PONDICHERRY UNIVERSITY

(A CENTRAL UNIVERSITY)

Bachelor of Computer Applications (Honors)

Bachelor of Computer Applications (Honors with Research)

REGULATIONS, CURRICULUM & SYLLABUS

(For Affiliated Colleges)

(Under the National Education Policy - NEP 2020)

Effective from the Academic Year 2023 - 2024

Revised in June 2024

Board of Studies (BOS) - Computer Applications

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13	The Head, Dept. of CS	Dept. of CS, PSV College of Arts & Sci.	
14	The Head, Dept. of CS	Dept. of CS, Rajiv Gandhi Arts & Science	

NEP Committee

S. No.	Name	Designation	Affiliation
1	Prof. S. K. V. Jayakumar	Professor and Head	Dept. of Computer Science, Pondicherry University
2	Prof. T. Chithralekha	Professor	
3	Prof. P. Sujatha	Professor	
4	Dr. R. Sunitha	Associate Professor	
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Syllabus Revision Committee (Bachelor of Computer Applications)

S. No.	Name	Designation	Affiliation
1	Prof. S. Ravi	Professor	Dept. of Computer Science, Pondicherry University
2	Dr. T. Vengattaraman	Associate Professor	
3	Dr. Sukhvinder Singh	Assistant Professor	

Table of Contents

1. PREAMBLE & PROGRAMME OUTCOMES

1.1. Preamble

This Bachelor of Computer Applications (B.C.A.) course is designed to provide the student with a comprehensive understanding of computer applications, covering a wide array of foundational concepts and practical skills. In the B.C.A. program, students will explore the fundamental principles of Computer Science, Programming Languages, Database Management, Software Development, and more.

This curriculum is crafted to equip the students with the knowledge and skills necessary to excel in the ever-evolving field of computer applications. From building a strong foundation in programming to gaining insights into system analysis and design, the B.C.A. program will prepare the students for a successful career in the dynamic and diverse world of IT.

1.2 Programme Outcomes

Upon completion of the Bachelor of Computer Applications (B.C.A.), students will demonstrate the following outcomes at:

UG Certificate Level:

Demonstrate proficiency in solving simple problems using programming.

Develop a foundational knowledge of key concepts in information technology.

UG Diploma Level:

Demonstrate the ability to analyze and solve more complex computational problems.

Acquire the ability to analyze and design computer-based systems.

UG Degree Level:

Design and implement efficient solutions for real-world computing challenges.

Demonstrate understanding of software project management principles.

UG Degree with Honors / Honors with Research:

Demonstrate advanced proficiency in programming languages and software development.

Clearly articulate complex ideas to technical and non-technical audiences.

Innovate and contribute to the development of efficient solutions.

Engage in collaborative projects and demonstrate strong teamwork skills.

Adapt to evolving technologies and continue professional development.

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 a 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 Programme 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, F = 0 and 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 weighted average of all courses the student has taken in a given Programme.

H. A Common Course: Means the set of courses that all student's who are admitted to any Programme 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 programme, 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 the courses which are specific to the 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 table below).

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 5.**

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

Four years B.C.A. 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 Multimedia & Animation if, in addition, they complete work based vocational courses / 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 Computer Applications if, in addition, they complete work based vocational courses / 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 Computer Applications after successful completion of three years, earning a minimum of 120 credits and satisfying the minimum credit requirements as mentioned in Table 1.

3.3.4. Four-year UG Degree (Honors)

A four-year UG Honors degree in the Computer Applications 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 Table 1.

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, Computer Applications. The students who secure a minimum of 160 credits, including 12 credits from a research project/dissertation, will be awarded UG Degree in Computer Applications (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 Table 1.

Table 1: Breakup of Credits and Courses – Minimum Requirements

S. No.	Component	3 Years UG	4 Years 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.

- Bachelor of Computer Applications *
- Bachelor of Computer Applications (Honors) #
- Bachelor of Computer Applications (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 following Figure 1.

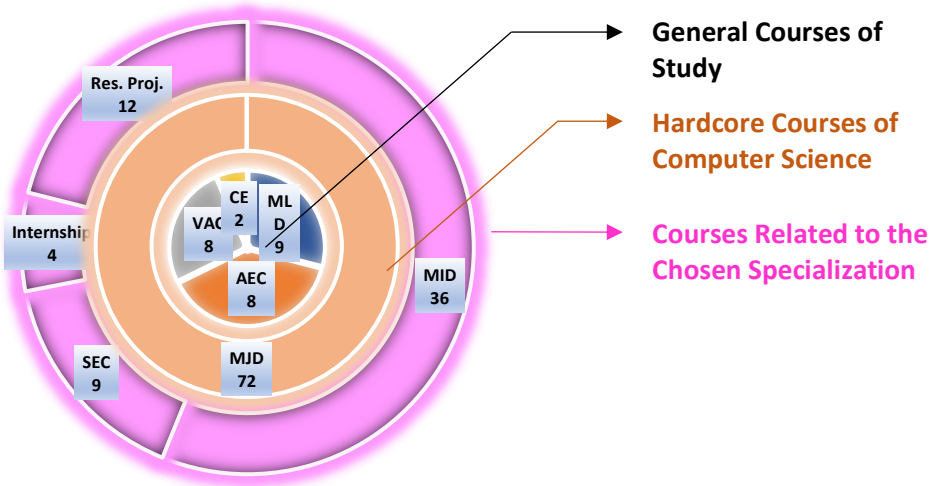

Figure 1: Programme Structure with credit breakup

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 years programme), should have completed atleast one internship for a minimum period of 8 weeks.

Exit after 2nd Semester: Certificate in Multimedia & Animation 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 Computer Applications 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 Computer Applications (B.C.A.) 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 Multimedia & Animation
4th Semester	Min: 80 Credits & Internship	Diploma in Computer Applications
6th Semester	Min: 120 Credits & Internship	Bachelor of Computer Applications

4. STRUCTURE OF THE UNDERGRADUATE PROGRAMME

This B.C.A. Honors programme is 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 years UG and 4 years UG (Honors) or UG (Honors with Research) programmes as given in Table 1 at Section 3.3.6.

4.1. Types of Courses

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

4.2. Description of Courses

The following are the types of courses in this programme:

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

Major discipline here means to Computer Science. 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 Years UG & 40 Credits - 4 Years UG

Minor discipline helps a student to gain a broader understanding beyond the major discipline.

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 Years 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 example, COMS 201) as given in Section 12. 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:

Table 2: 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.
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 Years UG and 4 Years 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 years 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 the 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 exploring newer applications of their 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 categories 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 categories 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 at least 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. Table 3 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.

Table 3: 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 Course Based on Practical examinations conducted by CoE of University **Internship / Research Project Work** Presentation of the work / Report / Viva-voce examinations conducted by CoE of 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 examinations 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 below.

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 years 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 schemes 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 for	Grade Points for
X to (X-K) + 1	O	10
(X-K) to (X-2K) + 1	A+	9
(X-2K) to (X-3K) + 1	A	8
(X-3K) to (X-4K) + 1	B+	7
(X-4K) to (X-5K) + 1	B	6
(X-5K) to 50	C	5
40 – 49	P	4
Below 40	F	0
Absent (Lack of Attendance)	Ab	0

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

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

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 × Grade)
I	Course 1	3	A	8	3 × 8 = 24
I	Course 2	4	B+	7	4 × 7 = 28
I	Course 3	3	B	6	3 × 6 = 18
I	Course 4	3	O	10	3 × 10 = 30
I	Course 5	3	C	5	3 × 5 = 15
I	Course 6	4	B	6	4 × 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 × Grade)
I	Course 1	3	A	8	3 × 8 = 24
I	Course 2	4	B+	7	4 × 7 = 28
I	Course 3	3	B	6	3 × 6 = 18
I	Course 4	3	O	10	3 × 10 = 30
I	Course 5	3	C	5	3 × 5 = 15
I	Course 6	4	F	0	4 × 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 × Grade)
I	Course 1	3	A	8	3 × 8 = 24
I	Course 2	4	B+	7	4 × 7 = 28
I	Course 3	3	F	0	3 × 0 = 00
I	Course 4	3	B	6	3 × 6 = 18
I	Course 5	3	C	5	3 × 5 = 15
I	Course 6	4	F	0	4 × 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.	Component	3-years UG			4-years 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 12credits 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 course in the given year (12)

13. CURRICULUM

FIRST SEMESTER								
S. No.	**Component**	**Course Code**	**Title of the Course**	**H/S**	**Credits**	**Hours/Week**		
						L	**T**	**P**
1	MJD 1	CSCA101	Digital Logic Fundamentals	H	4	3		2
2	MID 1	CSCA102	Multimedia and Animation	S	4	3		2
3	MLD 1		One course from the MLD streams 1 to 10 (Table 15)	H	3	4		
4	AEC 1		English I / Modern Indian Languages I	H	2	4		
5	SEC 1	CSCA103 / CSCA104	S. No. 1 or 2 from Table 7	S	3	2		2
6	VAC 1		Understanding India	H	2	4		
7	VAC 2		Environmental Sciences / Education / Higher Order Thinking	H	2	4		
				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	CSCA105	Problem Solving & Programming Fundamentals	H	4	3		2
2	MID 2	CSCA106	Digital Marketing	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	CSCA107 / CSCA108	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	CAVA101	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	CSCA201	Object Oriented Programming	H	4	3		2
2	MJD 4	CSCA202	Data Structures	H	4	3		2
3	MID 3	CSCA203	Management Information Systems	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	CSCA204 / CSCA205	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	CSCA206	Computer System Architecture	H	4	3		2
2	MJD 6	CSCA207	Design and Analysis of Algorithms	H	4	3		2
3	MJD 7	CSCA208	Database Management Systems	H	4	3		2
4	MID 4	CSCA209	IT Enabled Services & Applications	S	4	3		2
5	AEC 4		English II / Modern Indian Languages II	H	2	4		
6	Project	CSCA210	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	CSCA301	Operating Systems	H	4	3		2
2	MJD 9	CSCA302	Mathematical Foundations of Computer Science	H	4	4	1	
3	MJD 10	CSCA303	Computer Networks	H	4	3		2
4	MID 5	CSCA304	Visual Programming with C#	S	4	4	1	
5	MJD 11	CSCA305	Summer Internship	H	4			6
				Total	20	26 Hours		

SIXTH SEMESTER								
S. No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 12	CSCA306	Management Strategies & Concepts	H	4	5		
2	MJD 13	CSCA307	Software Engineering Theory and Practice	H	4	3		2
3	MJD 14	CSCA308	Distributed Systems	H	4	3		2
4	MJD 15	CSCA309	Operations Research	H	4	4	1	
5	MID 6	CSCA310 / CSCA311	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	CSCA401	Web Engineering	H	4	3		2
2	MJD 17	CSCA402	System Modelling & Simulation	H	4	3		2
3	MJD 18	CSCA403	Wireless Communication Networks	H	4	3		2
4	MID 7	CSCA404 / CSCA405	Any one course from Table 2	S	4	3		2
5	MID 8	CSCA406 / CSCA407	Any one course from Table 3	S	4	3		2
				Total	**20**	**25 Hours**		

EIGTH SEMESTER – B.C.A. (Honors)								
S. No.	Component	Course Code	Title of the Course	H/S	Credits	Hours/Week		
						L	T	P
1	MJD 19	CSCA408 / CSCA409	Any one course from Table 4	S	4	3		2
2	MJD 20	CSCA410 / CSCA411	Any one course from Table 5	S	4	3		2
3	MJD 21	CSCA412	Robotic Process Automation	H	4	3		2
4	MJD 22	CSCA413	Low-code / No-code Technologies	H	4	3		2
5	MJD 23	CSCA414	Blockchain Application Development	H	4	3		2
				Total	**20**	**25 Hours**		

EIGTH SEMESTER – B.C.A. (Honors with Research)								
S. No.	**Component**	**Course Code**	**Title of the Course**	**H/S**	**Credits**	**Hours/Week**		
						L	**T**	**P**
1	MJD 19	CSCA408 / CSCA409	Any one course from Table 4	S	4	3		2
2	MJD 20	CSCA410 / CSCA411	Any one course from Table 5	S	4	3		2
3	MJD 21	CSCA415	Research Project	H	4			5
4	MJD 22	CSCA416	Project Report	H	4			5
5	MJD 23	CSCA417	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	CSCA310	Virtual Reality	S	4	3		2
2	MID 6	CSCA311	Internet of Things	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	CSCA404	UI/UX Design	S	4	3		2
2	MID 7	CSCA405	Mobile Application Development	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	CSCA406	E-Commerce Application Development	S	4	3		2
2	MID 8	CSCA407	Artificial Intelligence	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	CSCA408	Data Warehousing & Mining	S	4	3		2
2	MJD 19	CSCA409	Data Science	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	CSCA410	Data Analytics and Business Intelligence	S	4	3		2
2	MJD 20	CSCA411	Machine Learning	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	CSCA412	Robotic Process Automation	H	4	3		2
2	MJD 22	CSCA413	Low-code / No-code Technologies	H	4	3		2
3	MJD 23	CSCA414	Blockchain Application Development	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	CSCA103	Office Management Tools	S	3	3		2
2	SEC 1	CSCA104	Programming with AppInventor	S	3	3		2
3	SEC 2	CSCA107	Python Programming	S	3	3		2
4	SEC 2	CSCA108	3D Modelling & Animation	S	3	3		2
5	SEC 3	CSCA204	Data Visualization Tools	S	3	3		2
6	SEC 3	CSCA205	Game Programming	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	CSCA101	Digital Logic Fundamentals	H
2	MJD 2	CSCA105	Problem Solving & Programming Fundamentals	H
3	MJD 3	CSCA201	Object Oriented Programming	H
4	MJD 4	CSCA202	Data Structures	H
5	MJD 5	CSCA206	Computer System Architecture	H
6	MJD 6	CSCA207	Design and Analysis of Algorithms	H
7	MJD 7	CSCA208	Database Management Systems	H
8	MJD 8	CSCA301	Operating Systems	H
9	MJD 9	CSCA302	Mathematical Foundations of CS	H
10	MJD 10	CSCA303	Computer Networks	H
11	MJD 11	CSCA305	Summer Internship	H
12	MJD 12	CSCA306	Management Strategies & Concepts	H
13	MJD 13	CSCA307	Software Engineering Theory & Practice	H
14	MJD 14	CSCA308	Distributed Systems	H
15	MJD 15	CSCA309	Operations Research	H
16	MJD 16	CSCA401	Web Engineering	H
17	MJD 17	CSCA402	System Modeling & Simulation	H
18	MJD 18	CSCA403	Wireless Communication Networks	H
19	MJD 19	CSCA408 / CSCA409	Data Warehousing & Mining / Data Science	S
20	MJD 20	CSCA410 / CSCA411	Data Analytics and Business Intelligence / Machine Learning	S

Table 9: List of Minor Disciplinary Courses				
S. No.	**Component**	**Course Code**	**Title of the Course**	**H/S**
1	MID 1	CACA102	Multimedia & Animation	S
2	MID 2	CACA106	Digital Marketing	S
3	MID 3	CACA203	Management Information Systems	S
4	MID 4	CACA209	IT Enabled Services & Applications	S
5	MID 5	CACA304	Visual Programming with C#	S
6	MID 6	CSCA310 / CSCA311	Virtual Reality / Internet of Things	S
7	MID 7	CSCA404 / CSCA405	UI/UX Design / Mobile App Development	S
8	MID 8	CSCA406 / CSCA407	E-Commerce App Development / Artificial Intelligence	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	CSCA103	Office Management Tools	S
2	SEC 1	CSCA104	Programming with AppInventor	S
3	SEC 2	CSCA107	Python Programming	S
4	SEC 2	CSCA108	3D Modelling & Animation	S
5	SEC 3	CSCA204	Data Visualization Tools	S
6	SEC 3	CSCA205	Game Programming	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		Community Engagement and Service	H

14. SYLLABUS

SEMESTER I

Year	I	**Course Code:** CSCA101	**Credits**	4
Sem.	I	**Course Title:** Digital Logic 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	• 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			
Unit No.	**Course Content**			**Hours**
Theory Component				
Unit I	**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			9
Unit II	**Gate-Level Minimization** Introduction - The 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			9
Unit III	**Combinational Logic** Introduction - Combinational Circuits - Analysis Procedure - Design Procedure - Binary Adder–Subtractor - Decimal Adder - Binary Multiplier - Magnitude Comparator – Decoders – Encoders – Multiplexers - HDL Models of Combinational Circuits.			9
Unit IV	**Synchronous Sequential Logic** Introduction - Sequential Circuits - Storage Elements: Latches - Storage Elements: Flip-Flops - Analysis of Clocked Sequential Circuits - Synthesizable HDL Models of Sequential Circuits - State Reduction and Assignment - Design Procedure			9
Unit V	**Registers and Counters** Registers - Shift Registers - Ripple Counters - Synchronous Counters - Other Counters - HDL for Registers and Counters			9

Practical Component		
List of Exercises	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 a) Code Converters b) Arithmetic (Adders, Subtractors, Multipliers, Comparators) c) 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", Sixth Edition, Pearson, 2018. 2. M. Rafiquzzaman, "Fundamentals of Digital Logic and Microcomputer Design", Fifth Edition, John Wiley & Sons, Inc., 2009.	
Syllabus Design: Dr. M. Sathya, Assistant Professor, PUDoCS		

Year	I	Course Code: CSCA102 Course Title: Multimedia and Animation	Credits	4
Sem.	I		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	• Describe the various elements and aspects of multimedia and Animation • Learn to work with text and images • Learn to work with audio processing tools • Learn to work with video editing tools • To make an animated movies using Animation and rendering tools			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Multimedia Overview** Presentation and production – Characteristics – Hardware and software requirements – Uses – Analog and Digital Representations – OS Support – Hardware Support –Multimedia Extensions	9
Unit II	**Text and Image** Types of Text – Unicode Standard – Font – Text Compression – File Formats – Image Data Representation – Image Acquisition and Processing – Binary and Color Image Processing – Image File Formats	9
Unit III	**Audio** Types and Properties of sound - Components of audio – Digital Audio - Synthesizers – Musical Instrument Digital Interface (MIDI) – Digital Audio Processing – Speech – Sound Card – Audio File Formats	9
Unit IV	**Video** Analog Video - Signal Representation - Digital Video - Digital Video Processing - Recording and Storage Formats - File formats - Editing - Video Processing Software	9
Unit V	**Animation** Uses – Traditional Animation – Principles of Animation – Computer Based Animation – 3D animation – Rendering Algorithms – Animation File Formats and Software	9

Practical Component		
List of Exercises	1. Design a multimedia presentation on a topic of your choice. Include text, images, audio, and video elements. 2. Identify the essential tools and equipment needed to create high-quality multimedia content. 3. Choose an existing multimedia project or create one, and develop a promotional strategy for it. 4. Create a simple document, such as a poster or brochure, with varying fonts, sizes, and styles. 5. Perform basic image processing tasks like resizing, cropping, and applying colour filters to the image using image editing software. 6. Set up a simple audio system that includes a microphone, amplifier, audio mixer, and loudspeaker. 7. Design a visual representation of the flow of video signals from an analog video camera to a digital format. 8. Create a short tutorial video demonstrating basic editing functions of a chosen video editing software. 9. Create a storyboard for a 3D animation project. Outline key scenes, characters, and movements. 10. Design an interactive web animation prototype. Use any animation software to create a sample animation that responds to user interactions on a webpage.	30
Recommended Learning Resources		
Print Resources	1. Ranjan Parekh, "Principles of Multimedia", Second Edition, Tata McGraw Hill, 2013. 2. Tay Vaughan, "Multimedia Making It Works", Eighth Edition,Tata McGraw Hill, 2013.	
Syllabus Design: Dr. Sukhvinder Singh, Assistant Professor, PUDoCS		

Year	I	Course Code: CSCA103	Credits	3
Sem.	I	Course Title: Office Management Tools	Hours	75
			Category	B

Course Prerequisites, if any	Nil	
Internal Assessment Marks: 50	End Semester Marks: 50	Duration of ESA (Practical): 03 hrs.

Course Outcomes	• Understand the basics of office management tools • Able to create and format document using Word Processor • Able to store and analyse data using Spreadsheet • Skills to create and deliver effective presentations • Able to design and manage data using database

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Exploring Office** Working in the program environment changing program settings customizing the ribbon and quick access toolbar -Working with Files -Creating and saving files- opening moving and closing files -viewing files in different ways	9
Unit II	**Word Processor** Making text changes- finding and replacing text spelling and grammar- Quickly formatting text -creating and modifying list -presenting information in tables –word art-document background-page layout - printing documents	9
Unit III	**Spreadsheet** Spreadsheet – Workbook Window – Formatting Cells / Worksheet – Working with Formula, Function and Charts – Filtering data	9
Unit IV	**Presentation** Working with Slides – Work with Slide Text – Formatting Slides – Adding – Custom Animations and Transitions	9
Unit V	**Database** Understanding Database Concepts – Exploring tables-forms-queries-reports	9
	Practical Component	

List of Exercises	1. Design a personalized business card, including your name, contact information, and any relevant details, using shapes and text boxes. 2. Develop a professional resume showcasing your skills, education, and work experience. Utilize appropriate formatting for headings and bullet points. 3. Develop a newsletter layout with multiple columns, images, and articles. 4. Create a personal budget spreadsheet that includes income, expenses, and a summary of the financial situation. Utilize Excel's functions for calculations. 5. Develop a grade tracker for a semester, including columns for subjects, grades, and credits. Calculate the GPA using Excel formulas. 6. Build a photo album slideshow with captions. Apply slide transitions for smooth navigation between images. 7. Create an interactive quiz presentation. Include questions on different slides, and use hyperlinks to navigate to correct or incorrect answers. 8. Present the findings of a scientific experiment. Include graphs, charts, and visuals to illustrate the experiment process and results. 9. Create tables for student details, courses, and grades. 10. Design a database to manage inventory for a small business	30
Recommended Learning Resources		
Print Resources	1. Joyce Cox, Joan Lombert, Curtis Fyre, “Step by Step, Microsoft Office Professional 2010”, First Edition, 2010.	
Syllabus Design: Dr. T. Vengattaraman, Associate Professor, PUDoCS		

Year	I	**Course Code:** CSCA104	**Credits**	3
Sem.	I	**Course Title:** Programming with AppInventor	**Hours**	60
			Category	B

Course Prerequisites, if any	Basic Computer Knowledge	
Internal Assessment Marks: 50	**End Semester Marks:** 50	**Duration of ESA (Practical):** 03 hrs.

Course Outcomes	• Understand the importance and basic details of App inventor • Analyze and compare methods for storing and accessing data in App Inventor • Design and construct a mobile application using App Inventor • Analyze and compare methods for storing and accessing data in App Inventor • Evaluate the APK generated by App Inventor

Unit No.	**Course Content**	**Hours**
	Theory Component	
Unit I	**Introduction to programming and App Inventor –** Introduction-Computer Program-Introducing App Inventor-Getting Hands-on with App inventor - Working with Media - Displaying Images-Sounds-Color Blocks	6
Unit II	**Input, Variables and Calculations-** Text box component-Performing Calculations-Storing data with variables-Math functions - Decision Blocks and Boolean logic – If then else-Relational Operators-Logical Operators-Working with Random Numbers	6
Unit III	**Procedures & Functions-** Procedures- Passing arguments to Procedures-Returning values from Procedures- Lists – Creating a list-Iterating over a list-selecting an item-Inserting and appending items-removing and replacing items-searching an item	6
Unit IV	**Storing data on the device:** storages component - application sandbox - file component - retrieve data- tinyDB,-Tag-values pair-tinyDB access multiple screen - Sensors **–** Location and Orientation Sensor – Accelerometer-Component to Launch Google Maps	6
Unit V	Setting up App Inventor-Connecting an Android device to App Inventor-Uploading your Application to App Inventor Gallery and Google Play Store	6
	Practical Component	
List of Exercises	1. Building apps by selecting components. 2. Defining the variables to remember the values and working with iterative and control structures using blocks. 3. Working with canvas component for drawing, buttons and event handlers. 4. Working with list picker and activity starter.	30

	5. Adding media (sound and images) to apps by uploading them form computer. 6. Working with the block editor to blocks that define the components behaviour. 7. Working with database, connecting, storing and retrieval of information in app and App Inventor's live testing. 8. Packaging the apps you build and downloading them to phone. 9. Create an app that can speak out a message when you shake your mobile phone. 10. Create an app for Quiz competition and display as a dashboard leader.	
Recommended Learning Resources		
Print Resources	1. David Wolber, Hal Abelson, Ellen Spertus, & Liz Looney "App Inventor create own android app", O'Reilly, 2023. 2. Tony Gaddis and Rebecca Halsey, "Starting out with App inventor for android", Pearson, 2015.	
Syllabus Design: Dr. Sukhvinder Singh, Assistant Professor, PUDoCS		

SEMESTER II

Year	I	Course Code: CSCA105	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	
List of 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.	30

	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. 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, Thirteenth 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: CSCA106 Course Title: Digital Marketing	Credits	4
Sem.	II		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	• Understand the fundamental components and strategies of Digital Marketing • Develop and implement effective SEO and SEM strategies • Apply the various types of email marketing and automation techniques • Utilize social media platforms to create engaging content and successful campaigns • Analyze and adapt Digital Marketing strategies based on comprehensive data analytics			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction to Online Market** Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.	9
Unit II	**Search Engine Optimisation** Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors - On-Page Techniques - Off-Page Techniques. Search Engine Marketing - SEM components - PPC advertising	9
Unit III	**E- Mail Marketing** Types of E- Mail Marketing - Email Automation – Integrating Email - Email campaign - Mobile Marketing - Location based - Context based - SMS Campaigns - Profiling and targeting	9
Unit IV	**Social Media Marketing** Social Media Channels- Leveraging social media for brand conversations and buzz. Benchmark social media campaigns. Engagement Marketing- Creating Loyalty drivers - Influencer Marketing.	9
Unit V	**Digital Transformation** Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, social media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.	9

Practical Component		
List of Exercises	1. Create a content calendar for a month, detailing blog post topics, social media posts, and email newsletters. 2. Optimize an existing webpage (or a sample webpage) by updating meta titles, meta descriptions, headers, and including relevant keywords in the content. 3. Create a simple email campaign for a product launch or promotional event using an email marketing tool. 4. Select a brand and analyze its social media presence across three different platforms (e.g., Facebook, Instagram, Twitter). 5. Analyze a mock digital marketing report with data from various channels (AdWords, email, social media).	30
Recommended Learning Resources		
Print Resources	1. Puneet Singh Bhatia, "Fundamentals of Digital Marketing, Pearson Education", First Edition, 2017.	
Syllabus Design: Dr. T. Vengattaraman, Associate Professor, PUDoCS		

Year	I	**Course Code:** CSCA107	**Credits**	3
Sem.	II	**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 • Ability to write programs using packages • Understand the file manipulation			

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	30

	6. Sum the array of numbers 7. Perform linear search, binary search 8. Perform Matrix operations using NumPy 9. Perform Data frame operations using Pandas 10. Use Matplotlib on dataset and visualise 11. Perform Word count, copy file operations	
Recommended Learning Resources		
Print Resources	1. Mark Lutz, "Learning Python", Fifth Edition, O'Reilly, 2013. 2. Daniel Liang, "Introduction to programming using Python", First Edition, Pearson, 2021. 3. Wes Mc Kinney, "Python for Data Analysis", O'Reilly Media, 2012. 4. Tim Hall and J-P Stacey, "Python 3 for Absolute Beginners", First Edition, Apress, 2009. 5. Magnus Lie Hetland, "Beginning Python: From Novice to Professional", Second Edition, Apress, 2005.	
Syllabus Design: Dr. V. Uma, Associate Professor, PUDoCS		

Year	I	Course Code: CSCA108	Credits	3
Sem.	II	Course Title: 3D Modelling & Animation	Hours	60
			Category	B

Course Prerequisites, if any	Basic Computer Knowledge	
Internal Assessment Marks: 50	**End Semester Marks:** 50	**Duration of ESA (Practical):** 03 hrs.

Course Outcomes

- Understand the basics of 3D modeling and animation concepts.
- Learn the various stages of the production pipeline.
- Acquire skills to handle digital images, videos, and process them
- Become proficient in the usage of 3D modeling and adding visual effects, lighting, and rendering
- Develop a model for a given specification
- Develop an animated game, story, virtual tour of a building, etc.

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction** Defining 3D Animation, Exploring the 3D Animation Industry - History of 3D Animation: Early Computers- The Dawn of Computer Animation-The Building Blocks of 3D Animation- The Foundations of Modern Computing- 3D Animation Achieves Commercial Success- The Refining of 3D Animation.	6
Unit II	**Production Pipeline** Understanding the Production Pipeline's Components- Working in 3D Animation PreProduction- Working in 3D Animation Production – Working in 3D Animation Postproduction- Using Production Tools.	6
Unit III	**Understanding Digital Imaging and Video** Understanding Digital Imaging - Understanding Digital Video - Exploring Animation, Story, and Pre-visualization: Using Principles of Fine Art and Traditional Animation- Building a Good Story - Using Pre-visualization Techniques.	6
Unit IV	**Understanding Modeling and Texturing** Modeling: Polygons, NURBS, Subdivision Surfaces-Texturing: UVs,Texture Maps, Texturing Workflows- Rigging and Animation.	6
Unit V	**Understanding Visual Effects, Lighting, and Rendering** Creating Visual Effects - Lighting - Rendering- Hardware and Software Tools of the Trade: Choosing a computer - Using Monitors/Displays - Working with Graphics Tablets – Using 3D Scanners- Setting Up Render Farms- Finding Data Storage Solutions – Choosing Software.	6
	Practical Component	
List of Exercises	1. Implementing basic rendering techniques and effects. 2. Developing storyboards, scripts/screenplay, 3D Production layout for a sample scene Ex: Friends meeting at a bus stop.	30

	3. Creating 3D models of characters, props, and environments for the above scene. 4. Adding visual effects to the above scene 5. Adding texturing and minimal animation to the above scene. 6. Setting up lighting and rendering scenes to achieve desired visual results for early morning moon and night time happening of the above scene. 7. Animating the above scene when the friends board the bus and the bus moves. 8. Developing an animated game. 9. Developing an animated story. 10. Developing an animated virtual building tool.	
Recommended Learning Resources		
Print Resources	1. Andy Beane, "3D Animation Essentials", First Edition, Wiley & Sons, 2012. 2. Magesh Chandramouli, "3D Modeling & Animation: A Primer", CRC Press, 2021. 3. Tony Mullen, "Introducing Character Animation with Blender", Second Edition, Wiley Publishers, 2011.	
Syllabus design:	*Dr. T. Chithralekha, Professor, PUDoCS.* *Dr.S.L.Jayalakshmi, Assistant Professor, PUDoCS*	

Year	I	Course Code: CAVA101 Course Title: Digital Technologies	Credits	2
Sem.	II		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.	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	
List of Exercises	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”, First Edition, Chapman and Hall / CRC, 2021. 2. V. Rajaraman, “Introduction to Information Technology”, PHI, 2018.	

	3. E. Balagurusamy, “Fundamentals of Computers”, Third Edition, Tata Mc GrawHill, Second Edition, 2011. 4. Behrouz A. Forouzan, “Data Communications and Networking”, Fourth Edition, McGraw Hill, 2007. 5. Rajkumar Buvya, James Broberg, and Andrzej Gosciniski, “Cloud Computing-Principals and Paradigms”, Wiley, 2011. 6. Stuart Russel and Peter Norvig, “Artificial Intelligence - A Modern Approach”, Third Edition, Pearson Education, 2010. 7. Samuel Greengard, “Internet of Things”, The MIT Press, 2015. 8. C.S.V. Murthy, “E- Commerce – Concept, Models &Strategies”, Himalaya Publishing House, 2015. 9. Hurwith, Nugent Halper, Kaufman, “Big Data for Dummies”, First Edition, Wiley & Sons, 2013.
Syllabus Design: Prof. S.K.V. Jayakumar, Professor, PUDoCS	

SEMESTER III

<table>
<tr><td>Year</td><td>II</td><td colspan="2" rowspan="2">Course Code: CSCA201
Course Title: Object Oriented Programming</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="3"></td><td>Category</td><td>C</td></tr>
<tr><td>Course Prerequisites, if any</td><td colspan="5">Basic Programming knowledge</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 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</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">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</td><td>9</td></tr>
<tr><td>Unit II</td><td colspan="4">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</td><td>9</td></tr>
<tr><td>Unit III</td><td colspan="4">Object Initialization and Overloading
Types of Constructors - Dynamic Initialization of Objects - Destructors Operator overloading - function Overloading - Manipulation of Strings</td><td>9</td></tr>
<tr><td>Unit IV</td><td colspan="4">Inheritance
Derived Classes - Types of inheritance - Virtual Base Classes - Abstract Classes - Pointers to Derived Classes - Virtual base class - Method Overriding - Pure Virtual Functions</td><td>9</td></tr>
<tr><td>Unit V</td><td colspan="4">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</td><td>9</td></tr>
<tr><td colspan="6">Practical Component</td></tr>
<tr><td>List of Exercises</td><td colspan="4">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.</td><td>30</td></tr>
</table>

	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.	
Recommended Learning Resources		
Print Resources	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: CSCA202	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 and Queues** Representation – Polynomial Addition – Sparse Matrices – Multidimensional Arrays - 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	
List of 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	30

	5. Tree Traversal techniques 6. Graph Traversal techniques 7. Dijkstra's Algorithm to obtain the shortest paths	
Recommended Learning Resources		
Print Resources	1. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, India University Press, 2008. 2. Debasis Samanta, "Classic Data Structures", Second Edition, Prentice-Hall of India, Pvt. Ltd., 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		

Year	II	Course Code: CSCA203	Credits	4
Sem.	III	Course Title: Management Information Systems	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	• Understand the Strategic view of MIS • Understand the Basic concepts of MIS • Apply the technologies in business • Create the infrastructure using emerging technologies • Analysis of MIS in various businesses

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Strategic View of MIS** MIS in Digital Age - E-Business Enterprise - A digital Firm - Management of Business Performance, Information Security - Threats and Management - Information Technology - Impact on Society	9
Unit II	**Basics of MIS** Decision Making – Information, Knowledge, Business Intelligence, Systems Engineering – Analysis and Design – Development Process of MIS – Strategic Design of MIS	9
Unit III	**Application of MIS to Business** Applications in Manufacturing and Service Sector - Decision Support Systems and Knowledge Management - Management of Global Enterprise - Cloud Computing, Artificial Intelligence and Machine Learning - Business Intelligence for MIS	9
Unit IV	**Infotech Infrastructure** Technology of Information System - Unified Communications and Networks - DBMS, Client Server and Service Oriented Architecture - Data Warehouse - Architecture to Implementation E-Business– Technology - Emerging Trends in e-Business	9
Unit V	**Comprehensive Cases on MIS** Management Information Systems in a Digital Firm - Techno-Cases in E-Enterprise Management - Case Digest of SCM - FS Square Infotech Ltd. (FSIT) - Home Land Groceries and Stores (HLGS)	9
	Practical Component	
List of Exercises	1. Identify a business process (e.g., inventory management) and outline how MIS can support each function 2. Analyse a case study or scenario where an organization faces challenges with its current MIS. 3. Research and compile information on the knowledge requirements for MIS professionals in seven keys 4. Create visualizations and a summary report using a DSS tool (e.g., Microsoft Excel with Power Query).	30

	5. Explore and compare different planning tools, such as Gantt charts, SWOT analysis, and decision trees. 6. Plan a construction project using the Program Evaluation and Review Technique (PERT) or Critical Path Method (CPM). 7. Simulate a change management scenario within a company. 8. Investigate a case study where an organization successfully implemented TQM. Analyse the key steps taken, challenges faced, and the impact on overall organizational performance. Extract lessons learned for future implementations.	
Recommended Learning Resources		
Print Resources	1. W.S. Jawadekar, "Management Information System", Sixth Edition, Tata McGraw Hill Publishing Company Ltd, 2020.	
Syllabus Design: Dr. Sukhvinder Singh, Assistant Professor, PUDoCS		

Year	II	Course Code: CSCA204 Course Title: Data Visualization Tools	Credits	3
Sem.	III		Hours	60
			Category	B
Course Prerequisites, if any	Basic knowledge of Computer			
Formative Assessment Marks: 50	Summative Assessment Marks: 50		Duration of ESA (Practical): 03 hrs	
Course Outcomes	• Understanding the concepts of Data visualization • Explore various option with Tabula tool for visualization • Understand the Python Libraries associated with Data Visualization • Explore various visualization options in Seaborn • Explore the options in R tool for visualization			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction** Data Visualization – Importance – Key Factors – Various visualization Tools and type of data – Nominal, Ordinal, Discrete, Continuous	6
Unit II	**Tableau** Usage & Features of Tableau – Tableau vs MS Excel – Data Sources – Basic & Advance Visualization – Graphs & Charts – Creation of hierarchies – Building Map options – Calculations & Filters – Analytical Capabilities – Interactive Dashboards	6
Unit III	**R** Introduction – Plot types - Getting started with ggplot2, Scatter plots and Non-data elements of ggplot2 – Visualizing statistics – Visualizing clusters with heatmaps – Combining multiple plot to create a figure panel	6
Unit IV	**Matplotlib & Pandas** Introduction – Plotting functions – subplot functions – coloring – Building line plots – bar plots – scatter plots – Histogram – Pie charts - Pandas for plotting – various plots with pandas data – A case study with pandas based plotting.	6
Unit V	**Seaborn** Seaborn for visualization – features – benefits – plotting with seaborn – categorical data plotting with seaborn – Case studies using Seaborn	6
	Practical Component	
List of Exercises	1. Build a simple & Advance Visualization with Source data using Tableau 2. Built all the Map options in Tableau 3. Create interactive dashboard by applying calculations filters in tableau 4. Build the scatter plot and ggplot2 with Source data using R 5. Build a visualizing cluster with heatmaps using R 6. Build all types of charts using MatplotLib 7. Build histogram using Matplotlib 8. Build a visualization with source data handling using Pandas.	30

	9. Build all types of charts using Seaborn 10. Visualize the Categorical data plotting with Seaborn	
Recommended Learning Resources		
Print Resources	1. Kalilur Rahmman, "Python Data Visualization Essentials Guide", First Edition, BPB Publications, 2021. 2. Pritpal Singh, "Advance Data Visualization" First Edition, Publisher Lovely Professional University, 2021. 3. Margot Tollefson, "Visualizing Data in R 4: Graphics Using the base, graphics, stats, and ggplot2 Packages Paperback – Import", First Edition, APress, 2021.	
Syllabus Design: Dr. Sukhvinder Singh, Assistant Professor, PUDoCS		

Year	II	Course Code: CSCA205 Course Title: Game Programming	Credits	3
Sem.	III		Hours	60
			Category	B
Course Prerequisites, if any	Basic Programming Knowledge, Computer Graphics			
Formative Assessment Marks: 50	Summative Assessment Marks: 50		Duration of ESA (Practical): 03 hrs	
Course Outcomes	• Understand the concepts of designing a Game • Understand the concepts of 3D programming • Understand the basics of Game Programming • Able to design game play modules • Able to integrate music and sounds in game			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Game Designing** Magic Words - Importance of Skills a Game Designer Need - The Five Kinds of Listening - the Secret of the Gifted	6
Unit II	**3D Programming** 3D Models - Shapes - Transformation - Rendering - Scene Graphs - 3D Audio - 3D Programming - Translation - Rotation - Scaling - Animation - Basic Programming Concepts	6
Unit III	**Game Programming Basics** Torque Script - Strings - Objects - Data-Blocks - Game Structure - Server versus Client Design Issues - Common Functionality - Preparation - Root Main - Control Main - Initialization - Client, Server &Player - Running Emaga4	6
Unit IV	**Game Play Modules** The Changes - Folders - Modules - Control Modules - Client Control Modules - Server Control Modules - Running Emaga5 - Creating GUI Elements	6
Unit V	**Game Sound and Music** Player Sounds - Footsteps - Weapon Sounds - Vehicle Sounds - Environmental Sounds - Interface Sounds - Music	6
	Practical Component	
List of Exercises	1. Developing a Puzzle game. 2. Developing a Multiplayer game using unity. 3. Developing a 2D game. 4. Developing a 3D game. 5. Understand and develop the UI design in games. 6. Understanding and apply the role of AI in games.	30

Recommended Learning Resources	
Print Resources	1. Jesse Schell, “Art of Game Design”, Third Edition, A K Peters/CRC Press, 2019. 2. Kenneth C. Finney, “3D Game Programming – All in One”, Third Edition, Cengage Learning, Inc, 2012.

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

SEMESTER IV

Year	II	**Course Code:** CSCA206 **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 Microoperations	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”, Third Edition, Pearson Education, 2017.
Syllabus Design: Dr. Sukhvinder Singh, Assistant Professor, PUDoCS	

Year	II	Course Code: CSCA207	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 of 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.	30

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

<table>
<tr><td rowspan="2">Year</td><td rowspan="2">II</td><td rowspan="2" colspan="2">Course Code: CSCA208
Course Title: Database Management Systems</td><td>Credits</td><td>4</td></tr>
<tr><td>Hours</td><td>75</td></tr>
<tr><td>Sem.</td><td>IV</td><td>Category</td><td>C</td></tr>
<tr><td>Course Prerequisites, if any</td><td colspan="5">Knowledge of Data Structures and File-Handling</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 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</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 to Relational model
Structure of relational database, Database schema, Keys, Schema diagram, Relational Query language, Relational Algebra.</td><td colspan="2">9</td></tr>
<tr><td>Unit II</td><td colspan="3">Introduction to SQL
SQL data definition, basic structure of SQL Queries, set operations, null values, aggregate functions, nested subqueries</td><td colspan="2">9</td></tr>
<tr><td>Unit III</td><td colspan="3">Intermediate and advanced SQL
Join expressions, views, transaction, integrity constraints, functions and procedures, triggers.</td><td colspan="2">9</td></tr>
<tr><td>Unit IV</td><td colspan="3">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.</td><td colspan="2">9</td></tr>
<tr><td>Unit V</td><td colspan="3">Relational database design
Decomposition using functional dependencies, normal forms, functional dependency theory, algorithms for decomposition using functional dependencies, decomposition using multivalued dependencies.</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. To implement the DDL commands using SQL.
2. To implement the DML commands.
3. To implement the DDL constraints, DCL, and TCL commands.
4. To implement various built functions and aggregate functions.
5. To implement the various join operations.</td><td colspan="2">30</td></tr>
</table>

	6. To implement the various nested subqueries. 7. Creation and manipulation of Views. 8. To practice the basics of PL/SQL [control structures]. 9. To create the functions and procedures using PL/SQL. 10. To 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:** CSCA209	**Credits**	4
Sem.	IV	**Course Title:** IT Enabled Services & Applications	**Hours**	75
			Category	A
Course Prerequisites, if any	Basic knowledge on IT and applications			
Internal Assessment Marks: 25	**End Semester Marks:** 75		**Duration of ESA (Theory):** 03 hrs.	
Course Outcomes	• Define and explain the concept of IT-enabled services • Evaluate business processes to identify potential areas for outsourcing • Utilize information technology tools and platforms in the delivery of services • Implement and demonstrate the use of ITES applications in various industries (e.g., healthcare, finance, e-commerce) • Identify potential risks associated with IT-enabled services and applications			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction to IT Enabled Services (ITES)** Definition and Overview of ITES - Evolution and Growth of ITES Industry - Key Components: People, Process, Technology - Global Outsourcing Trends	9
Unit II	**Business Process Outsourcing (BPO)** Introduction to Business Process Outsourcing - Types of BPO: Voice and Non-voice Processes – BPO Services: Customer Support, Technical Support, Data Entry, etc. - Case Studies on Successful BPO Implementations	9
Unit III	**Knowledge Process Outsourcing (KPO)** Understanding Knowledge Process Outsourcing – Scope and Characteristics of KPO – KPO Domains: Research and Analysis, Legal Process Outsourcing, etc. - Intellectual Property and Innovation in KPO	9
Unit IV	**ITES Applications** Overview of ITES Applications in Various Industries – ITES in Healthcare: Medical Transcription, Billing, and Coding – ITES in Finance and Accounting: Outsourced Bookkeeping, Payroll Services – ITES in E-commerce: Customer Support, Order Processing	9
Unit V	**Emerging Technologies in ITES** Artificial Intelligence (AI) and Machine Learning (ML) in ITES – Robotic Process Automation (RPA) in Outsourcing – Cloud Computing and ITES – Cybersecurity in ITES: Challenges and Solutions	9
	Practical Component	
List of Exercises	1. Research and create a timeline of key milestones in the evolution of the ITES industry. 2. Identify and list three technological advancements that have significantly impacted ITES. 3. Develop a simple customer support scenario involving a common query or issue.	30

	4. Select a simple BPO process (e.g., data entry) and map out its workflow. 5. Research and present an overview of one specific KPO domain (e.g., legal process outsourcing). 6. Develop scenarios to illustrate the scope and characteristics of KPO. 7. Simulate a basic healthcare ITES scenario (e.g., medical transcription). 8. Design a simplified scenario for outsourcing finance and accounting tasks. 9. Develop a hands-on simulation of order processing in an e-commerce environment. 10. Explore the integration of ITES processes with cloud computing services. 11. Create cybersecurity scenarios related to ITES processes.	
Recommended Learning Resources		
Print Resources	1. Sanjiva Shankar Dubey, "IT Strategy and Management", PHI Learning, 2018. 2. Shiro Uesugi, "IT Enabled Services", Springer, 2013. 3. Sanjiva Shankar Dubey, "IT Services Business Management: Concepts, Processes and Practices", PHI Learning, 2012.	
Syllabus Design: Dr. T. Vengattaraman, Associate Professor, PUDoCS		

SEMESTER V

<table>
<tr><td rowspan="2">Year</td><td rowspan="2">III</td><td rowspan="3" colspan="2">Course Code: CSCA301
Course Title: Operating Systems</td><td>Credits</td><td>4</td></tr>
<tr><td>Hours</td><td>75</td></tr>
<tr><td>Sem.</td><td>V</td><td>Category</td><td>C</td></tr>
<tr><td>Course Prerequisites, if any</td><td colspan="5">Knowledge of Computers & Computer Organization.</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 the basic concepts of Operating System and Process
• Learn the various mechanisms of CPU scheduling, process synchronization and deadlocks
• Understand how the memory is utilized
• 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</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">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.</td><td>9</td></tr>
<tr><td>Unit II</td><td colspan="4">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.</td><td>9</td></tr>
<tr><td>Unit III</td><td colspan="4">Memory Management
Main Memory: Contiguous Memory Allocation – Paging – Structure of the Page Table – Swapping. Virtual Memory: Demand Paging – Page Replacement – Thrashing.</td><td>9</td></tr>
<tr><td>Unit IV</td><td colspan="4">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.</td><td>9</td></tr>
<tr><td>Unit V</td><td colspan="4">Case Studies
Linux System: Design Principles – Kernel Modules – Process Management – Scheduling – Memory Management – Linux File System. Windows Operating System: Systems Components – Windows File System.</td><td>9</td></tr>
</table>

Practical Component		
Exercises	1. To 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 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 a program 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.	30
Recommended Learning Resources		
Print Resources	1. Abraham Silberschatz, Peter B Galvin, G. Gagne, "Operating Systems Concepts", Tenth Edition, Addison Wesley, 2018. 2. William Stallings, "Operating Systems: Internals and Design Principles", Tenth Edition, Prentice Hall, 2021.	
Syllabus design: Dr. S.L. Jayalakshmi, Assistant Professor, PUDoCS		

Year	III	**Course Code:** CSCA302	**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	
List of Exercises	-	-

Recommended Learning Resources	
Print Resources	1. Kenneth H. Rosen, “Discrete Mathematics and its Applications”, Seventh Edition, McGraw Hill, 2017. 2. Trembley. J.P and Manohar. R., “Discrete Mathematical Structures with Applications to Computer Science”, First Edition, Tata McGraw Hill, 2017.

Syllabus design: Dr. M. Sathya, Assistant Professor, PUDoCS

Year	III	Course Code: CSCA303 Course Title: Computer Networks	Credits	4
Sem.	V		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	• 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 • Able to implement the various network protocols			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction** Introduction to Networks – Topology – Network Architecture – Reference Models – Transmission Media-Multiplexing – Switching	9
Unit II	**Data link layer** Design Issues – Error Detection and Correction – Elementary Data – Link Protocols – Sliding window Protocols	9
Unit III	**Network Layer** Design Issues – Routing – Logical Addressing – IP Working – IPV4 vs IPV6 – Address Mapping – delivery – Forwarding and Routing	9
Unit IV	**Transport Layer** Transport Service – Service provided to the Upper Layers – Flow Control & Buffering – TCP – Congestion Control – UDP – TCP vs UDP	9
Unit V	**Application layer** Domain Naming System – DNS Namespace – Resource Records – Name Servers – Electronic mail – Messages Formats – Message Transfer	9
	Practical Component	
List of Exercises	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	30

	8. Implementation of Socket program Remote Procedure Call 9. Implementation of any one routing protocol 10. Implementation of congestion control protocol	
Recommended Learning Resources		
Print Resources	1. Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks”, Fifth 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: CSCA304	Credits	3
Sem.	V	Course Title: Visual Programming with C#	Hours	75
			Category	C

Course Prerequisites, if any	Basic knowledge of computer 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 key components of the .NET Framework related to C# development • Learn the basic syntax and structure of C# programs • Design C# applications by integrating various object-oriented programming techniques in the .NET framework • Analyze the significance of graphical user interface (GUI) components and the Event Handling Model using C# programming • Learn and apply the fundamental skills to efficiently develop, test, and deploy ASP.Net Core applications

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction to .Net Framework** An Overview – Framework Components – The Common Language Runtime (CLR) – .NET Base Class Library – Common Language Specification (CLS) – Common Type System (CTS) – Metadata and Assemblies – .NET Namespaces – MSIL – JIT Compilers.	9
Unit II	**Overview of C#** Program structure – Literals – Variables – Constants – Data Types – Operators – Statements and Expressions – Branching – Looping and Loop Control Statements – Arrays – Strings Manipulation – Boxing and Unboxing – Pre-processors – Namespaces.	9
Unit III	**Object Oriented Programming concepts in C#** Class – Objects – Encapsulation – Constructors and its types – Inheritance – Polymorphism – Interface – Abstract Class – Operator Overloading – Properties – Indexers – Delegates – Collections.	9
Unit IV	**Windows Forms** Introduction to Windows Forms and various controls – SDI and MDI applications – Menu Creation, Common Dialog Boxes – Events and Event Handling.	9
Unit V	**Getting started with ASP.Net** Choosing a Code Editor, Creating an ASP.NET Core Project, Running the ASP.NET Core Application, ASP.NET Core Application - Creating the Project, Testing ASP.Net Core Applications - Creating a Unit Test Project, Writing and Running Unit Tests.	9

Practical Component		
List of Exercises	1. Installation of Visual Studio and creation of Simple Console Application. 2. Create a simple C# program for the following concepts: a) To Check whether a given number is an Armstrong or not. b) To Check whether the alphabet is a vowel or not using switch-case. c) To Check whether the given string is palindrome or not using arrays. 3. Create a program to demonstrate boxing and unboxing operations. 4. Implement the basic OOP concepts. 5. Implement Interfaces and Operator Overloading. 6. Create a GUI using standard controls, SDI & MDI forms. 7. Design an application with menu options and a Common Dialog box. 8. create a simple web application using ASP.Net 9. Develop any ONE case study listed below: a) Inventory Control b) Retail Shop Management c) Employee Information System d) Personal Assistant Program e) Students' Information System	30
Recommended Learning Resources		
Print Resources	1. Herbert Schildt, "C# 4.0: The Complete Reference", First Edition**,** McGraw Hill Education, 2017. 2. Albahari. J, "C# 10 in a Nutshell: The Definitive Reference", First Edition, O'Reilly, 2022. 3. Adam Freeman. A, "Pro ASP.NET Core 7", Tenth Edition. Manning Publication, 2023.	
Syllabus design: Dr. S Ravi, Professor, PUDoCS and Dr. S.L. Jayalakshmi, Assistant Professor, PUDoCS		

SEMESTER VI

Year	III	**Course Code:** CSCA306 **Course Title:** Management Strategies and Concepts	**Credits**	4
			Hours	75
Sem.	VI		**Category**	A
Course Prerequisites, if any	Nil			
Internal Assessment Marks: 25	**End Semester Marks:** 75		**Duration of ESA (Theory):** 03 hrs.	
Course Outcomes	• 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			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**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.	15
Unit II	**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.	15
Unit III	**Human Resource Management & Selection** Staffing-Manpower planning - Recruitment & Selection-Performance appraisal and career strategy - Organizational development.	15
Unit IV	**Managing the Human factor** Motivation - Leadership – Communication	15
Unit V	**The System & Process of Controlling** Control techniques and Information Technology - Productivity and Operations Management - Overall and Preventive Control - Towards a Unified - Global management theory.	15

Recommended Learning Resources	
Print Resources	1. Herald Knootz and Heinz Weihrich, “Essentials of Management”, Eleventh Edition, McGraw-Hill Publishing Company, 2020. 2. Fred R. David and Forest R. David, "Strategic Management: Concepts and Cases", Sixteenth Edition, Prentice Hall India Learning Private Limited, 2020.
Syllabus design: Dr. S.L. Jayalakshmi, Assistant Professor, PUDoCS	

Year	III	Course Code: CSCA307 Course Title: Software Engineering Theory and Practice	Credits	4
Sem.	VI		Hours	75
			Category	C
Course Prerequisites, if any	Basic knowledge of programming and information systems			
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 design thinking • Analyze and document the software requirements • Apply appropriate software engineering design concepts to develop software. • Apply software testing strategies • Understand and consider the significance of security in software development process			
Unit No.	**Course Content**		**Hours**	
Theory Component				
Unit I	**Introduction to Design Thinking** Design process - Traditional design - Design thinking - Existing sample design projects - Study on designs around us - Compositions/structure of a design - Innovative design - Breaking of patterns - Reframe existing design problems - Principles of creativity Empathy - Customer Needs - Insight-leaving from the lives of others/standing on the shoes of others - Observation.		9	
Unit II	**Software Engineering and Software Requirements** Defining software engineering, Software life cycle models, Selection of a life cycle model - Requirements engineering, Types of requirements, Feasibility studies, Requirements elicitation, Requirement analysis, Requirement documentation, Requirement validation.		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	**Testing Strategies** A strategic approach to software testing, Test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, The art of Debugging.		9	
Unit V	**Secure Software Engineering** Introduction - The problem – Software assurance and software security – Threats to software security – Software insecurity – Benefits of detecting software security defects early – Managing secure software development – Defining Properties – Influencing the security properties of software – To assert and specify desired security properties.		9	

Practical Component		
List of Exercises	1. Conceptualize a novel app that will help to save: a) Energy b) Water c) Food 2. Apply the phases of Software Development Life Cycle for the following applications and develop the same: a) Library Management System b) Hospital Management System 3. Design the above two systems with security features and implement the same.	30
Recommended Learning Resources		
Print Resources	1. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", First Edition, HarperCollins Publishers Ltd, 2019. 2. Roger S. Pressman, Bruce Maxim, "Software Engineering, A Practitioner's Approach", Ninth Edition, McGraw Hill International Edition, 2023. 3. Julia H. Allen, "Software Security Engineering: A Guide for Project Managers", First Edition, 2008.	
Syllabus Design: Dr. T. Chithralekha, Professor, PUDoCS *Dr. G. Krishnapriya, Assistant Professor, PUDoCS*		

Year	III	Course Code: CSCA308 Course Title: Distributed Systems	Credits	4
Sem.	VII		Hours	75
			Category	C

Course Prerequisites, if any	Basic knowledge of 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 • Learn to setup fault tolerance and replication servers • Design and implement CORBA and DCOM	

Unit No.	Course Content	Hours
	Theory Component	
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 File System – Distributed Document based System – WWW – Distributed Coordination based System – JINI	9

Practical Component		
List of 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	1. Andrew S. Tanenbaum, Maarten van Steer, "Distributed Systems Principles and Paradigms", Third Edition, Prentice Hall India, 2017. 2. George Couloursis, Jean Dollomore and Tim Kinderberg, "Distributed Systems - Concepts and Design", Fifth Edition, Addison-Wesley, 2011.	
Syllabus Design: Dr. T. Sivakumar, Assistant Professor, PUDoCS		

Year	III	Course Code: CSCA309 Course Title: Operations Research	Credits	4
Sem.	VI		Hours	75
			Category	A

Course Prerequisites, if any	Basic Mathematical and Problem-Solving Skills	
Internal Assessment Marks: 25	**End Semester Marks:** 75	**Duration of ESA (Theory):** 03 hrs.
Course Outcomes	• Understand and comprehend the basics of Linear Programming Problem (LPP) • Learn LPP solving methods and explore duality in LPP • Solve assignment problems and their variants • Find feasible and optimal solutions for transportation problem • Perform critical path analysis and reviewing of a project	

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction** Operation Research – Definition – Characteristics – Techniques – Applications. LPP – Introduction – Applications and components of LPP – Steps in solving LPP.	15
Unit II	**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.	15
Unit III	**Assignment Model** Mathematical formulations - Hungarian Method – Variants of the Assignment problem.	15
Unit IV	**Transportation Problem** Mathematical formulation – Finding basic feasible solutions – NWCR, LCM and VAM – Optimal solution – MODI method.	15
Unit V	**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.	15
	Practical Component	
List of Exercises	-	-

Recommended Learning Resources	
Print Resources	1. KantiSwarup, P.K. Gupta, Man Mohan, "Operations Research", Twentieth Edition, Sultan Chand & Sons, 2023. 2. Taha H.A., "Operations Research: An Introduction", Tenth Edition, Pearson Education, 2019.
Syllabus Design: Dr. G. Krishnapriya, Assistant Professor, PUDoCS *Revised by: Dr. M. Nandhini, Professor, PUDoCS*	

Year	III	Course Code: CSCA310 Course Title: Virtual Reality	Credits	3
Sem.	VI		Hours	75
			Category	C
Course Prerequisites, if any	Basics Knowledge of Programming and Computer Graphics			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.		
Course Outcomes	• Understand the core principles of VR technology and its applications • Analyze the hardware components of VR systems • Explore software development frameworks and tools for VR creation • Apply the knowledge to build basic VR experiences • Evaluate the ethical considerations and future directions of VR technology			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction** Virtual Reality – Hardware - Software - Human Physiology and Perception - Geometric Models - Viewing Transformations	9
Unit II	**Visual Perception** Light and Optics – Human Eye-Cameras – Cornea to Photoreceptors - Eye Movements-Implications for VR - Perception of Depth, Motion, Color	9
Unit III	**Tracking systems** Correcting Optical Distortions - Velocities and Accelerations - Tracking 2D, 3D Position and Orientation	9
Unit IV	**Interaction and Audio** Motor Programs and Remapping – Locomotion – Manipulation - Social Interaction - Physics of Sound - Human Hearing - Auditory Perception and Rendering	9
Unit V	**Perceptual Training** Recommendations for developers - VR sickness - Experiments on Human Subjects – Touch-smell-taste-robotic Interfaces - Brain-Machine Interfaces	9
	Practical Component	
Exercisers	1. Create a basic virtual reality environment using a VR development platform like Unity or Unreal Engine. 2. Develop a VR application where users can interact with virtual objects using hand gestures or controllers. 3. Build a VR application that allows users to watch 360-degree videos in a virtual reality environment. 4. Develop a VR tour experience where users can explore virtual replicas of real-world locations like museums. 5. Design a VR puzzle game where players must solve challenges or riddles to progress through levels.	30

Recommended Learning Resources	
Print Resources	1. Steven M. LaValle., “Virtual Reality”, Cambridge University Press, 2023.
Syllabus Design: Dr. Sukhvinder Singh, Assistant Professor, PUDoCS	

Year	II	Course Code: CSCA311 Course Title: Internet of Things	Credits	4
Sem.	IV		Hours	75
			Category	C
Course Prerequisites, if any	Basic knowledge of programming and networking			
Internal Assessment Marks: 25	End Semester Marks: 75		Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs.	
Course Outcomes	• Understand IoT fundamentals, including design, protocols, and technologies • Explore domain-specific applications such as home automation and industry • Learn about M2M applications and system management • Develop IoT systems using platforms like Raspberry Pi • Manage IoT server and cloud infrastructure, focusing on security			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction** Definition, Characteristics of IoT – Physical Design of IoT – Protocols – Logical Design of IoT – IoT Enabled Technologies – IoT Levels and Templates	9
Unit II	**Domain Specific IoT Applications** Home Automation – City – Environment – Energy – Retail – Logistics – Agriculture – Industry – Health and Lifestyle	9
Unit III	**M2M and IoT System Management** M2M Applications – Software Defined Networks – Network Function Virtualization – Need for IoT System Management – Simple Network Management Protocol – IoT System Management with NETCOZF-YANG	9
Unit IV	**Developing IoT Systems** IoT Platforms Design Methodology – Steps for IoT Design – Case Study on IoT System for Weather Monitoring – Introduction to Raspberry PI – Interfaces (Serial, SPI, I2C) – Programming Raspberry Pi – IoT Devices	9
Unit V	**IoT Server and Cloud Management** Introduction to Cloud Storage Models – Communication APIs, Webserver – Web Server for IoT – Cloud for IoT – Security Management in an IoT System	9
	Practical Component	
List of Exercises	1. Identify and list different types of IoT devices and their functionalities. 2. Sketch a physical design for a home automation system using IoT devices. 3. Compare and contrast different IoT protocols such as MQTT, CoAP, and HTTP.	30

	4. Set up a basic communication protocol between two IoT devices using MQTT. 5. Discuss the role of cloud computing in enabling IoT solutions. 6. Implement a simulation of the home automation system using IoT platforms like Arduino or Raspberry Pi. 7. Investigate and compare M2M applications in industries such as healthcare and logistics. 8. Program a Raspberry Pi to collect weather data from sensors and display it on a web server. 9. Explore different cloud storage models (e.g., public, private, hybrid) and their suitability for IoT applications. 10. Implement security measures such as encryption and authentication in an IoT system using cloud-based services.	
Recommended Learning Resources		
Print Resources	1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things – A Hands-on Approach”, First Edition, Orient Blackswan Private Limited, 2015.	
Syllabus Design: Dr. T. Vengattaraman, Associate Professor, PUDoCS		

SEMESTER VII

Year	IV	**Course Code:** CSCA401 **Course Title:** Web Engineering	**Credits**	4
Sem.	VII		**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			

Unit No.	Course Component	Hours
	Theory Component	
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. 4. Build a web application to demonstrate event handling in JavaScript.	30

	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:** CSCA402 **Course Title:** System Modelling and Simulation	**Credits**	4
			Hours	75
Sem.	VII		**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 • Able to verify the simulation models			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction** Simulation tool - 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 - Discrete-Event System Simulation example - 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 behaviour 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 - Verification of simulation	9

	models - Calibration and validation of models, Optimization via Simulation.	
Practical Component		
List of Exercises	1. Computer Generation of Random Numbers. 2. Chi-square goodness-of-fit test. 3. One-sample Kolmogorov-Smirnov test 4. Test for Standard Normal Distribution 5. 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. Two-sample Kolmogorov-Smirnov test.	30
Recommended Learning Resources		
Print Resources	1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, "Discrete-Event System Simulation", Fifth 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: CSCA403 Course Title: Wireless Communication Networks	Credits	4
Sem.	VII		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 Communications concepts and compare Generations of Wireless Communications • Explore IEEE 802.11WLAN Standard • Explore WAP and its Applications • Understand WLAN Technologies			

Unit No.	Course Content	Hours
	Theory Component	
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" Second edition, Pearson Prentice Hall, 2008.	
Syllabus Design: Dr. T. Sivakumar, Assistant Professor, PUDoCS		

Year	IV	Course Code: CSCA404	Credits	4
Sem.	VII	Course Title: UI / UX Design	Hours	75
			Category	C

Course Prerequisites, if any	Knowledge of Computer Application, Graphics Design	
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 in UI/UX design
- Develop proficiency in conducting user research techniques
- Create wireframes and interactive prototypes using industry-standard tools
- Learn to organize and structure information effectively
- Design accessible interfaces for users with disabilities

Unit No.	Course Content	Hours
Theory Component		
Unit I	**UI / UX Design Principles** UI/UX design concepts - Importance's of UI/UX design - User centered design (UCD) Principles - Basics of Visual Design - layout, typography, color theory, imagery	9
Unit II	**User Research and Analysis** User research methods - Conducting user interviews and creating user - Gathering and analyzing user feedback - Introduction to information architecture (IA) - Utilizing user data and analytics to inform design decisions.	9
Unit III	**UI / UX Design Tools** Popular UI / UX design tools - Sketch, Adobe XD, Figma, and InVision - Basics of wireframing and prototyping - Principles of responsive, interaction and collaborative design	9
Unit IV	**Visual Design UI components** Advanced principles of visual design – designing UI components - applying design patterns and frameworks - motion design and animation principles - designing for different platforms	9
Unit V	**UI / UX evaluation and iteration** Usability testing methods and techniques conducting usability studies and heuristic evaluations - analyzing user feedback-strategies for effective communication and presentation	9
Practical Component		
List of Exercisers	1. Design wireframes for a simple web or mobile application. 2. Develop an interactive prototype for a specific user flow within an application. 3. Conduct usability testing on an existing website or application. 4. Design a mobile version of a website or application to ensure responsiveness across different screen sizes. 5. Create user personas based on research and analysis of target users.	30

	6. Develop a style guide or design system for a website or application.	
Recommended Learning Resources		
Print Resources	1. Jason Beaird, James George, "The Principles of Beautiful Web Design", Third Edition, O'Reilly, 2014. 2. Tom Mulligan, "UX/UI Design 2021-2022 Tutorial the Complete step by step guide to UX/UI Design and Best Practices for designers with no experience", 2022.	
Syllabus Designed by: Dr. Sukhvinder Singh, Assistant Professor, PUDoCS		

Year	IV	Course Code: CSCA405 Course Title: Mobile Application Development	Credits	4
Sem.	VII		Hours	75
			Category	C
Course Prerequisites, if any	Basic knowledge of programming			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory) : 03 hrs. Duration of ESA (Practical) : 03 hrs.		
Course Outcomes	• Understanding of Mobile Development Concepts • Proficiency in Mobile App Design and Development • Skill in Data Storage and Retrieval • Ability to Build and Deploy Mobile Apps • Design and build a responsive UI using various features			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction** Overview of Android Platform and its Architecture – Android Studio IDE – Setting up Development Environment – Basic Android Components	9
Unit II	**User Interface Design and Development** Design Principles for Android UI/UX - Layouts and Views - Handling User Input - Styling and Theming Android Applications	9
Unit III	**Data Storage and Retrieval** Working with SQLite database - Preferences and Settings - Room Persistence Library - Working with content providers and loaders	9
Unit IV	**Networking and Data Persistence** Making Network Requests with Retrofit or Volley - Parsing JSON and XML Responses - AsyncTask and AsyncTaskLoader for Background Tasks - Working with RESTful APIs	9
Unit V	**Advanced Topics in Android Development** Fragments and FragmentManager – Responsive UI with ConstraintLayout and ViewPager – Services and Background Processing – Material Design Components and Animations	9
	Practical Component	
List of Exercises	1. Create a simple Android application with one activity displaying text 2. Implement Multiple Activities and Navigation with buttons 3. Design and Implement a Sign-Up form 4. Implement a To-Do List App with SQLite Database 5. Implement setting screen using Shared Preferences 6. Fetch data from a RESTful API 7. Implement AsyncTask for Background Task 8. Implement communication between Fragments 9. Implement ViewPager with TabLayout	30
	Recommended Learning Resources	

Print Resources	1. Google Developer Training, "Android Developer Fundamentals Course – Concept Reference", Google Developer Training Team, 2017.
Syllabus Design: Dr. T. Vengattaraman, Assistant Professor, PUDoCS	

Year	IV	Course Code: CSCA406 Course Title: E-Commerce Application Development	Credits	3
Sem.	VII		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 basic concepts of E– commerce and Business Model • Understand the web development basics for E-Commerce • Understand the backend and database for E-Commerce • Explore the integration of payment gateway and user management • Deployment, testing and analysing the performance of E-Commerce application			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction to E-Commerce Development** E-commerce v/s Traditional Commerce - E-Business – EDI – Importance, Features & Benefits – Business Models – Architectural Framework of E-Commerce & Development Life Cycle – Platforms and Technologies	9
Unit II	**Web Development for E-Commerce** PHP/JavaScript - Control Structures - The elements of e-commerce – Responsive design principle – Frontend framework – building user interface-browse, search, cart, checkout - A web site Evaluation Model	9
Unit III	**Backend and Database Management** Server-Side Languages – Backend Framework – DBMS for E-Commerce Application – SQL, NO SQL – Designing and Implementing – Catalog, User Accounts Orders	9
Unit IV	**Security, Payment Integration, and User Management** Authentication and authorization for user accounts – Implementing Secure Payment Gateway – Compliance with PCI DSS – Managing user profile, address and order history	9
Unit V	**Deployment, Testing and Performance** Implementing search and recommendation system – Performance optimization and scalability – Testing – Deploying to Cloud Platform	9
	Practical Component	
List of Exercises	1. Home page design of web site 2. Validation using PHP 3. Implement Catalogue design 4. Implement Access control mechanism (eg: username and password)	30

	5. Case study on business model of online E-Commerce store	
Recommended Learning Resources		
Print Resources	1. Turban, Rainer, and Potter, "Introduction to E-Commerce", Second Edition, 2003. 2. H. M. Deitel, P. J. Deitel and T. R. Nieto, "E-Business and E-Commerce: How to Program", Prentice Hall, 2001. 3. Developers from DevZone, "Building eCommerce Applications", O'Reilly Media, Inc., 2011.	
Designed By: S. Ravi, Professor, PUDoCS and Dr. Sukhvinder Singh, Assistant Professor, PUDoCS		

Year	IV	Course Code: CSCA407 Course Title: Artificial Intelligence	Credits	4
Sem.	VII		Hours	75
			Category	C
Course Prerequisites, if any	Basic Programming Skills			
Internal Assessment Marks: 25	End Semester Marks: 75		Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.	
Course Outcomes	• Understanding the diverse traits of a problem-solving agent • Explore methods for tackling problems amidst different constraints • Implement AI techniques in various applications • Grasp the distinct models of learning • Develop an expert system			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction** Foundation and History of AI - Intelligent Agents - Agents and Environments - The Concept of Rationality - Nature of Environments - Structure of Agents - Problem Solving Agents - Examples	9
Unit II	**Searching** Searching for Solutions, Uniformed Search Strategies - Heuristics Search Strategies - Local Search Algorithms and Optimization Problems- Hill Climbing- Simulated Annealing- Local Beam Search- Genetic Algorithms - Optimal Decisions in Games - Alpha–Beta Pruning	9
Unit III	**Agents** Logical Agents- Knowledge-Based Agents- The Wumpus World- Logic- Propositional Logic - Propositional Theorem Proving - Effective Propositional Model Checking - Agents Based on Propositional Logic	9
Unit IV	**First Order Logic** Introduction- Syntax and Semantics - Inference - Propositional Vs. First-Order Inference - Unification and Lifting - Forward Chaining - Backward Chaining- Resolution.	9
Unit V	**Learning** Forms of Learning- Supervised Learning- Learning Decision Trees- Hypothesis- Theory of Learning - Prolog - Programs - Data Objects	9

Practical Component		
List of Exercises	1. Implement Breadth First Search 2. Implement Depth First Search 3. Implement Tic-Tac-Toe game 4. Implement 8-Puzzle problem 5. Implement Water-Jug problem 6. Implement Monkey Banana Problem 7. Implement Alpha-Beta Pruning 8. Develop an expert system using Prolog	30
Recommended Learning Resources		
Print Resources	1. S. Russell and P. Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2022. 2. Max Bramer, "Logic Programming with Prolog", Springer, 2013.	
Syllabus Design Dr. P. Shanthi Bala, Professor, PUDoCS		

SEMESTER VIII

Year	IV	Course Code: CSCA408 Course Title: Data Warehousing & Mining	Credits	3
Sem.	VIII		Hours	75
			Category	C
Course Prerequisites, if any	Basic Computer 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 fundamental concepts in Data Warehousing • Learn the architecture of Data Warehouse • Understand the concepts in Data mining • Learn the Data Preprocessing concepts like Data Cleaning, Data Integration and Data Reduction • Learn to use Data Visualization techniques with advance charts			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction to Data Warehousing** The modern Data warehouse - Data Warehouse Roles and Structure - Stores, Warehouses and Marts- Data Warehouse Architecture- Metadata	9
Unit II	**Data Warehouse Architecture** Steps for design and construction of Data Warehouse – Three-Tier Data Warehouse Architecture – Backend tools – Metadata Repository	9
Unit III	**Data Mining** Online Analytical Processing- Techniques Used to Mine the Data- Market Basket Analysis – Current Limitations and challenges to Data Mining	9
Unit IV	**Data Preprocessing** Need of Data Preprocessing – Methods – Data Cleaning – Data Integration – Data Transformation - Data Reduction	9
Unit V	**Data Visualization** Pixel-Oriented Visualization Techniques - Geometric Projection Visualization Techniques - Icon-Based Visualization Techniques - Hierarchical Visualization Techniques - Visualizing Complex Data and Relations	9
	Practical Component	
List of Exercises	1. Setting up a data warehouse environment using a relational database management system (e.g., MySQL)	30

	2. Data cleaning and preprocessing techniques for handling missing values, outliers, and inconsistencies. 3. Applying data mining algorithms to extract insights from a given dataset and evaluate their performance.	
Recommended Learning Resources		
Print Resources	1. George M. Marakas, "Modern Data Warehousing, Mining and Visualization: Core Concepts", Pearson Education, 2012. 2. Dr. Jugnesh Kumar. "Data Warehouse and Data Mining: Concepts, techniques and real-life applications", BPB Publication, 2024. 3. Parteek Bhatia, "Data mining and data warehousing", Cambridge University Press, 2019.	
Designed By: S. Ravi, Professor, PUDoCS & Dr. Sukhvinder Singh, Assistant Professor, PUDoCS		

Year	IV	Course Code: CSCA409 Course Title: Data Science	Credits	3
Sem.	VIII		Hours	75
			Category	C
Course Prerequisites, if any	Basic Computer Knowledge			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.		
Course Outcomes	• Understand Fundamental of Data Science Concepts • Learn about Data Exploration and Visualization techniques • Understand Classification and Regression Techniques • Learn the basic concepts of Association Rule and Clustering • Learn the Python Programming			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction to Data Science** Introduction – Data Science – Learning Algorithms – Classification – Core Algorithms – Data Science Process – Data Preparation – Modeling - Application	9
Unit II	**Data Exploration & Visualization** Objectives – Data Sets – Types of Data – Descriptive Statistics – Univariate Visualization – Multivariate Visualization – High-Dimensional Data	9
Unit III	**Classification & Regression** Decision Trees – K-Nearest Neighbors – Naïve Bayes – ANN – Support Vector Machines – Linear Regression – Logistic Regression	9
Unit IV	**Association Rule & Clustering** Association Rules – Apriori Algorithm – Clustering Process – Types – K-Means Clustering	9
Unit V	**Python Programming** Introduction – Python fundamentals – Functions – Modules – Files – Numpy – Pandas – Matplotlib – Jupyter	9
	Practical Component	
List of Exercises	1. Python Program for Arithmetic Operations 2. Program for factorial using Python 3. Create a Python script that reads a text file, and counts the occurrences of each word 4. Python programs on the concept of Lists, Dictionary 5. Program on Numpy concepts 6. Load a CSV file into a Pandas DataFrame and display its first 5 rows. 7. Create a scatter plot of two variables from a DataFrame and label the axes appropriately. 8. Load a dataset suitable for classification (e.g., Iris dataset) and split it into training and testing sets.	30

	9. Apply K-Means clustering to partition a dataset into ‘k’ clusters and visualize the cluster centers. 10. Implement Python Program on K-Nearest Neighbor	
Recommended Learning Resources		
Print Resources	1. Vijay Kotu, Bala Deshpande, “Data Science Concepts and Practice”, Second Edition, Morgan Kaufmann Publishers, 2018. 2. Martin.C.Brown, “Python The Complete Reference”, Fourth Edition, McGraw Hill Education, 2018. 3. Wes McKinney, “Python for Data Analysis”, Third Edition, O'Reilly Media, Inc, 2022.	
Designed By: S. Ravi, Professor, PUDoCS & Dr. Sukhvinder Singh, Assistant Professor, PUDoCS		

Year	IV	Course Code: CSCA410	Credits	3
Sem.	VIII	Course Title: Data Analytics and Business Intelligence	Hours	75
			Category	C
Course Prerequisites, if any	Basic Computer Knowledge			
Internal Assessment Marks: 25	End Semester Marks: 75	Duration of MJD-20 (Theory): 03 hrs. Duration of MJD- 20 (Practical): 03 hrs.		
Course Outcomes	• Understand the basic concepts of data Analytics • Working with machine learning and statistical methods for data analytics • Evaluation and performance measure for business analytics • Text enhancement using advance techniques • Analysing case studies to inform strategic decision-making			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Data Analytic Thinking** Ubiquity of Data Opportunities - Data Science, Engineering, and Data -Driven Decision Making - Data Processing and "Big Data" – Data Mining – Process – Statistics - Database Querying - Data Warehousing - Regression Analysis	9
Unit II	**Predictive Modeling** Models Induction and Prediction - Supervised Segmentation - Visualizing Segmentation - Probability Estimation – Classification - Regression	9
Unit III	**Decision Analytical Thinking** Evaluating Classifiers - Generalizing Beyond Classification - Evaluation and Performance for Investments in Data – Ranking - Profit Curves - ROC Graphs and Curves	9
Unit IV	**Representing and Mining Text** Representation - Beyond BOW - Link Prediction and Social Recommendation - Data Reduction – Bias – Variance - Ensemble Methods	9
Unit V	**Data Science and Business Strategy** Achieving and Sustaining Competitive Advantage - Nurturing Data Scientists - Examine Data Science Case Studies.	9
	Practical Component	
List of Exercises	1. Provide specific steps and techniques you would use to clean and prepare the data for analysis. 2. Identify key variables to analyze, and describe the visualizations and statistical techniques for Customer Dataset 3. Discuss the choice of features, model selection, evaluation metrics, and potential challenges in the predictive analytics 4. What ethical considerations should you keep in mind when handling sensitive customer information?	30

Recommended Learning Resources	
Print Resources	1. Foster Provost, Tom Fawcett, “Data Science for Business”, First Edition, O'Reilly Medi, 2013.
Syllabus Design: Dr. S. Ravi, Professor, PUDoCS & Dr. Sukhvinder Singh, Assistant Professor, PUDoCS	

Year	IV	Course Code: CSCA411	Credits	4
			Hours	75
Sem.	VIII	Course Title: Machine Learning	Category	C

Course Prerequisites, if any	Probability and 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 basic concepts and types of Machine Learning (ML) • Prepare the data for ML model, train the model and evaluate the model's performance • Understand the fundamentals of features and feature engineering • Build a ML model with the appropriate supervised algorithm for the data • Build a ML model with the appropriate unsupervised algorithm for the data	

Unit No.	Course Content	Hours
	Theory Component	
UNIT I	**Introduction to Machine Learning** Human Learning – Machine Learning – Types of Machine Learning – Supervised Learning –Unsupervised Learning – Reinforcement Learning – Applications – Preparing to Model – Types of Data – Structure – quality and Remediation – Pre-Processing.	9
UNIT II	**Modelling and Evaluation** Selecting – Training – Model Representation and Interpretability – Performance Evaluation – Feature Engineering – Introduction – Transformation – Feature Subset Selection – Issues in High Dimensional Data – Feature selection – Key Drivers – Measures – Process – Approaches	9
UNIT III	**Supervised Learning – Classification** Introduction – Example – Model – Learning Steps – Algorithms – k–Nearest Neighbor – Decision tree – Random Forest Model – Support Vector Machines.	9
UNIT IV	**Supervised Learning – Regression** Introduction – Example – Model – Algorithms – Simple and Multiple linear regression – Assumptions – Main problems in regression analysis – Logistic regression – Maximum Likelihood estimation.	9
UNIT V	**Unsupervised Learning** Introduction – Applications – Clustering – Types – Partitioning Methods – Hierarchical Clustering – Density–based Methods – DBSCAN – Apriori algorithm for Association Rule Learning.	9
	Practical Component	
List of Exercises	1. Develop a Python script that uses a decision tree classifier for prediction 2. Develop a ML model that runs a random forest for classification 3. Create a Python program that uses SVM to classify images from the MNIST dataset.	30

	4. Implement K–Means clustering to segment customers into groups based on their shopping data such as purchase history and customer demographics. 5. Implement a linear regression model. 6. Develop a program to perform multiple linear regression to predict house prices Implement logistic regression to classify emails as spam or notspam.	
Recommended Learning References		
Print Resources	1. Saikat Dutt, Chandramouli.S, Amit Kumar Das., " MachineLearning", Pearson, 2018. 2. Alpaydin, E., "Introduction to Machine Learning", Fourth Edition, MIT Press, 2020.	
Syllabus Design: Dr. M. Nandhini, Professor, PUDoCS		

Year	IV	Course Code: CSCA412 Course Title: Robotic Process Automation	Credits	4
Sem.	VIII		Hours	75
			Category	C
Course Prerequisites, if any	Knowledge of programming, AI and ML			
Internal Assessment Marks: 25	End Semester Marks: 75		Duration of ESA (Theory): 03 hrs. Duration of ESA (Practical): 03 hrs.	
Course Outcomes	• Understand RPA, its benefit and role in business process automation • Understand the RPA tools and their features, functionalities, and user interfaces • Analyze business processes, potential automation opportunities, and design RPA • Developing an automation workflow using RPA tools • Integrating RPA with other technologies			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Foundation** RPA - Benefits – Downsides - RPA vs BPO, BPM & BPA - Consumer Willingness for Automation - RPA Skills - Web Technology - Programming Languages and Low Code - OCR Databases - APIs, Artificial Intelligence - Cognitive Automation - DevOps	9
Unit II	**Process Methodologies** Lean - Six Sigma - Roles and Levels - Applying Lean and Six Sigma to RPA - Planning-Preliminaries - RPA Consulting - Case Studies - What to Automate - ROI for RPA - Use Cases	9
Unit III	**Center of Excellence (CoE)** CoE - Forming the Team - Business Analyst – Developer - RPA Solution Architect - RPA Supervisor – Communication - Change Management	9
Unit IV	**Bot Development** Installation of UiPath - Flowcharts and Sequences - Log Message – Variables - Loops and Conditionals - For each Loop - Do Loop - While Loop - If Statements	9
Unit V	**Deployment and Monitoring** Testing – Production – Monitoring – Security – Scaling - Data Preparation - Types of Data - Big Data - Data Process - Types of Algorithms	9
	Practical Component	
List of Exercises	1. Develop an RPA bot to automate data entry tasks. 2. Create an RPA bot to automate email processing tasks 3. Implement an RPA solution for automating invoice processing 4. Develop an RPA bot to automate data migration tasks between different systems or databases. 5. Create an RPA bot to automate file management tasks 6. Develop an RPA bot to scrape data from websites	30

	7. Implement an RPA solution for automating HR onboarding processes. 8. Create an RPA bot to automate customer service tasks. 9. Develop an RPA bot to automate report generation tasks. 10. Implement an RPA solution for automating quality assurance tasks.	
Recommended Learning Resources		
Print Resources	1. Tom Taulli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", First Edition, Apress, 2020.	
Syllabus Design: Dr. Sukhvinder Singh, Assistant Professor, PUDoCS		

Year	IV	Course Code: CSCA413	Credits	4
Sem.	VIII	Course Title: Low Code / No Code Technologies	Hours	75
			Category	C

Course Prerequisites, if any	Basic computer knowledge and problem-solving abilities	
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 LC/NC
- Understand the application of LC/NC in Real-World Scenarios
- Understand the concepts of Citizen developer
- Able to develop & deploy LC/NC based applications
- Awareness of LC/NC Tools and Techniques

Unit No.	Course Content	Hours
Theory Component		
Unit I	**Introduction** Workplace Tech - Isolating Cause and Effect - Importance of Workplace Tech - Dual Nature of Contemporary IT - Limitations of IT - Conventional Business Technology - Defining Terms - Workplace Technologies Development Methods	9
Unit II	**Reimagining Application Development** Low-Code/No-Code Building Blocks and Precursors - LC/NC Rebranding - Distinguishing Between NC and LC Tools - Characteristics of LC/NC Tools - Major LC/NC Subcategories - Contextualizing Low-Code/No-Code	9
Unit III	**Citizen Developer** Definition - The Rise of the Citizen Developer - Common Attributes of Citizen Developers - IT Benefits, Organizational Benefits - Individual and Team Benefits of Citizen Developers	9
Unit IV	**Unleashing LC/NC and Citizen Developers** Municipality of Rotterdam - Outcome for a Budding Entrepreneur - Low-Code/No-Code Powers Up Synergis Education - Low-Code/No-Code Transforms a Family Business - Approaches of Citizen Development	9
Unit V	**Tools and LC/NC App** Evaluating Existing Tools - Learning New LC/NC Tools - Navigating the LC/NC App - Myths and Realities - Management Strategies - Tech Strategies	9
Practical Component		
List of Exercises	1. Design a survey to collect information from the employees about the workplace. 2. Choose a low-code/no-code development platform and use it to create a basic application, such as a task tracker or simple data collection tool. 3. Select a pre-built template or app from a low-code/no-code platform and customize it to meet specific requirements or preferences.	30

	4. Demonstrate the use of a specific LC/NC tool to create a basic application or workflow. 5. Divide students into groups and assign each group a specific business scenario or problem to solve using LC/NC development tools.	
Recommended Learning Resources		
Print Resources	1. Phil Simon, "Low-Code/No-Code: Citizen Developers and the Surprising Future of Business Applications", Racket Publishing, 2022.	
Syllabus Design: Dr. T. Vengattaraman, Associate Professor, PUDoCS		

Year	IV	Course Code: CSCA414	Credits	4
Sem.	VIII	Course Title: Blockchain Application Development	Hours	75
			Category	C

Course Prerequisites, if any	Computer Science Fundamentals, Data Structures, Programming language	
Internal Assessment Marks: 25	**End Semester Marks:** 75	**Duration of ESA (Theory):** 03 hrs. **Duration of ESA (Practical):** 03 hrs.
Course Outcomes	• Understand Blockchain Technology, its principles, components, and architecture • Able to design and develop Blockchain-based applications • Comprehend the Security and Privacy challenges associated with Blockchain Technology • Explore methods to integrate Blockchain Solutions with existing systems and platforms • Examine governance models and regulatory frameworks to Blockchain Technology	

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Blockchain Introduction** Growth and History of Blockchain- Definition - Generic Elements - Benefits and Limitations - Features and Types of Blockchain	9
Unit II	**Decentralization** Definition – Methods – Routes - Platforms and Organizations of Decentralization	9
Unit III	**Cryptography** Definition – Confidentiality – Integrity – Authentication - Non-Repudiation - Accountability - DES – AES - Public Key Cryptography - Asymmetric Cryptography - Public and Private Keys – Encryption – Decryption - Hash Functions - Digital Signatures	9
Unit IV	**Bitcoin** Definition - Digital Keys and Address - Transactions and its types - Bitcoin Network – Wallets - Bitcoin Payments - Innovation in Bitcoins	9
Unit V	**Ethereum** Introduction - Ethereum Network – Components – EVM - Test Networks - Setting up Private Network	9
	Practical Component	
List of Exercises	1. Develop a decentralized application (DApp) that utilizes blockchain technology. 2. Set up a private blockchain network using a blockchain platform like Ethereum 3. Create a custom token on a blockchain platform of your choice 4. Build a blockchain explorer application that allows users to view transaction history, block details, and network statistics. 5. Integrate a blockchain network with external systems or applications. 6. Perform a security audit of smart contracts deployed on a blockchain network.	30

	7. Design a blockchain governance model for a decentralized network. 8. Research and analyze real-world use cases for blockchain technology in various industries.	
Recommended Learning Resources		
Print Resources	1. Imran Bashir, “Mastering Blockchain”, Fourth Edition, Packt, 2023.	
Syllabus Design: Dr. Sukhvinder Singh, Assistant Professor, PUDoCS		

Multi-Disciplinary Course

Year	I / II	**Course Code:** COMS101 **Course Title:** Introduction to Python Programming	**Credits**	3
			Hours	60
Sem.	I / III		**Category**	A
Course Prerequisites, if any	Problem-solving skills			
Internal Assessment Marks: 25	**End Semester Marks:** 75		**Duration of ESA (Theory):** 03 hrs.	
Course Outcomes	• 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			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**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	12
Unit II	**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 ()	12
Unit III	**Sets** Definition – Accessing – Operations – Functions – Mathematical Set Operations – Updating Set Operations – Dictionaries – Definition – Accessing – Operations – Functions – Nested Dictionary	12
Unit IV	**Functions** Definition – Communication – Types – Unpacking – Lambda, Recursive Functions – Modules and Packages – Creation and Importing	12
Unit V	**Exception handling** Syntax Errors – Handling Exceptions – Try-Except – User-Defined Exceptions – Else, Finally Blocks – Tips – Visualization – Matplotlib Package – Plotting Graphs	12
	Recommended Learning Resources	
Print Resources	1. Aditya Kanetkar, Yashavant Kanetkar, “Let us Python”, Sixth Edition, BPB Publisher, 2023.	

Syllabus Design: Dr. R. Sunitha, Associate Professor, PUDoCS

Year	I	**Course Code:** COMS102 **Course Title:** Foundations of Information Technology	**Credits**	3
			Hours	60
Sem.	II		**Category**	A
Course Prerequisites, if any	Basic knowledge of Computers			
Internal Assessment Marks: 25	**End Semester Marks:** 75	**Duration of ESA (Theory):** 03 hrs.		
Course Outcomes	• 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			

Unit No.	Course Content	Hours
	Theory Component	
Unit I	**Introduction** Overview of IT – Computer Basics – Software Fundamentals – Networks & Internet – IT Ethics and Policies	12
Unit II	**Hardware and Software Management** Computer Assembly and Maintenance - Operating Systems – Software Installation and Maintenance – Virtualization, Cloud Computing	12
Unit III	**Networking Essentials** Network Fundamentals – Hardware – Protocols and Services – Wireless Networking – Security	12
Unit IV	**Data Management and Security** Data and Fundamentals of Database – Data Backup and Recovery – Cyber Security – Encryption and Cryptography	12
Unit V	**IT Support and Troubleshooting** Help Desk and IT Support – Troubleshooting Methodologies – Diagnostic Tools and Utilities – Future Trends in IT	12

Recommended Learning Resources

Print Resources

1. Floyd Fuller, Brian Larson, “Computers: Understanding Technology, Fourth Edition, EMC Paradigm, 2011.
2. Mike Meyers, “CompTIA A+ Certification All-in-One Exam Guide”, Eleventh Edition, McGraw-Hill Education, 2023.
3. Jeffrey S. Beasley, Piyasat Nilkaew, “Networking Essentials”, Third Edition, Prentice Hall Certification, 2012.
4. Charles J. Brooks, Christopher Grow, Philip Craig, and Donald Shor, “Cybersecurity Essentials”, First Edition, Sybex Publisher, 2018.

Syllabus Design: Dr. R. Sunitha, Associate Professor, PUDoCS