30
Recommended Learning Resources		
Print Resources	1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd., 2011 2. Hands-On Artificial Intelligence for Cybersecurity by Alessandro Parisi. Packt Publishing., 2019	
Syllabus Design: Dr.T.Sivakumar, Assistant Professor, PUDoCS		

Year	IV	**Course Code: CSAI410**	**Credits**	4
Sem.	VIII	**Course Title : GENERATIVE AI**	**Hours**	75
			Category	C
Course Prerequisites, if any	Basic concepts in AI, Machine learning and Deep learning			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	● Understand the fundamental concepts and techniques of generative modeling, deep learning, and their applications in various domains. ● Differentiate between generative and discriminative modeling approaches and recognize their respective strengths and challenges. ● Understand and analyse GANs. ● Understand the power VAEs. ● Understand Transformer networks and their applications			
Unit No.	**Course Content**		**Hours**	
Theory Component				
Unit I	**INTRODUCTION** Generative Modeling: Generative Versus Discriminative Modeling - Advances in Machine Learning-The Rise of Generative Modeling - The Generative Modeling Framework - Probabilistic Generative Models - Hello World! - Understand Probabilistic Generative Model - Naive Bayes - Hello World! Continued - The Challenges of Generative Modeling - Representation Learning - Setting Up the Environment.		9	
Unit II	**DEEP LEARNING** Structured and Unstructured Data – Deep Neural Network- Keras and TensorFlow - First Deep Neural Network – Loading the Data – Building , Compiling, training and evaluating the model – Improving the model – Convolutional Layers – Batch Normalization – Dropout Layers		9	
Unit III	**VARIATIONAL AUTOENCODERS** The Art Exhibition – Autoencoders – Build First Autoencoder – The Encoder – The Decoder – Joining the Encoder to the Decoder – Analysis of the Autoencoder – The Variational Art Exhibition- Building a variational Autoencoder – The Encoder- The Loss Function – Analysis of the Variational Autoencoder – Using VAE's to Generate Faces – Training the VAE – Analysis of the VAE		9	

Unit IV	**GENERATIVE ADVERSARIAL NETWORKS** Introduction to GANs - Building First GAN - The Discriminator - The Generator - Training the GAN - GAN Challenges - Oscillating Loss - Mode Collapse - Uninformative Loss - Hyperparameters - Tackling the GAN Challenges - Wasserstein GAN - Wasserstein Loss - The Lipschitz Constraint - Weight Clipping - Training and analysing WGAN - WGAN-GP - The Gradient Penalty Loss	9
Unit V	**TRANSFORMER NETWORKS** The Transformer - Positional Encoding - Multihead Attention - The Decoder - Analysis of the Transformer - BERT - GPT	9
Practical Component		
List of Exercises	1. Implement CNN and perform object classification 2. Implement VAE and perform image generation 3. Implement GAN and perform image generation 4. Implement transformer networks and perform text generation 5. Implement transformer networks and perform image captioning 6. Implement BERT 7. Implement GPT	30
Recommended Learning Resources		
Print Resources	1. David Foster, Generative Deep Learning-Teaching Machines to Paint, Write, Compose, and Play, O'Reilly, 2019 2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016 3. Jakub Langr and Vladimir Bok, GANs in Action: Deep learning with Generative Adversarial Networks, Manning,2019 4. Magnus Ekman, Learning Deep Learning: Theory and Practice of Neural Networks, Computer Vision, Natural Language Processing, and Transformers Using TensorFlow, Addison-Wesley Professional, 1st edition 2021	
Syllabus design: Dr. V.Uma, Associate Professor, PUDoCS		

Year	IV	Course Code: CSAI411	Credits	4
Sem.	VIII	Course Title : EXPLAINABLE AI	Hours	75
			Category	C
Course Prerequisites, if any	Basic understanding of Artificial Intelligence terminologies.			
Internal Assessment Marks: 25	End Semester Marks : 75		Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs	
Course Outcomes	● Understand fundamental concepts and methodologies of Explainable AI (XAI). ● Develop proficiency in implementing and applying XAI methods using Python libraries. ● Gain the ability to interpret and visualize feature attributions effectively. ● Apply XAI techniques to real-world datasets, communicating insights to stakeholders.			

Unit No.	Course Component	Hours
Theory Component		
Unit I	**An Overview of Explainable AI** Introduction to Explainable AI (XAI): Historical background and evolution, significance, Needs, Challenges Explainability Evaluation – Interpretability and Explainability – Types of Explanations – Themes Throughout Explainability – Case Studies.	9
Unit II	**Explainability for Tabular Data** Permutation Feature Importance – Shapley Values and SHAP – Visualizing Feature Attributions – Explaining Tree-Based Models – LIME for Tabular Data – Surrogate Models for Model Interpretation – Counterfactual Explanations – Partial Dependence Plots and Related Plots – Case Study.	9
Unit III	**Explainability for Image Data** Integrated Gradients (IG) – XRAI and Grad-CAM – LIME for Image Data – Guided Backpropagation and Grad-CAM – Adversarial Attacks – Robustness in Image Explainability – Attention Mechanisms for Image Explanation – Explanation by Disentanglement.	9
Unit IV	**Explainability for Text Data** Tokenization and Word Embeddings – LIME for Text Data – Gradient x Input and LRP – Language Interpretability Tool – Transformer Interpretability Methods – Attention-based Explanation Techniques – Concept-based Explanations.	9
Unit V	**Advanced and Emerging Topics** Alternative Explainability Techniques – Evaluation of Explainability Techniques – Interpretable Deep Learning Models – Counterfactual Reasoning for Explainable AI – Explanation by Example Generation – Explainability in Reinforcement Learning – Meta-Explanations and Human-in-the-loop Explainability.	9
Practical Component		
List of Exercises	1. Permutation importance analysis with scikit-learn	30

	2. Shapley values analysis for ML interpretation 3. Visualize feature attributions using bar plots, heatmaps, etc. 4. Interpret decision trees and ensemble models 5. Use the LIME library to generate local model-agnostic explanations 6. Grad-CAM visualization of parts of an image contributed most to CNN predictions. 7. Utilize LIME or SHAP to interpret words or phrases in text-based machine learning models. 8. Implement LRP to interpret the relevance of input features. 9. Adversarial attacks on model interpretability and explore methods for robust explanations. 10. Create an interactive dashboard using visualization libraries like Plotly or Dash.	

Recommended Learning Resources	
Print Resources	**Text books:** 1. Michael Munn, David Pitman, "Explainable AI for Practitioners", O'Reilly Media, Inc., October 2022. **Reference books:** John Liu, Uday Kamath , "Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning", Springer Nature Switzerland AG, December 2021. **Web resources** 1. https://arxiv.org/ftp/arxiv/papers/2211/2211.06579.pdf 2. https://iphome.hhi.de/samek/pdf/HolXXAI22b.pdf 3. diposit.ub.edu/dspace/bitstream/2445/192075/1/tfg_nieto_juscafresa_aleix.pdf
Syllabus design: Dr.K.S.Kuppusamy, Associate Professor, PUDoCS	

Year	IV	Course Code: CSAI412	Credits	4
Sem.	VIII	Course Title : LARGE LANGUAGE MODELS	Hours	75
			Category	C
Course Prerequisites, if any	Basic understanding of Artificial Intelligence.			
Internal Assessment Marks : 25	End Semester Marks : 75		Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical) : 03 hrs	
Course Outcomes	● Understand the Fundamentals of Transformer Architectures and LLMs. ● Analyse the Infrastructure and Algorithms for Large Language Models. ● Gaining insights into Ethical Considerations in Large Language Models. ● Understand the applications of LLM ● Analyse societal impact of LLM.			

Unit No.	Course Component	Hours
	Theory Component	
Unit I	**Introduction to LLMs and Transformers** Overview of NLP – Historical Development of Language Models – Introduction to Transformer Architecture: Evolution from RNNs, Self-attention Mechanism and Positional Encoding, multi-head attention mechanisms.	9
Unit II	**Architectural Techniques and Systems** Introduction to GPT, BERT, and T5 model's: Architecture, Training, and In-context Learning – Scaling Issues: Model Size, Computation, and Memory.	9
Unit III	**Introduction to Prompting Techniques** Overview of prompting techniques – Prompting LLMs – Different prompting strategies – Theoretical Insights into Prompting – Prompt Design Principles – Transfer Learning, Fine-tuning, and Applications in NLP.	9
Unit IV	**Safety and Trustworthiness of LLMs** Ethical considerations – Bias Identification Methods – Bias Mitigation Methods – Fairness Assurance Techniques – LLM Safety Assessment – Robustness Evaluation for LLMs.	9
Unit V	**Systems and Societal Impact** Societal Implications of Deployment – Impact of LLMs Across Domains – Ethical Dilemmas – LLM Implications: Healthcare, Finance and Media – Privacy Concerns and Misinformation – Algorithmic Responsibility.	9
	Practical Component	
List of Exercises	1. Framework installation (TensorFlow or PyTorch) 2. Explore basic TensorFlow/PyTorch	30

	functions 3. Explore and analyze LLM training datasets 4. PyTorch fine-tuning of pre-trained LLM 5. Evaluate the performance of different LLM architectures on benchmark datasets. 6. Train a language model on domain-specific data 7. Experiment with advanced LLM architectures 8. Implement conditional text generation with TensorFlow 9. Explore real-world applications of LLMs (e.g., chatbots, text summarization)	

Recommended Learning Resources	
Print Resources	**Text books:** 1. Jay Alammar, Maarten Grootendorst, "Hands-On Large Language Models", O'Reilly Media, Inc 2024. 2. Sebastian Raschka, "Build a Large Language Model (From Scratch)", MEAP December 2023. **Reference books:** 1. Sinan Ozdemir, "Quick Start Guide to Large Language Models: Strategies and Best Practices for Using ChatGPT and Other LLMs", Addison-Wesley Professional, October 2023.
Syllabus design: Dr.K.S.Kuppusamy, Associate Professor, PUDoCS	

Year	IV	**Course Code: CSAI413**	**Credits**	4
Sem.	VIII	**Course Title : PROMPT ENGINEERING**	**Hours**	75
			Category	C
Course Prerequisites, if any	Basic understanding of Artificial Intelligence			
Internal Assessment Marks : 25	End Semester Marks : 75		Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs	
Course Outcomes	● Gain an understanding of Large Language Models. ● Gain foundational knowledge of prompts design. ● Acquire skills to design effective prompts for LLMs. ● Understand advanced prompt engineering techniques. ● Acquire skills to analyse real-world applications of prompt engineering			

Unit No.	**Course Component**	**Hours**
	Theory Component	
Unit I	**Introduction to Large Language Models** LLMs - Nature and Capabilities - Applications - Different LLM Models and their limitations - Real-world applications of LLMs.	9
Unit II	**Foundations of Prompt Engineering** Prompt engineering - Role in LLM Communication - Basics of prompts - Elements of prompts: Instruction, Context, Input Data, and Output Indicator.	9
Unit III	**Prompt Design Techniques** Basics of prompt design - examples of prompt design - Text summarization prompt - Information extraction prompt - Question answering prompt - Text classification prompt - Conversation prompts - Code generation prompt - Reasoning prompts.	9
Unit IV	**Advanced Prompt Engineering Techniques** Prompt designing techniques - Zero shot prompting - Few Shot prompting - Chain of Thoughts prompting - Self-consistency prompts - General Knowledge Prompts.	9
Unit V	**Prompt Engineering in Open AI Playground** LLM Settings: Temperature - Max Length - Stop Sequences - TopP - Frequency Penalty - Presence Penalty - Best of - Text classification - Code generation - Creativity - Information Extraction - Mathematics - Question answering.	9
	Practical Component	
List of Exercises	(Open Large Language Models through Ollama can be utilized) 1. Explore Open AI Playground 2. Explore Prompt design elements and techniques 3. Explore and implement Text classification Prompts 4. Explore and implement a Few Shot Prompts 5. Explore and implement Text Summarization Prompts 6. Explore and implement General Knowlege Prompts 7. Implement Information Extraction Prompts 8. Implement Question Answering Prompts	30

Recommended Learning Resources	
Print Resources	**Text books:** 1. John. Ibrahim, ART OF ASKING CHATGPT FOR HIGH-QUALITY ANSWERS: A Complete Guide to Prompt Engineering Techniques, Nzunda Technologies Limited, 2023. **Web Resources:** 1. https://www.promptingguide.ai/
Syllabus design: Dr.K.S.Kuppusamy, Associate Professor, PUDoCS	

Year	IV	**Course Code: CSAI414**	**Credits**	4
Sem.	VIII	**Course Title : TIME SERIES ANALYSIS**	**Hours**	75
			Category	C
Course Prerequisites, if any	Knowledge in deep learning architectures			
Internal Assessment Marks: 25	End Semester Marks: 75		Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.	
Course Outcomes	● Learn concepts related to time series forecasting ● Understand the characteristics of time series data ● Learn the widely used time series models ● Learn time series data visualisation techniques ● Understand deep learning architectures used for time series forecasting			

Unit No.	**Course Content**	**Hours**
	Theory Component	
Unit I	**INTRODUCTION** Time series analysis - forecasting - characteristics - python for time series analysis - deep learning with PyTorch - time series as deep learning problem - Univariate - multivariate - single step vs multistep	9
Unit II	**PREPROCESSING** Normalisation - trend removal - differencing - sliding window - loss function - training - validating - testing - model optimisation	9
Unit III	**EXPLORATORY DATA ANALYSIS FOR TIME SERIES** Data visualisation - Histograms - Scatterplots - Understanding stationarity - Understanding correlation - 1D,2D,3D visualisations	9
Unit IV	**AUTOREGRESSIVE AND AUTOMATED METHODS** Autoregression - Moving average - Autoregressive moving average - automated machine learning - clustering - decision tree	9
Unit V	**RECURRENT NEURAL NETWORKS** Architecture - importing dataset - Perform training and evaluation of RNN model - Develop GRUs and LSTMs for Time Series Forecasting	9

Practical Component		
List of Exercises	Perform time series analysis for 1. Health care data 2. Stock price 3. Financial data 4. Stream data 5. Weather data 6. Sales data	30
Recommended Learning Resources		
Print Resources	1. Francesca Lazzeri, Machine Learning for Time Series Forecasting with Python, Wiley, 2020 2. Ivan Gridin, Time Series Forecasting Using Deep Learning, BPB publications, 2021 3. Aileen Nielsen, Practical Time Series Analysis, O'Reilly, 2019 4. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer International Publishing AG, part of Springer Nature, 2018	
Syllabus design: Dr. V.Uma, Associate Professor, PUDoCS		

MULTI-DISCIPLINARY COURSES

<table>
<tr><td>Year</td><td>I / II</td><td colspan="2" rowspan="2">Course Code: COMS101
Course Title: Introduction to Python Programming</td><td>Credits</td><td>3</td></tr>
<tr><td>Sem.</td><td>I / III</td><td>Hours</td><td>60</td></tr>
<tr><td>Course Prerequisites, if any</td><td colspan="5">Problem-solving skills</td></tr>
<tr><td>Internal Assessment Marks: 25</td><td colspan="2">End Semester Marks: 75</td><td colspan="3">Duration of ESA (Theory): 03 hrs.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">• Understand Python programming constructs
• Learn about different data structures in Python
• Write programs using functions
• Explore the use of Python modules and packages
• Perform Visualization using Python package</td></tr>
<tr><td>Unit No.</td><td colspan="3">Course Content</td><td colspan="2">Hours</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>Unit I</td><td colspan="3">Introduction
Python Basics: Working – Identifiers – Comments – Types – Operations – Buit-in, library functions
Strings: Accessing – Properties – Operations
Control-flow Instructions: Decision Control – logical operators – conditional expressions Repetition control instruction – break and continue – pass Statement</td><td colspan="2">12</td></tr>
<tr><td>Unit II</td><td colspan="3">Console Input/Output: Console Input – Console Output – Formatted printing
Lists
Definition – Accessing – Operations – Methods – Varieties – Comprehension
Tuples
Definition – Accessing – Operations – Varieties – Comprehension – Conversion – Iterators and Iterables - zip()</td><td colspan="2">12</td></tr>
<tr><td>Unit III</td><td colspan="3">Sets
Definition – Accessing – Operations – Functions – Mathematical set operations – Updating set operations
Dictionaries
Definition – Accessing – Operations – Functions – Nested Dictionary</td><td colspan="2">12</td></tr>
<tr><td>Unit IV</td><td colspan="3">Functions
Definition – Communication – Types – Unpacking – Lambda, Recursive functions
Modules and Packages
Creation and importing</td><td colspan="2">12</td></tr>
<tr><td>Unit V</td><td colspan="3">Exception handling
Syntax errors – handling exceptions – try-except – user-</td><td colspan="2">12</td></tr>
</table>

	defined exceptions – *else, finally* blocks – Tips **Visualization** - Matplotlib package – Plotting Graphs	
Recommended Learning Resources		
Print Resources	1. Aditya Kanetkar, Yashavant Kanetkar, Let us Python, BPB Publisher, 6th Edition, 2023	
Syllabus Design: Dr. R.Sunitha, Associate Professor, PUDoCS		

<table>
<tr><td>Year</td><td>I</td><td colspan="2" rowspan="2">Course Code: COMS102
Course Title: Foundations of Information Technology</td><td>Credits</td><td>3</td></tr>
<tr><td></td><td></td><td>Hours</td><td>60</td></tr>
<tr><td>Sem.</td><td>II</td><td colspan="2"></td><td>Category</td><td>A</td></tr>
<tr><td>Course Prerequisites, if any</td><td colspan="5">Basic knowledge of Computers</td></tr>
<tr><td>Internal Assessment Marks: 25</td><td colspan="2">End Semester Marks: 75</td><td colspan="3">Duration of ESA (Theory): 03 hrs.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">• Familiarize the fundamentals of Information Technology.
• Understand the management of hardware and software
• Describe the basics of networking
• Discuss about data management and security aspects of data
• Ability to troubleshoot computer systems</td></tr>
<tr><td>Unit No.</td><td colspan="3">Course Content</td><td colspan="2">Hours</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>Unit I</td><td colspan="3">Introduction
Overview of IT – Computer Basics – Software fundamentals – Networks & Internet – IT ethics and policies</td><td colspan="2">12</td></tr>
<tr><td>Unit II</td><td colspan="3">Hardware and Software Management
Computer Assembly and maintenance - Operating Systems – Software installation and maintenance – Virtualization, Cloud Computing</td><td colspan="2">12</td></tr>
<tr><td>Unit III</td><td colspan="3">Networking Essentials
Network Fundamentals - Hardware – Protocols and services – Wireless Networking – Security</td><td colspan="2">12</td></tr>
<tr><td>Unit IV</td><td colspan="3">Data Management and Security
Data and fundamentals of Database – Data Backup and recovery – Cyber Security – Encryption and Cryptography</td><td colspan="2">12</td></tr>
<tr><td>Unit V</td><td colspan="3">IT Support and Troubleshooting
Help desk and IT support – Troubleshooting methodologies – Diagnostic tools and utilities – Future trends in IT</td><td colspan="2">12</td></tr>
<tr><td colspan="6">Recommended Learning Resources</td></tr>
<tr><td>Print Resources</td><td colspan="5">1. Floyd Fuller, Brian Larson, Computers: Understanding Technology, EMC Paradigm, 4th Edition, 2011.
2. Mike Meyers , CompTIA A+ Certification All-in-One Exam Guide, McGraw-Hill Education, 11th Edition, 2023.
3. Jeffrey S. Beasley, Piyasat Nilkaew, Networking Essentials, Prentice Hall Certification, 3rd Edition, 2012.
4. Charles J. Brooks, Christopher Grow, Philip Craig, and Donald Short , Cybersecurity Essentials, Sybex Publisher, 1st Edition, 2018.</td></tr>
<tr><td colspan="6">Syllabus Design: Dr. R.Sunitha, Associate Professor, PUDoCS</td></tr>
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