

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

(Abstract)

Faculty of Technology - Asian School of Business - Scheme and Syllabus of Bachelor of Computer Applications (Honors) in Data Science and Artificial Intelligence Programme with effect from 2025 admission - Resolution of the Academic Council - Communicated - Orders issued.

ACADEMIC A SECTION

No.CUSAT/AC(A).A3/669/2026

Dated,KOCHI-22,19.02.2026

- Read:-1.Short Minutes of Outside Agenda Item No: 1 of the Meeting of the Academic Council held on 23.01.2026
2. U.O.No.CUSAT/AC(A).A3/3215/2025 dated 12.08.2025

ORDER

The Academic Council, vide item read(1) above, considered the Scheme and Syllabus of Bachelor of Computer Applications (Honors) in Data Science and Artificial Intelligence programme offered by Asian School of Business and resolved to approve the same, with effect from 2025 admission.

The Regulation, Scheme and Syllabus of the programme is appended.

The U.O read at (2) above stands modified to this extent.

Dr. Arun A U *
Registrar

To:

1. The Dean, Faculty of Technology
2. The Chairperson, BoS BCA in Data Science and Artificial Intelligence
3. The Director, Asian School of Business
4. All AR/DR Examination wing - with a request to forward the U.O to sections concerned
5. The Director, IQAC/ DoA
6. CIRM. Webmaster/Conference Sections
7. PS To VC/PS to PVC/ PA To Registrar/PA to CE

8. Stock File/File Copy

* This is a computer generated document. Hence no signature is required.

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY



REGULATIONS & CURRICULUM FOUR YEAR UNDER GRADUATE PROGRAMME

BACHELOR OF COMPUTER APPLICATIONS (HONORS) IN DATA SCIENCE AND ARTIFICIAL INTELLEGENGE

(For Asian School of Business, Thiruvananthapuram)

Regulations of the Four Year Under Graduate Programme(FYUGP) in 'BACHELOR OF COMPUTER APPLICATIONS (HONORS) IN DATA SCIENCE AND ARTIFICIAL INTELLIGENCE (BCA (Honors) IN DATA SCIENCE and AI)', June 2025

Cochin University of Science and Technology
(2025 Admission onwards)



PREAMBLE

These regulations shall be referred to as the **Regulations for the Four-Year Under-Graduate Programme (FYUGP) in BCA (Honors) IN DATA SCIENCE and AI**. They form an integral part of the FYUGP curriculum framework for these specific degree programs.

The purpose of these regulations is to serve as a comprehensive guideline for the development and implementation of the curriculum for the aforementioned FYUGP. They are designed to ensure a structured, coherent, and enriching educational experience tailored to the needs of students enrolled in these specialized fields.

These regulations aim to foster a student-centric approach, aligning academic delivery with the dynamic demands of higher education and the evolving landscape of employment opportunities. Through this framework, the programs aspire to facilitate a transformative learning journey that prepares graduates for successful careers in their respective domains.

1. Scope

- 1.1. These regulations shall apply to the Four-Year Under-Graduate Programme (FYUGP) in **BCA (Honors) IN DATA SCIENCE and AI** offered under the Faculty of Technology at Cochin University of Science and Technology (CUSAT), effective from the 2025 admissions cycle.
- 1.2. These regulations have been formulated in response to the introduction of the aforementioned programs commencing with the 2025 academic session.

2. Definitions

- 2.1. **Credit** is the quantity of instruction given or the learning outcomes and a notional time to achieve those outcomes.
- 2.2. **Discipline Specific Course (DSC)** is that focuses on a specific subject or field of study. These courses are designed to provide students with a deep understanding of the theories, concepts, and practices within a particular discipline. This is a course that should be pursued by a student as a mandatory requirement of his/her programme of study.
- 2.3. **Discipline Specific Elective (DSE)** is a course of a particular discipline that a student has the choice to select from a pool of such courses from his/her programme of study. The DSEs to offer in a program of study would be identified by the Department/School/Institution concerned.

- 2.4. **Capstone Level Courses (CLC), a discipline specific course (DSC)**, allow the students to demonstrate their cumulative knowledge in their field of study. It plays a vital role in preparing students for the world of work with practical applications, professional knowledge, and skills.
- 2.5. **Ability Enhancement Courses (AEC)** are the courses designed specifically to achieve competency in modern Indian/world languages and English with special emphasis on communication skills.
- 2.6. **Skill Enhancement Courses (SEC)** are designed to develop Creativity, Critical Thinking, Communication, and Collaboration, which are known as 21st-century skills.
- 2.7. **Value Addition Courses (VAC)** are the courses meant for personality development, perspective building and developing self-awareness of a graduate student.
- 2.8. **Multi-Disciplinary Courses (MDC)** are the courses intended to broaden the intellectual experience and to build a conceptual foundation about arts, science, commerce, language, and social sciences among students.
- 2.9. **Audit Course** means a course which can be opted by a student but which will not accrue any credit.
- 2.10. **MOOC Course** means a Massively Open Online Course offered by UGC, CUSAT or any other recognized educational agencies approved by the University.

3. Structure of FYUG Programmes

The new FYUGP curriculum framework is designed to provide a comprehensive redesign strategy that addresses the specific needs of the undergraduate programs. It facilitates a systematic, evidence-based approach to curriculum transformation, ensuring that the program structure upholds quality standards and supports continuous improvement.

The programme pathways available for the students are the following:

Programme Pathways Available to Students

3.1. Three-Year UG Degree:

Students opting to exit the program after three years will be awarded an undergraduate degree in their major discipline upon successful completion of a minimum of 133 credits and fulfillment of the prescribed course requirements.

3.2. Four-Year UG Degree (Honors):

A four-year undergraduate Honors degree in the major discipline will be awarded to students who complete the program with at least 177 credits and meet the minimum course requirements. Honors students are required to undertake a mini-project or internship worth 4 credits under the supervision of a faculty member, which may be conducted within the university, any higher education institution (HEI), research institution, or industry during the fourth year.

4. The Curriculum Structure of the FYUGP

The curriculum structure of FYUGP contains the following mandatory components:

- 4.1. General Foundation Components (4 major course baskets)
 - Ability Enhancement courses (AEC)
 - Skill Enhancement Courses (SEC)
 - Value Addition Courses (VAC)
 - Multi-Disciplinary Courses (MDC)
- 4.2. Discipline Specific Pathway Components
 - Discipline Specific Core Course (DSC)
 - Discipline Specific Elective Course (DSE)

4.3. Discipline Specific Capstone Components.

- Advanced DSC and DSE Courses
- Projects, field training, internship, community activity etc.
- (Any programmes to promote experiential learning)

5. The Credit Structure of the FYUGP

5.1. General Foundation Courses

It is mandatory for all the students who enrolled for an FYUG degree programme to acquire 39 credits from general foundation courses, which are classified into four different sub-categories (approximately 30% credit decided for the three-year programme).

5.1.1. General Foundation Courses can be grouped into 4 major baskets, namely

(1) Ability Enhancement Courses (AEC), (2) Skill Enhancement Courses (SEC), (3) Value Addition Courses (VAC), and (4) Multi-Disciplinary Courses (MDC).

5.1.2. All these foundation courses are 3-credit courses.

5.1.3. The ability Enhancement Courses (AEC) and Skill Enhancement Courses can include practicum components as well.

5.1.4. The students have to complete 12 credits (4 courses) from AEC, 9 credits (3 courses) from SEC, 9 credits (3 courses) from VAC, and 9 credits (3 courses) from MDC as part of their UG Programme as in the table.

General Foundation Courses			
Sl. No.	Name of the General Foundation Course	No. of Courses	Required Credit
1.	Ability Enhancement Courses (AEC)	4	12
2.	Skill Enhancement Courses (SEC)	3	9
3.	Value Addition Courses (VAC)	3	9
4.	Multi-Disciplinary Courses (MDC)	3	9
	Total in the first three years of FYUGP	13	39

5.2. Discipline Specific Foundation and Pathway Courses for a 3-year Degree

5.2.1. The student who wishes to exit with a degree after three years needs to acquire 94 credits (approximately 70% of the total 133 credits) from Discipline Specific pathway, and capstone level courses, decided for the three-year programme.

5.2.2. Each DSC has 3 or 4 credits

5.3. Discipline Specific Foundation and Pathway Courses for 4-year Honors Degree

The student who wishes to continue to the fourth year for the Honors degree, he/she should successfully complete 133 credits in the first 3 years and should acquire 44 credits during their fourth year.

5.4. Capstone Level Courses

The capstone level discipline specific courses allow the students to demonstrate their cumulative knowledge in their field of study. Capstone level courses include topics on specialized/advanced level, internships, projects etc.

5.5. Signature Courses

5.5.1. Each Department can design signature courses in DSE/SEC/VAC/ Vocational Courses offered by their faculty members, approved by the BoS or the academic committee.

5.5.2. A Department can empanel distinguished individuals who have excelled in their field of specialization like cyber security, Data analytics, as adjunct faculty as per the UGC guidelines with the approval of the University, with approval of the BoS or the academic committee, the adjunct faculty can offer DSE/SEC/ VAC/Vocational Courses as signature courses.

5.5.3. Guest Faculty/Visiting Faculty/Visiting Scholars can also offer DSE/SEC/VAC/ Vocational Courses as signature courses, approved by the BoS or the academic committee.

5.6. Audit Courses

A student has the choice of auditing not more than one course in each semester. Students who desire to audit courses over and above the number of courses prescribed have to choose from amongst the courses offered by different Departments in that semester and inform their department in writing. Courses thus audited should also be indicated in the Course Registration Forms along with other courses opted for that semester. A student should attain a pass for compulsory audit course for obtaining the degree.

5.7. Credit Details

The proposed number of credits per course and the credit distribution of them for the FYUGP are given below

5.7.1. A course that includes one hour of lecture or tutorial or a minimum of two hours of lab work, practical work, or field work per week is given one credit hour.

5.7.2. One credit in a semester should be designed for 15 hours of Lectures or Tutorials or 30 hours of practicum and learner engagement in terms of course- related activities such as seminar preparation, submitting assignments, etc.

5.7.3. A one credit seminar or internship or studio activities or field work/ projects or community engagement and service will have two-hour engagements per week (30 hours of engagement per semester).

5.7.4. A course can have a combination of lecture credits, tutorial credits, and practicum credits, as

1. **Lecture (L):** Courses involving lectures

2. **Tutorial (T):** Courses involving problem-solving and discussions

3. **Practicum or Laboratory (P):** Course requiring students to participate in a project or practical or lab act

4. **Seminar:** Course requiring structured discussion/conversation or debate focused on assigned tasks

5. **Internship:** Course requiring actual work situations. Internships involve working with industry, government etc.

5.7.5. A course should be of a minimum of 2 credits, and a maximum of 4 credits. The maximum is not applicable to projects or related activities.

5.7.6. A student shall be able to opt for a certain number of extra credits over and above the requirements for the award of a Degree.

6. Admissions

The students are admitted as per the admission rules of the institution concerned university (CUSAT).

6.1. Eligibility

Candidates with 50% marks or equivalent in the Plus Two examination with Computer

Science/ Informatics Practices/ Information Technology/ Mathematics/ Computer Application as one of the optional subjects of the State of Kerala or any other examination accepted as equivalent thereto can apply.

6.2. The rules in force regarding the relaxation in qualifying marks/grades and the reservation in admission shall be applicable to candidates belonging to the reservation categories.

7. Course Registration and Attendance

- 7.1. The Programmes are conducted in conformity with the attributes of the Outcome Based Education (OBE) and Choice Based Credit System (CBCS). The syllabi of all academic programmes are to be prepared in such a way that they contain the OBE attributes such as Programmes Outcomes (POs), Programme Specific Outcomes (PSOs), Course Outcomes (COs), course prerequisites, credits etc.
- 7.2. All students have to register for the general foundation and core courses. They can choose the elective courses of their choice in consultation with their Mentors/Faculty Members.
- 7.3. The student can drop/re-register any elective course(s) or audit course within 15 working days after the commencement of the classes if the audit course is a compulsory one.
- 7.4. The students can choose MOOC courses from CUSAT, SWAYAM or other platforms as approved by the Department Council of the institution from time to time.
- 7.5. The course registration and provision for credit transfer for the credits acquired from the MOOC/SWAYAM platform shall be as per the general rules and regulations for MOOC courses issued by the university from time to time.
- 7.6. **A minimum of 75% attendance is compulsory for the continuous evaluation and the End semester examination. The university may condone the shortage of attendance on valid grounds as per the existing university rules.**

8. Criteria

8.1. Marks for continuous assessment (CA)

8.0.1. The final result in each course will be determined on the basis of continuous assessment and performance in the end semester examination which will be in the ratio of 30:70 in the case of theory courses.

8.0.2. The Faculty handling the course shall be responsible for evaluating all the components of Continuous Assessment (CA). The components and marks for the CA are as follows:

Internal Written Test	18 marks (Average of two tests)
Assignment, seminar, Mini project, etc.	9 marks
Attendance	3 marks
Total	30 marks

8.0.3. For all project works there shall be only Continuous Assessment (CA). The components and marks for the evaluation of Project are as follows

Seminar presentation:	10 marks
Written Report	20 marks
Viva-voce	70 marks
Total	100 marks

The students will have to submit three copies of the report of the work done of the project work at the end of the Semester; they will present the results in a Seminar and should defend the work in a Viva-Voce.

- 8.0.4. The internship has to be done by affiliating with a company in IT industry in India / abroad. The Continuous Assessment Components and marks for the evaluation are as follows.

Seminar presentation:	10 marks
Written Report	20 marks
Viva-voce	70 marks
Total	100 marks

The Written report and the attendance must be signed by the team leader of the project where the student has to undergo internship.

- 8.0.5. The evaluation For Laboratory Courses (Practicum Courses), Open Ended Laboratory Courses, Mini project work and Final semester project work there shall be Continuous Assessment (CA) and/or End Semester Evaluation, as per the procedures laid down by the syllabi and curriculum framework of the department offering the programme. The End Semester Evaluation should also be done Internally with at least two examiners.

Practical Experiment in the Lab Sessions	18 marks
Record	9 marks
Attendance	3 marks
Total	30 marks
End Semester examination	70 marks
Algorithm/Design (20%)	14 marks
Coding (50%)	35 marks
Viva Voce (20%)	14 marks
Result/ Output (10%)	7marks

- 8.0.6. However, for courses that have combinations of both lecture credits and practicum credits, the following evaluation methodology shall be applied. As per the FYUGP curriculum framework, there only 3 or 4 credits courses that have combinations of theory and practicum. The possible combinations of theory and practicum components in the 3 credit or 4 credit courses can be either two theory and one practicum ($2 + 1 = 3$ credits), one theory and two practicum ($1 + 2 = 3$ credits) or three theory and one practicum ($3 + 1 = 4$ credits), and two theory and two practicum ($2 + 2 = 4$ credits).

- 8.0.6.1.** For 3 credits course with a combination of two credits for the theory and one credit for the practicum ($2 + 1$): The continuous evaluation with 50 marks shall be split into 30 marks for the theory part, and 20 marks for the practicum. The end semester examination questions with 50 marks may preferably contain 15% from numerical/problem solving/practicum components to ensure a total of about 35% weightage is given to the practicum components out of 100 marks. **Therefore continuous evaluation with 30 marks shall split into 18 marks for theory and 12**

marks for practicum. The end semester examination questions with 70 marks may preferably contain 15% from numerical/problem solving/practicum components (10 marks) rest 60 marks can be split as per the percentage given in 8.0.5

8.0.6.2. For 3 credits course with a combination of one credit for the theory and two credits for the practicum (1 + 2): The continuous evaluation with 50 marks shall be split into 20 marks for the theory part and 30 marks for the practicum. The end semester examination questions with 50 marks may preferably contain 35% from the numerical/problem solving/practicum components to ensure a total of about 65% weightage is given to the practicum components out of 100 marks. **Therefore continuous evaluation with 30 marks shall split into 12 marks for theory and 18 marks for practicum. The end semester examination questions with 70 marks may preferably contain 35% from numerical/problem solving/practicum components (25 marks), rest 45 marks can be split as per the percentage given in 8.0.5**

8.0.6.3. For 4 credits course with a combination of three credits for the theory and one credit for the practicum (3 + 1): The continuous evaluation with 50 marks shall be split into 25 marks for the theory part, and 25 marks for the practicum. In this case, the end semester examination questions with 50 marks are completely for the theory part. **Therefore continuous evaluation with 30 marks shall split into 15 marks for theory and 15 marks for practicum. The end semester examination questions with 70 marks are completely for theory.**

8.0.6.4. For 4 credits course with a combination of two credits for the theory and two credits for the practicum (2 + 2): The continuous evaluation with 50 marks shall be split into 20 marks for the theory part, and 30 marks for the practicum. The end semester examination questions with 50 marks may preferably contain 20% from numerical/problem solving/practicum components to ensure a total of about 50% weightage is given to the practicum components out of 100 marks. . **Therefore continuous evaluation with 30 marks shall split into 12 marks for theory and 18 marks for practicum. The end semester examination questions with 70 marks may preferably contain 20% from numerical/problem solving/practicum components (15 marks), rest 55 marks can be split as per the percentage given in 8.0.5**

8.1. Continuous Assessment

The programs will have a scheme of rigorous and continuous internal assessment.

- 8.1.1. Written exams shall be precisely designed using a variety of tools and processes (e.g., constructed responses, open-ended items, multiple-choice with more than one correct answer), and the students should be informed about the evaluation modalities well in advance.
- 8.1.2. The time schedule for the CA and the nature of tests/assignments/quizzes that are relevant to the course may be followed. The specific nature of the assignments/tests will be described by the faculty member concerned in the class and can vary from course to course subject to the components prescribed above.
- 8.1.3. The faculty Member concerned must ensure that all modules in the course syllabus is covered in the continuous assessment process. The Department Council shall over see this process for compliance
- 8.1.4. The marks obtained in the Continuous Assessment (CA) shall be displayed on the notice

board of the Department; and grievances, if any, may be addressed to the respective Head of the Department/Head of the Institution. Further grievances will be resolved by the Department Council or as per the rules of the university. The Department Council which offers the programme/course concerned shall will approve the marks of the Continuous Assessment of each course after addressing such grievances.

8.2. End Semester Examination (ES)

- 8.2.1. A final examination at the end of the each semester for each course will follow the Continuous Assessments during the semester. The University End Semester Examination (External Examination) shall cover the entire syllabus of the course.
- 8.2.2. The question paper pattern should be the same as the pattern specified by CUSAT for FYUGP.**
- 8.2.3. The question paper for the university end semester examination for each course is to be set by an external examiner (Question Paper Setter) for each course by CUSAT, which must be scrutinized by a committee or experts(one expert for each question paper), appointed by the Controller of Examinations, CUSAT.
- 8.2.4. The scrutiny committee or expert concerned to ensure that questions are within the scope of the syllabus and also the entire syllabus of the course is fairly covered in the question paper. Modifications suggested by this committee/expert concerned should be reflected in the final question paper.
- 8.2.5. The Evaluation for the end semester examination should be done by external examiner appointed by the Controller of Examinations, CUSAT or as per the university examinations guidelines from time to time. Immediately after the examination is over, the evaluations to be completed and the results shall be finalized within 30 working days after the last examination is over for further process, if any.
- 8.2.6. The final result in each course is calculated on the basis of continuous assessment and performance in the end-semester examination
- 8.2.7. For the End Semester Examination, the students have to score a minimum of 40% marks to get a pass. Also, the students should get a total of 40% marks for each course (Sum of CA and ESE) to get a pass in the course. There is no minimum marks to get a pass in the internal/CA. Those who could not obtain 40% marks in the End semester examination for each course and 40% marks in total for a course will be declared as failed in that course.
- 8.2.8. Those who fail in the end semester examination can appear for the supplementary examination in the **next available chance along with the regular students**.
- 8.2.9. **Supplementary Examination:** The students, who after completion of the prescribed duration of the course, are left with backlogs, are eligible to appear for supplementary exams within eight years.
- 8.2.10. **Save A Year :** A Special " Save an Year" supplementary examinations will be conducted for students who fail in their final two semesters (**7th and 8th semesters for all FYUGP programmes**). Special supplementary examination for a final semester will be conducted after the publication of that semester results and the exam will be conducted for all courses of that semester. The student will be awarded the actual grade he/she obtains in the special supplementary examination and those who fail in the end-semester examination/ special supplementary examination of any course may repeat the semester end examination of that course in the next available chance(s).
- 8.2.11. The results of the semester examinations will be finalized by a passing board headed by a Chairman and two to three members nominated by the Controller of Examinations; and be published by the Controller of the Examinations within 30 days of the last examination. The Board will send the minutes of the passing board to the Controller of Examinations to issue the grade card of that examination.

8.2.12. The students are **permitted to improve** their marks in the end-semester examination on certain conditions.

- a. The student can write the improvement exam only for courses where he/she secured a **P** grade or above in the regular chance.
- b. The number of courses where a student can register for improvement exam is restricted to a maximum of 2 courses per semester.
- c. The improvement exam is not permitted for courses offered in the final two semesters of the programme
- d. The improvement exam should be written in the next available chance with the immediate following batch.
- e. There will be no improvement examinations for internal examinations / practical / dissertation /seminar / project / internship examinations.

The higher of the marks (original marks or improvement marks) will be treated as the final end semester marks for grade calculations.

8.3. Backlogs

No student of the FYUGP shall be allowed to move to the 5th or 7th semester, if he/she does not satisfy the following conditions:

Promotion to	Minimum number of credits to be earned
V Semester	Half of the total credits registered for Semesters I, II, & III put together
VII Semester	Pass in all the registered courses up to Semesters VI

8.4. Readmission

- 8.4.1. The students who are not eligible for promotion to the next higher semester as per rules will be given opportunities to clear the backlogs in the previous semesters by appearing for supplementary examinations.
- 8.4.2. Once the student gets eligibility for promotion to the higher semester, he/she will be given re-admission along with the junior regular batch and can further continue his/her studies as a regular student from the semester where he/she is re-admitted.
- 8.4.3. This will be subject to the maximum period available for the completion of the course permitted by these regulations.
- 8.4.4. Re-admission under the above provision shall be permitted only once.

8.5. Exit Option / Completion of the Courses

The option of an exit with a 3-year Bachelor's degree shall be available for desiring students. The distinguishing features of the exit option are:

8.5.1. Exit with 3-year UG Degree

The Exit Option with 3-year UG Degree will be available at the end of three years of the FYUGP programme. Students who seek to exit after 3 years (six semesters) should have passed all the courses of the preceding six semesters. For exercising the Exit Option, the students should have secured a minimum of 133 Credits in toto for semesters 1-6. The students who exercise the Exit Option have to surrender the Mark lists of the previous semesters and pay a cancellation fee as per the rules of the University. They will be issued new mark lists in conformity with the 3-year UG Degree that will be conferred to them. Those students who avail the exit options after the completion of 7th semester shall retain the credits earned in that semester in their ABC account. A cumulative grade card up to 6 semesters will be issued for the 3 year UG degree.

8.5.2. Completion of 4-year UG Honors Degree

4-year UG Honors Degree will be available at the end of Four years for the FYUGP students. Should have passed all the courses of the preceding eight semesters. The students should have secured a minimum of 177 Credits in toto for semesters 1-8. They will be issued grade card in conformity with the 4- year UG Honors Degree that will be conferred to them.

8.6. Grade Card

The University under its seal shall issue a Grade Card to the students on completion of each semester. The Grade card shall contain the following:

- a) Title of the course taken as core, elective and audit
- b) The credits associated with and the grades awarded for each course.
- c) The number of credits (core and elective separately) earned by the student and the Grade point Average.
- d) The total credits (core and elective) earned till that semester.
- e) The following 10-point grading system shall be adopted for all the programmes. The grades will be awarded for each course based on the aggregate marks (continuous assessment marks + semester end exam marks) obtained subject to the requirement of minimum 40% for the semester end examination.

% Marks (Range)	Grade point (G)	Letter Grade	Description
95 - 100	10	O	(Outstanding)
85 - 94.99	9	A+	(Excellent)
75 - 84.99	8	A	(Very Good)
65 - 74.99	7	B+	(Good)
55 - 64.99	6	B	(Above Average)
45 - 54.99	5	C	(Average)
40-44.99	4	P	(Pass)*
Below 40	0	F	Fail
Absent	0	Ab	Absent

The following is the procedure to compute the Grade Point Average (GPA)

$GPA = \frac{\sum(C_i \times G_i)}{\sum C_i}$ where C_i is the number of credits of the i th course and G_i is the grade point scored by the student in the i th course.

The CGPA is also calculated in the same manner taking into account all the courses done by a student over all the semester of a programme

Accordingly, the pass requirements shall be modified as:-

- i. For each course, 40% of the aggregate marks (continuous assessment marks *plus* end semester marks) with a separate minimum requirement of 40% for the end semester examination.
- ii. Minimum aggregate CGPA required for successful completion of the programme will be

4.0

iii. **The CGPA to percentage conversions shall be done using the formula %marks = CGPA * 10**

iv. Classification for the Degree/Diploma will be given as follows based on the CGPA:

First Class with Distinction (FCD)	CGPA 7.5 and above
First Class	CGPA 6 to 7.499
Second Class	CGPA 5 to 5.999
Third Class	CGPA 4 to 4.999

The Grade Card issued at the end of the final semester shall contain the details of all the courses taken which shall include the titles of the courses, the credits associated with each course, the CGPA and the class. The rank shall be awarded based on CGPA corrected to the 2nd Decimal.

9. Degrees Awarded to FYUGP

After successful completion of FYUGP, the degrees in respective subject(s) will be awarded to the students.

- I. The format of the 3-year UG Degree shall be ‘BACHELOR OF COMPUTER APPLICATIONS IN DATA SCIENCE AND ARTIFICIAL INTELLIGENCE.**
- II. The format of the FYUG (Honors) Degree shall be ‘BACHELOR OF COMPUTER APPLICATIONS (HONORS) IN DATA SCIENCE AND ARTIFICIAL INTELLIGENCE**

10. Mentoring , Tutorial and Remedial classes

A system of mentoring by a teacher for a group of 5-10 students shall be coordinated by departments. Mentors shall conduct orientation sessions to plan studies, utilize library and other common university and departmental resources. Mentors shall monitor academic progress of their mentee and identify weak learners in advance and arrange for remedial sessions in association the department. Special talents of the mentee may be identified and be given guidance to nurture them. Mentors in association with Department shall coordinate internships/summer research programs/vacation activity during vacation months.

11. The above regulations will be overridden by any regulations by university (CUSAT) from time to time.



COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

Asian School of Business
Experience the Change



**Bachelor of Computer Applications(Honors)
in Data science and AI**

SYLLABUS

**w.e.f. 2025 admission onwards
(FYUGP Regulations 2025)**

Bachelor of Computer Applications (Honors)in Data Science and Artificial Intelligence

Program Preamble

The **Bachelor of Computer Applications (BCA) (Honors)in Data Science and Artificial Intelligence** is a specialized undergraduate program designed to prepare students with comprehensive knowledge and applied skills in computing, data analytics, machine learning, and artificial intelligence. This program integrates core computer science principles with the latest advances in data science and AI, equipping students to thrive in a data-driven world. Emphasizing both theoretical understanding and hands-on experience, this curriculum addresses the growing demand for data science and AI professionals who can design, develop, and deploy intelligent systems across diverse industries.

Program Objective

The primary objective of the Bachelor of Computer Applications(Honors) in Data Science and Artificial Intelligence program is to:

- Develop skilled professionals proficient in data science and artificial intelligence, capable of innovating and contributing solutions to real-world challenges.
- Provide a solid foundation in computer science, mathematics, data processing, and analytical skills.
- Foster problem-solving abilities, critical thinking, and creativity essential for AI and data science applications.
- Prepare students for careers in data science, machine learning, AI, software development, business analytics, and other IT domains.
- Encourage lifelong learning, teamwork, and effective communication, enabling graduates to excel in both individual and collaborative projects.

Program Educational Objectives (PEOs)

The Bachelor of Computer Applications (Honors)in Data Science and AI program aims to equip graduates with the following abilities:

PEO1	Domain Expertise Cultivate proficiency in core computing, data science, and artificial intelligence, enabling graduates to solve complex problems with technological solutions and emerging data-driven techniques.
-------------	---

PEO2	Practical Application and Innovation Encourage practical application of theoretical knowledge through projects, internships, and industry engagements, promoting innovation in fields like machine learning, deep learning, data analytics, and IoT.
PEO3	Professional and Ethical Standards Instill professional ethics, a commitment to continuous learning, and a responsibility toward societal issues, ensuring that graduates make ethical, informed contributions to technology and business communities.
PEO4	Adaptability and Lifelong Learning Develop adaptability in a rapidly evolving technological landscape, preparing graduates for advanced education and research in data science, artificial intelligence, and other computing disciplines.

Programme Outcomes (POs)

Upon successful completion of the Bachelor of Computer Applications in Data Science and Artificial Intelligence, graduates will be able to:

PO1	Knowledge Acquisition Demonstrate a deep understanding of the fundamental concepts, techniques, and tools in Data Science, Artificial Intelligence, and programming. Graduates will be able to apply this knowledge effectively to solve real-world problems.
PO2	Communication, Collaboration, Inclusiveness, and Leadership Work effectively within multidisciplinary teams, communicating complex technical information clearly to both technical and non-technical audiences. Graduate students will demonstrate leadership skills and encourage inclusivity in team environments.
PO3	Professional Skills Exhibit professional skills in problem-solving, decision-making, and critical thinking, adapting to the rapidly changing field of Data Science and Artificial Intelligence. Graduates will demonstrate a high level of adaptability and readiness for career success in diverse work environments.
PO4	Digital Intelligence Demonstrate proficiency in a range of digital tools, platforms, and technologies, including machine learning, data mining, and artificial intelligence, to analyze complex datasets and make informed decisions based on data.
PO5	Scientific Awareness and Critical Thinking Utilize scientific methodologies and critical thinking to analyze and solve complex problems. Graduates will be able to develop innovative solutions in AI and Data Science, integrating both theoretical and applied approaches.

PO6	<p>Human Values, Professional Ethics, and Societal and Environmental Responsibility</p> <p>Demonstrate a commitment to ethical principles, human values, and social responsibility while developing AI and data-driven solutions. Graduates will contribute to positive societal impact and sustainable development through their work in the field of Data Science and AI.</p>
PO7	<p>Research, Innovation, and Entrepreneurship</p> <p>Engage in research and innovation to develop novel solutions in Data Science and AI. Graduates will be equipped to undertake entrepreneurial ventures, collaborate with industry leaders, and drive technological advancements to address global challenges.</p>

Program Specific Outcomes (PSOs)

Upon completing the Bachelor of Computer Applications(Honors) in Data Science and Artificial Intelligence, graduates will be able to:

PSO1	<p>Data Science Expertise</p> <p>Analyze, visualize, and interpret complex data sets to provide actionable insights using statistical methods, machine learning, and data mining techniques.</p>
PSO2	<p>AI System Development</p> <p>Design, develop, and deploy artificial intelligence applications and intelligent systems that solve real-world problems in fields such as healthcare, finance, and e-commerce.</p>
PSO3	<p>Advanced Programming and Problem-Solving</p> <p>Apply advanced programming skills in Python, Java, and data-centric languages to build efficient and optimized solutions tailored to industry needs.</p>
PSO4	<p>Interdisciplinary Collaboration and Communication</p> <p>Work effectively as part of multidisciplinary teams, demonstrating strong communication skills and the ability to present complex data science and AI concepts to varied audiences</p>

Course Outcomes (COs)

Upon successful completion of the Bachelor of Computer Applications (Honors)in Data Science and Artificial Intelligence program, students will be able to:

CO1	Remembering: Retrieve, recognize, and recall foundational concepts, principles, and theories relevant to computing, data science, and artificial intelligence, laying a strong knowledge base for advanced studies and professional applications
CO2	Understanding: Demonstrate an understanding of key tools, techniques, and models within computing, data science, and AI by interpreting data, classifying problems, summarizing insights, and explaining core principles applicable to real-world scenarios.
CO3	Applying: Select and apply appropriate programming languages, algorithms, and software tools to solve practical and complex problems in data science and AI, demonstrating proficiency in implementing theoretical knowledge into actionable solutions.
CO4	Analyzing: Analyze and break down complex problems in data science and artificial intelligence into component parts, evaluating relationships and dependencies to develop data-driven solutions and optimize decision-making processes.
CO5	Creating: Design and develop innovative solutions, models, or systems in response to industry-relevant challenges, employing critical thinking and creativity to synthesize knowledge from computing, data science, and AI disciplines.

Mapping of Programme Outcomes and Course Outcomes

Programme Outcomes (POs)	Course Outcomes (COs)				
	CO1	CO2	CO3	CO4	CO5
PO1	3	3	3	3	3
PO2	2	3	3	3	2
PO3	2	2	3	3	3
PO4	3	3	3	3	3
PO5	2	2	2	3	2
PO6	1	3	1	1	1
PO7	1	1	3	3	3

Bachelor of Computer Applications (Honors) in Data science and AI

Induction program (Mandatory)

Induction program for students to be offered right at the start of the first year.

Three-week duration

- Physical activity
- Creative Art
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Department/Branch
- Innovations

Mandatory Visits/ Workshop/Expert Lectures:

1. It is mandatory to arrange one industrial visit every semester for the students of each branch.
2. It is mandatory to conduct a One- week workshop during the winter break after fifth 922-2semester on professional/ industry/ entrepreneurial orientation.
3. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry.

BACHELOR OF COMPUTER APPLICATIONS (Honors) in Data science and AI

Course Framework

Semester	Course Code	Course Title	Course Name	Core / Elective	L (Hours)	T (Hours)	P (Hours)	Credits	CA	ESE	Total
1	25-922-0101	MDC	Mathematics for Computing	C	2	1	0	3	30	70	100
1	25-922-0102	DSC	Python Programming	C	2	2	0	4	30	70	100
1	25-922-0103	DSC	Lab - Python Programming	C	0	0	8	4	100	0	100
1	25-922-0104	DSC	Fundamentals of Computer Architecture	C	2	2	0	4	30	70	100
1	25-922-0105	DSC	Design for Developers (UI and UX)	C	3	1	0	4	30	70	100
1	25-922-0106	AEC	Interpersonal and Essential Skills – I	C	2	1	0	3	30	70	100
1	25-922-0107	SEC	Analytical Reasoning and Problem-solving – I	C	2	1	0	3	30	70	100

1	25-922-0108	VAC	Fundamentals of Programming Certification	C(Audit)	0	0	2	0	100	0	100
			Total					25			
Semester	Course Code	Course Title	Course Name	Core / Elective	L (Hours)	T (Hours)	P (Hours)	Credits	CA	ESE	Total
2	25-922-0201	DSC	Introduction to Data Science	C	2	2	0	4	30	70	100
2	25-922-0202	DSC	Object Oriented Programming in Java	C	2	2	0	4	30	70	100
2	25-922-0203	DSC	Lab - Object Oriented Programming in Java	C	0	0	8	4	100	0	100
2	25-922-0204	DSC	Computer Networks	C	2	2	0	4	30	70	100
2	25-922-0205	MDC	Statistics for Data Science	C	2	1	0	3	30	70	100
2	25-922-0206	AEC	Interpersonal and Essential Skills-II	C	2	1	0	3	30	70	100

2	25-922-0207	VAC	Environmental Studies	C	3	0	0	3	30	70	100
			Total					25			
Semester	Course Code	Course Title	Course Name	Core / Elective	L (Hours)	T (Hours)	P (Hours)	Credits	CA	ESE	Total
3	25-922-0301	DSC	Data Structures and Algorithms	C	2	2	0	4	30	70	100
3	25-922-0302	DSC	Data Visualization	C	3	1	0	4	30	70	100
3	25-922-0303	DSC	Security and Cryptography	C	2	2	0	4	30	70	100
3	25-922-0304	DSC	Database Management Systems	C	0	0	8	4	100	0	100
3	25-922-0305	MDC	Introduction to Forecasting models	C	2	1	0	3	30	70	100
3	25-922-0306	SEC	Analytical Reasoning and Problem solving – II	C	2	1	0	3	30	70	100

3	25-922-0307	VAC	Data Structures & Algorithm Certification	C	0	0	6	3	100	0	100
			Total					25			
Semester	Course Code	Course Title	Course Name	Core / Elective	L (Hours)	T (Hours)	P (Hours)	Credits	CA	ESE	Total
4	25-922-0401	DSC	Data Warehousing and Mining	C	2	1	0	3	30	70	100
4	25-922-0402	DSC	Business Analytics	C	2	1	0	3	30	70	100
4	25-922-0403	DSC	Machine Learning Fundamentals	C	2	1	0	3	30	70	100
4	25-922-0404	DSC	Operating Systems	C	2	1	0	3	30	70	100
4	25-922-0405	DSC	Cloud Computing	C	2	2	0	4	30	70	100
4	25-922-0406	DSC	Full Stack Development – Lab	C	0	0	8	4	100	0	100

4	25-922-0407	AEC	Virtual Internship	C	0	0	6	3	100	0	100
4	25-922-0408	VAC	The Indian Knowledge System	C	2	1	0	3	30	70	100
			Total					26			
Semester	Course Code	Course Title	Course Name	Core / Elective	L (Hours)	T (Hours)	P (Hours)	Credits	CA	ESE	Total
5	25-922-0501	DSC	Capstone Project	C	0	0	8	4	100	0	100
5	25-922-0502	DSC	Deep Learning	C	3	1	0	4	30	70	100
5	25-922-0503	DSC	Big Data Analytics	C	2	1	0	3	30	70	100
5	25-922-0504	DSC	Natural Language Processing	C	0	0	8	4	100	0	100
5	25-922-0505	DSC	Introduction to Internet of Things (IoT)	C	2	1	0	3	30	70	100

5	25-922-0506	AEC	Recruitment Essentials	C	2	1	0	3	30	70	100
5	25-922-0507	SEC	Career Competency Enhancement	C	0	0	6	3	100	0	100
			Total					24			
Semester	Course Code	Course Title	Course Name	Core / Elective	L (Hours)	T (Hours)	P (Hours)	Credits	CA	ESE	Total
6	25-922-0601	DSC	Industry Internship Program	C	0	0	4	2	100	0	100
6	25-922-0602	DSC	Entrepreneurship in AI and Data Science	C	2	1	0	3	30	70	100
6	25-922-0603	DSC	Robotic Process Automation	C	2	1	0	3	30	70	100
			Total					8			
								Total Credits Upto 6th Semester		133	
Semester	Course Code	Course Title	Course Name	Core / Elective	L (Hours)	T (Hours)	P (Hours)	Credits	CA	ESE	Total

7	25-922-0701	DSC	Capstone Project/Research	C	0	0	12	6	100	0	100
7	25-922-0702/ 25-922-0703/ 25-922-0704	DSE	Generative AI / Optimization Techniques / Data Ethics and Privacy	E	3	1	0	4	30	70	100
7	25-922-0705/ 25-922-0706/ 25-922-0707	DSE	Reinforcement Learning / Geospatial Data Science / AI Analytics in Internet Of Things	E	3	1	0	4	30	70	100
7	25-922-0708/ 25-922-0709/ 25-922-0710	DSE	Robotics and AI / Cloud Computing for Data Science / Computer Vision	E	3	1	0	4	30	70	100
7	25-922-0711	DSC	Industry Internship Program	C	0	0	8	4	100	0	100
			Total					22			
Semester	Course Code	Course Title	Course Name	Core / Elective	L (Hours)	T (Hours)	P (Hours)	Credits	CA	ESE	Total
8	25-922-0801	DSC	Capstone Project/Research	C	0	0	16	8	100	0	100

8	25-922-0802	DSC	Industry Internship Program	C	0	0	12	6	100	0	100
8	25-922-0803/ 25-922-0804/ 25-922-0805	DSE	AI Ethics and Social Implications / Principles of Management / Introduction to Cybersecurity	E	3	1	0	4	30	70	100
8	25-922-0806/ 25-922-0807/ 25-922-0808	DSE	Data Privacy, Security, and Compliance / Digital Marketing and E-Commerce / Introduction to Game Design	E	3	1	0	4	30	70	100
			Total					22			
							Total	177			

DSC	Credits
Python Programming	4
Lab - Python Programming	4
Fundamentals of Computer Architecture	4
Design for Developers (UI and UX)	4
Introduction to Data Science	4
Object Oriented Programming Java	4
Lab - Object Oriented Programming Java	4

Computer Networks	4
Data Structures and Algorithms	4
Data Visualization	4
Security and Cryptography	4
Database Management Systems	4
Data Warehousing and Mining	3
Business Analytics	3
Machine Learning Fundamentals	3
Operating Systems	3
Cloud Computing	4
Full Stack Development - Lab	4
Deep Learning	4
Big Data Analytics	3
Natural Language Processing	4
Introduction to Internet of Things (IoT)	3
Entrepreneurship in AI and Data Science	3
Robotic Process Automation	3
Total	88

	DSE	Credits
1	Generative AI	4
	Optimization Techniques	4
	Data Ethics and Privacy	4
2	Reinforcement Learning	4
	Geospatial Data Science	4
	AI Analytics in Internet Of Things	4
3	Robotics and AI	4
	Cloud Computing for Data Science	4
	Computer Vision	4
4	AI Ethics and Social Implications	4
	Principles of Management	4
	Introduction to Cybersecurity	4
5	Data Privacy, Security, and Compliance	4
	Digital Marketing and E-Commerce	4
	Introduction to Game Design	4
	Total	20

- Students shall complete a minimum of one course from the above DSE's as a MOOC course from

SWAYAM / NPTEL / any other platform approved by CUSAT from time to time.

MDC	Credits
Mathematics for Computing	3
Statistics for Data Science	3
Introduction to Forecasting models	3
Total	9

VAC	Credits
Fundamentals of Programming Certification	0
Environmental Studies	3
DSA Certification	3
The Indian Knowledge System	3
Total	9

AEC	Credits
Interpersonal and Essential Skills - I	3
Interpersonal and Essential Skills-II	3
Virtual Internship	3
Recruitment Essentials	3
Total	12

SEC	Credits
Analytical Reasoning and Problem-solving - I	3
Analytical Reasoning and Problem solving - II	3
Career Competency Enhancement	3
Total	9

Projects / Internship (DSC)	Credits
(Mini)Capstone Projects	4
Industry Internship Program	2
Industry Internship Program	4
Capstone Project/Research	6
Capstone Project/Research	8
Industry Internship Program	6
Total	30

Semester I

**SYLLABUS OF Bachelor of Computer Applications (Honors) in Data
Science and Artificial Intelligence**

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
1	25-922-0101	Mathematics for Computing	2	1	0	3	45

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall fundamental mathematical concepts applicable in computing, including set theory, logic, and basic calculus.
CO2	Understanding	Understand computational techniques and apply mathematical models in problem-solving.
CO3	Applying	Apply mathematical logic and operations in programming and computing scenarios.
CO4	Analyzing	Analyze mathematical algorithms and derive solutions for complex problems.
CO5	Evaluating	Evaluate computational solutions using mathematical approaches for accuracy and efficiency.
CO6	Creating	Create mathematical models and simulations applicable in computing fields.

Course Objectives

1. To provide foundational knowledge in mathematics essential for computing.
2. To develop skills in mathematical reasoning and problem-solving relevant to programming.
3. To familiarize students with various mathematical models used in computing and data science.

Course Modules

Module	Topic	45hrs
Module I	Mathematical Logic and Proof Techniques Propositions and logical operators. Truth tables. Tautologies and contradictions. Predicates and quantifiers. Rules of inference. Direct and indirect proofs, contradiction, contrapositive. Applications in computer algorithms	9hrs
Module II	Set Theory, Relations and Functions Sets, subsets, power sets, operations on sets. Venn diagrams and set identities. Relations: properties, types, matrix representation. Equivalence and partial ordering relations. Functions: injective, surjective, bijective. Composition of functions, inverse functions	9hrs
Module III	Algebraic Structures Binary operations and algebraic structures. Semigroups, monoids, groups: definitions and properties. Subgroups, cyclic groups, permutation groups. Applications to coding theory and finite automata. Homomorphism and isomorphism	9hrs
Module IV	Combinatorics and Graph Theory Counting principles: addition and multiplication rules. Permutations and combinations. Pigeonhole principle and inclusion-exclusion. Recurrence relations and generating functions. Graphs: terminology, types of graphs. Graph representations, Euler and Hamiltonian paths. Trees and spanning trees	9hrs

Module V	<p>Matrix Algebra and Linear Transformations Matrices: types, operations, determinants. Inverse, rank, echelon form. Solving linear equations using Gaussian elimination. Vector spaces, basis and dimension. Linear transformations and their matrices. Eigenvalues and eigenvectors. Applications in computer graphics and data science</p>	9hrs
-----------------	---	-------------

Books for Study:

1. A First Course in Probability, Sheldon Ross, 9th Edition, 2014.
2. Probability & Statistics for Engineers & Scientists, Ronald E. Walpole, Raymond H. Myers, 9th Edition, 2016.
3. Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, 2011.

Books for Reference:

1. Discrete Mathematics and Its Applications, Kenneth H. Rosen, 7th Edition, 2012.
2. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, 2016.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
1	25-922-0102	Python Programming	2	2	0	4	60

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall the syntax, basic functions, and data structures in Python programming.

CO2	Understanding	Understand Python's data types, control flow, and built-in functions.
CO3	Applying	Apply Python to solve basic programming problems, including algorithm design.
CO4	Analyzing	Analyze and debug Python programs for errors and performance improvements.
CO5	Evaluating	Evaluate and optimize Python code for readability, efficiency, and scalability.
CO6	Creating	Create Python applications for real-world problems and deploy them effectively.

Course Objectives

1. To introduce students to Python programming, focusing on its syntax, functions, and libraries.
2. To develop skills in solving computational problems using Python.
3. To provide an understanding of object-oriented programming concepts in Python.
4. To explore Python's role in real-world applications such as web development, data science, and automation.

Course Modules

Module	Topics Covered	60 Hrs
Module I	Introduction to Python History of Python. Installing Python and IDEs. Writing and running Python scripts. Python syntax, keywords, variables. Data types and type conversions. Input/output operations.	12hrs
Module II	Data Types, Control Flow & Iteration Built-in data types: int, float, bool, str. Type conversion and casting. Input/output functions. Conditional	12hrs

	Statements: if, if-else, if-elif-else. Loops: for, while, nested loops. Loop control: break, continue, pass, else with loop	
Module III	Functions and Modular Programming Defining and calling functions. Function arguments: positional, keyword, default, variable-length return statement. Recursion and lambda expressions. Scope and lifetime of variables. Built-in functions vs. user-defined functions. Importing and creating modules. Python standard libraries (math, random, time)	12hrs
Module IV	Python Data Structures Lists: creation, indexing, slicing, methods. Tuples: immutability, unpacking. Sets: uniqueness, set operations. Dictionaries: key-value pairs, nested dictionaries. Iterating over data structures. List comprehensions and dictionary comprehensions	12hrs
Module V	File Handling and Exception Management Working with files: open, read/write/append modes. Reading from and writing to text files. File object methods: read, readline(), readlines, write. CSV file operations using csv module. Exception handling: try, except, else, finally. Built-in exceptions and raising exceptions manually	12hrs

Books for Study:

1. *Learning Python*, Mark Lutz, 5th Edition, 2013.
2. *Python Programming for the Absolute Beginner*, Michael Dawson, 3rd Edition, 2010.
3. *Automate the Boring Stuff with Python*, Al Sweigart, 1st Edition, 2015.

Books for Reference:

1. *Learn Python the Hard Way*, Zed Shaw, 3rd Edition, 2014.
2. *Python Crash Course: A Hands-On, Project-Based Introduction to Programming*, Eric Matthes, 1st Edition, 2016.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
1	25-922-0103	Lab - Python Programming	0	0	8	4	60

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Applying	Implement basic Python programs and solve computational problems in a lab setting.
CO2	Understanding	Understand how Python can be used to manipulate data, handle exceptions, and perform tasks programmatically.
CO3	Creating	Develop Python-based applications and scripts that solve real-world problems.
CO4	Analyzing	Debug Python programs, identify issues, and improve code quality.
CO5	Evaluating	Evaluate and optimize Python code for performance and functionality.

Course Objectives

1. To provide practical experience with Python programming concepts and techniques.
2. To enable students to work on projects that reinforce programming concepts learned in the theory course.
3. To develop debugging and testing skills while working with Python.
4. To provide hands-on experience in solving real-world problems using Python.

Course Modules

Module	Topics Covered	60 Hrs
Module I	<ol style="list-style-type: none"> 1. Write a Python program to swap two variables. 2. Write a Python program to check if a number is even or odd. 3. Write a Python program to find the largest among three numbers. 	12hrs
Module II	<ol style="list-style-type: none"> 4. Write a Python program to find factorial of a number using recursion. 5. Write a Python program to generate Fibonacci series up to n terms. 6. Write a Python program to check whether a string is palindrome or not. 	12hrs
Module III	<ol style="list-style-type: none"> 7. Write a Python program to count the number of vowels in a given string. 8. Write a Python program to check if a given number is a prime number. 9. Write a Python program to display the multiplication table of a given number. 	12hrs
Module IV	<ol style="list-style-type: none"> 10. Write a Python program to find the sum and average of elements in a list. 11. Write a Python program to perform linear search in a list. 12. Write a Python program to sort a list using bubble sort. 	12hrs
Module V	<ol style="list-style-type: none"> 13. Write a Python program to demonstrate the use of dictionaries. 14. Write a Python program to remove duplicate elements from a list. 	12hrs

	15. Write a Python program to count the occurrence of each word in a string.	
--	--	--

Books for Study:

1. *Learn Python the Hard Way*, Zed Shaw, 3rd Edition, 2014.
2. *Python Crash Course: A Hands-On, Project-Based Introduction to Programming*, Eric Matthes, 1st Edition, 2016.
3. *Learning Python*, Mark Lutz, 5th Edition, 2013.

Books for Reference:

1. *Python Programming for the Absolute Beginner*, Michael Dawson, 3rd Edition, 2010.
2. *Automate the Boring Stuff with Python*, Al Sweigart, 1st Edition, 2015.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
1	25-922-0104	Fundamentals of Computer Architecture	2	2	0	4	60

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understand the basic principles of computer organization and architecture.
CO2	Applying	Apply concepts of instruction set architecture (ISA), memory, and CPU design.

CO3	Analyzing	Analyze and differentiate various computer architectures and systems.
CO4	Evaluating	Evaluate computer systems in terms of performance, efficiency, and scalability.
CO5	Creating	Design and simulate simple computer systems or components for practical applications.

Course Objectives

1. To introduce students to the basic principles of computer architecture and organization.
2. To familiarize students with key concepts such as CPU, memory, I/O systems, and instruction sets.
3. To develop an understanding of how hardware components communicate and work together.
4. To analyze computer system performance and understand the impact of hardware on software execution.

Course Modules

Module	Topics Covered	60hrs
Module I	<p>Introduction to Computer Science and Architecture</p> <p>Basic concepts in computer science: hardware, software, and data representation. Overview of computer architecture: definition, history, and evolution. The Von Neumann architecture and its components: CPU, memory, I/O systems. Introduction to the different types of computers</p>	12hrs
Module II	<p>Number Systems and Data Representation</p> <p>Binary, octal, hexadecimal, and decimal number systems. Conversions between number systems. Representation of data in computers: integers, floating-point numbers, characters, and strings. Representation of negative numbers: Two's complement, signed</p>	12hrs

	magnitude.	
Module III	<p>Central Processing Unit (CPU) Architecture</p> <p>The architecture of the CPU: ALU, control unit, registers, and buses. The instruction cycle: fetch, decode, execute. Machine-level programming and assembly language. The role of the instruction set architecture (ISA) in CPU design. Caching and pipelining techniques in CPU performance.</p>	12hrs
Module IV	<p>Memory Hierarchy and Storage</p> <p>Types of memory: RAM, ROM, cache memory, and secondary storage (HDD, SSD). The concept of memory hierarchy: registers, cache, main memory, and virtual memory. Addressing modes: direct, indirect, indexed, and relative addressing. Memory management and virtual memory concepts. The role of the memory management unit (MMU).</p>	12hrs
Module V	<p>Input/Output Systems and Computer Performance</p> <p>Overview of input and output devices: keyboards, mice, monitors, printers, and external storage. Input/output control mechanisms: interrupts, DMA, and polling. The role of buses and I/O ports in communication. Performance metrics: clock cycles, execution time, throughput, and latency. RISC vs. CISC architectures and their impact on performance.</p>	12hrs

Books for Study:

1. *Computer Organization and Architecture: Designing for Performance*, William Stallings, 10th Edition, 2016.

2. *Computer Organization and Design: The Hardware/Software Interface*, David A. Patterson and John L. Hennessy, 5th Edition, 2013.
3. *Computer Organization*, Carl Hamacher, Zvonko Vranesic, and Safwat Zaky, 5th Edition, 2011.

Books for Reference:

1. *Computer Architecture and Organization*, John P. Hayes, 3rd Edition, 2012.
2. *Computer System Architecture*, M. Morris Mano, 3rd Edition, 2017.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
1	25-922-0105	Design for Developers (UI and UX)	3	1	0	4	60

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Explain the fundamentals of UI/UX design, including user-centered design principles.
CO2	Understanding	Apply design thinking methodologies to create user-friendly digital products.
CO3	Applying	Analyze different visual design elements like typography, color theory, and layout.
CO4	Analyzing	Evaluate usability testing techniques and accessibility guidelines (WCAG).

CO5	Evaluating	Design interactive wireframes, prototypes, and UI components using modern tools like Figma or Adobe XD.
CO6	Creating	Design and implement basic shell scripts to automate system tasks and enhance operating system efficiency.

Course Objectives

1. To introduce fundamental concepts, structures, and functions of operating systems.
2. To provide insights into process, memory, file, and security management in operating systems.
3. To develop practical skills in system programming and shell scripting.

Course Modules

Module	Topic	60hrs
Module I	Introduction to UI and UX What is UI and UX? Understanding their roles and differences. The importance of design in the software development lifecycle. Design thinking process: empathize, define, ideate, prototype, and test. Basics of user-centered design.	12hrs
Module II	Design Principles Layout and grid systems: creating balanced and responsive designs. Typography, color theory, and visual hierarchy. Components of a good UI: buttons, icons, menus, and forms. Best practices for designing mobile-first and responsive interfaces.	12hrs
Module III	Design Fundamentals User research methods: interviews, surveys, and personas. Designing user journeys and user flows. Wireframing tools and techniques. Accessibility standards and inclusive design.	12hrs
Module IV	Prototyping and Design Tools Introduction to popular design tools: Figma, Adobe XD, Sketch. Creating high-fidelity prototypes and mockups. Interactive prototyping and linking screens. Design handoff for developers: using design systems and assets.	12hrs

Module V	Usability Testing and Iteration Conducting usability testing: techniques and tools. Analyzing user feedback to improve designs. A/B testing and metrics for design success. Case studies: good and bad UI/UX designs in real-world applications.	12hrs
-----------------	--	--------------

Books for Study:

1. *Designing the User Interface: Strategies for Effective Human-Computer Interaction*, Ben Shneiderman, 5th Edition, 2010.
2. *About Face: The Essentials of Interaction Design*, Alan Cooper, Robert Reimann, David Cronin, 4th Edition, 2014.
3. *The Elements of User Experience: User-Centered Design for the Web and Beyond*, Jesse James Garrett, 2nd Edition, 2010.

Books for Reference:

1. *UI/UX Design: A Beginner's Guide*, Rajesh R., 1st Edition, 2020.
2. *The Best Interface is No Interface: The Simple Path to Brilliant Technology*, Golden Krishna, 1st Edition, 2015.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
1	25-922-0106	Interpersonal and Essential Skills - I	2	1	0	3	45

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description

CO1	Remembering	Identify key principles of interpersonal communication and essential skills in the workplace.
CO2	Understanding	Explain various communication techniques and problem-solving approaches used in professional settings.
CO3	Applying	Demonstrate active listening, feedback techniques, and assertive communication skills in real-world scenarios.
CO4	Analyzing	Analyze different communication styles and their impacts on team dynamics.
CO5	Evaluating	Assess personal strengths and areas for improvement in interpersonal and essential skills.

Course Objectives

1. To introduce foundational interpersonal skills essential for effective communication in professional settings.
2. To develop skills in problem-solving, teamwork, and presentation skills.
3. To promote self-assessment and improvement of personal communication and interpersonal abilities.

Course Modules

Module	Topic	45hrs
Module I	Introduction to Interpersonal Skills - Importance of interpersonal skills in professional environments - Basics of communication: verbal, non-verbal, and listening skills - Building rapport and effective interpersonal interactions	9hrs
Module II	Effective Communication Techniques - Active listening and feedback	9hrs

	<ul style="list-style-type: none"> - Assertive vs. passive communication - Managing workplace conflicts and negotiation skills 	
Module III	Teamwork and Collaboration <ul style="list-style-type: none"> - Fundamentals of teamwork and collaborative work - Understanding team roles and responsibilities - Techniques for effective collaboration and conflict resolution in teams 	9hrs
Module IV	Problem-Solving and Critical Thinking <ul style="list-style-type: none"> - Introduction to problem-solving strategies and techniques - Critical thinking: analysis, synthesis, and evaluation - Applying critical thinking in decision-making and problem-solving 	9hrs
Module V	Presentation and Public Speaking Skills <ul style="list-style-type: none"> - Preparing and structuring presentations - Public speaking techniques and managing stage presence - Using visual aids effectively in presentations - Overcoming presentation anxiety and enhancing audience engagement 	9hrs

Books for Study:

1. *How to Win Friends and Influence People*, Dale Carnegie, Revised Edition, 2009.
2. *The 7 Habits of Highly Effective People*, Stephen R. Covey, 30th Anniversary Edition, 2020.
3. *The Fine Art of Small Talk*, Debra Fine, 1st Edition, 2005.

Books for Reference:

1. *Unlimited Power*, Tony Robbins, Revised Edition, 2003.
2. *People Skills*, Neil Thompson, 4th Edition, 2019.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
1	25-922-0107	Analytical Reasoning and Problem-Solving - I	2	1	0	3	45

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Identify the fundamental principles of analytical reasoning and basic problem-solving techniques.
CO2	Understanding	Explain patterns, sequences, and logical structures to develop systematic problem-solving approaches.
CO3	Applying	Solve structured problems using logical reasoning and mathematical approaches in real-world scenarios.
CO4	Analyzing	Analyze problems to identify relationships and derive conclusions based on given data.
CO5	Evaluating	Evaluate multiple solution strategies and select the most efficient one based on the problem context.
CO6	Creating	Create logical frameworks for approaching and solving complex analytical problems.

Course Objectives

1. To introduce analytical reasoning skills for solving structured and unstructured problems.
2. To enhance students' logical thinking, pattern recognition, and problem-solving abilities.
3. To develop critical thinking and the ability to analyze, evaluate, and create solution strategies.

Course Modules

Module	Topic	45Hrs
Module I	Introduction to Analytical Reasoning <ul style="list-style-type: none">- Importance of reasoning and problem-solving skills- Types of reasoning: deductive, inductive, and abductive reasoning- Basic problem-solving methods	9hrs
Module II	Logical and Verbal Reasoning <ul style="list-style-type: none">- Pattern recognition and sequences- Analogies, classifications, and syllogisms- Logical reasoning puzzles, including seating arrangements and blood relations	9hrs
Module III	Quantitative and Mathematical Reasoning <ul style="list-style-type: none">- Number series, analogies, and sequences- Basic arithmetic and algebra in problem-solving- Ratio, proportion, percentages, and their applications	9hrs
Module IV	Data Interpretation and Analytical Puzzles <ul style="list-style-type: none">- Tables, charts, and graphs for data interpretation- Analytical puzzles: Sudoku, crosswords, and riddles- Problem-solving with Venn diagrams and sets	9hrs

Module V	Advanced Problem-Solving Techniques - Introduction to probability and combinatorics - Basic geometry in problem-solving - Case studies and real-life problem scenarios to apply analytical skills	9hrs
-----------------	---	-------------

Books for Study:

1. *How to Prepare for Logical Reasoning for CAT*, Arun Sharma, **3rd Edition**, 2017.
2. *A Modern Approach to Verbal and Non-Verbal Reasoning*, R.S. Aggarwal, **2nd Edition**, 2018.
3. *Problem-Solving Strategies*, Richard N. Fogiel, **1st Edition**, 2001.

Books for Reference:

1. *Logical Thinking Puzzles*, Charles Phillips, **1st Edition**, 2014.
2. *Six Thinking Hats*, Edward de Bono, **Revised Edition**, 2017.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
1	25-922-0108	Fundamentals of Programming Certification	0	0	2	0	-

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description

CO1	Understanding	Understand the fundamental programming constructs and data types.
CO2	Applying	Apply control structures, loops, and functions in solving simple problems
CO3	Analyzing	Develop modular code using functions and user-defined data types.
CO4	Evaluating	Design and build structured programs using file handling and pointers.
CO5	Creating	Create logical frameworks for approaching and solving complex analytical problems.

Course Objectives

1. Understand the basic concepts of programming and problem-solving techniques.
2. Learn how to use variables, data types, and operators effectively.
3. Apply control structures like loops and conditionals to develop logical programs.
4. Develop skills to write modular programs using functions and arrays.
5. Gain knowledge of file handling and basic memory management concepts.

Course Modules

Module	Topic
Module I	Purpose of VAC Courses
Module II	The Value Added Course (VAC) in Fundamentals of Programming (Fundamentals of Programming) is designed to strengthen students' core programming abilities through rigorous practice and real-world application. The primary objective is to enable students to become proficient in problem-solving by applying programming constructs effectively. As part

Module III	of this course, each student is required to solve 200 structured problems that cover essential topics such as input/output operations, control statements, loops, arrays, strings, functions, recursion, file handling, and basic data structures. These problems are to be solved in the student's preferred programming language , such as Python or Java, using
Module IV	platforms like HackerRank, and even offline IDEs like VS Code and Eclipse. This hands-on approach ensures that students develop fluency in writing, debugging, and optimizing code independently.
Module V	<p>Upon completing the problem-solving component, students will undertake a capstone project that allows them to integrate and apply their programming knowledge to solve a real-world problem. The project could involve building systems such as a student record manager, online quiz application, inventory system, or a simple game. Each project must be documented with a clear objective, tools used, features, screenshots, and complete code. A video demo of the project is encouraged to showcase functionality and user interaction. This comprehensive learning experience culminates in the submission of a final report and project deliverables.</p> <p>The importance of this VAC lies in its emphasis on consistent practice, which is critical for mastering programming. Unlike theoretical subjects, programming proficiency can only be achieved through repetitive application and practical experimentation. This course fosters critical thinking, logic development, problem decomposition, and debugging skills, all of which are vital for advanced computing, internships, and job interviews.</p> <p>After the completion and submission of the required problems and final project, students will be awarded 2 academic credits as part of the VAC program. The certification issued will reflect their effort, practical knowledge, and applied learning throughout the course. By encouraging self-paced, goal-oriented learning, this VAC also instills confidence, discipline, and a growth mindset, making students well-prepared for academic progression and professional opportunities in software development and computational fields.</p> <p>Top of Form</p> <p>Bottom of Form</p> <p>Mandatory Components for Successful Completion</p>

To qualify for VAC credits or institutional recognition, **students must submit the following three key deliverables:**

1. Course Completion Certificate (Proof of Learning)

- A valid **course completion certificate** from a recognized online platform, institution, or faculty-guided program.
- **Must Include:**
 - Student's Full Name
 - Course Title
 - Instructor/Institution Name
 - Duration/Number of Hours
 - Date of Completion
 - Unique ID or QR verification (if available)

Accepted Platforms: HackerRank, FACE Prep, Infosys Springboard, Microsoft, LinkedIn.

2. Demo / Practical Implementation or Mini Project

Students must submit a **project, case study, simulation, or implementation** based on the course content. This demonstrates the ability to apply learned knowledge.

Expected Submission Format:

- **Title and Objective of the Project**
- **Tools / Languages / Platforms Used**
- Description of **Implementation Steps**
- **Code Files**, Dataset, Screenshots or Working Link
- **GitHub Repository Link** (if applicable)
- **Demo Video (3–5 mins)** uploaded via YouTube/Google Drive (optional but encouraged)

3. Final Presentation or Viva

Students must deliver a **structured presentation** or attend a viva session explaining their learning and project.

Presentation Format:

- 6–10 Slides (PPT/PDF)
 - Slide 1: Introduction to the Course

	<ul style="list-style-type: none"> ○ Slide 2: Key Takeaways / Concepts Learned ○ Slide 3–6: Project Description and Demo ○ Slide 7: Tools & Technologies Used ○ Slide 8: Challenges & Solutions ○ Slide 9: Learning Outcome ○ Slide 10: Future Scope / Industry Relevance ● Optional: Include graphs, screenshots, or metrics ● Presentation Duration: 5–10 mins ● Mode: In-person / Online (Zoom/Google Meet) <p>Submission Guidelines</p> <ul style="list-style-type: none"> ● All deliverables must be submitted in a single ZIP folder or through a submission portal (LMS or department email). ● Folder Naming Convention: VAC_<CourseName>_<StudentRollNo>_<Name> ● Late submissions will be subject to departmental approval.
--	--

Evaluation Rubric (Out of 100 Marks)

Component	Marks	Evaluation Criteria
Course Certificate	20	Authenticity, completeness, platform reputation
Project / Demo / Implementation	50	Relevance, functionality, innovation, code quality, documentation
Presentation / Viva	30	Clarity, articulation, understanding, creativity

Minimum pass requirement: 40 /100 overall, and at least 40% in each component.

Professional Benefits

- **Enhanced Resume & Portfolio**
- **Improved Industry Readiness**
- **Eligible for Academic Credits / Internal Assessment Weightage**

Opportunity to showcase during campus placements

Semester II

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
2	25-922-0201	Introduction to Data Science	2	2	0	4	60

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Define the basic principles of data science and identify key data science concepts and techniques.
CO2	Understanding	Explain the data science workflow, including data collection, processing, and exploration.
CO3	Applying	Apply data cleaning and data visualization techniques on datasets to extract insights.
CO4	Analyzing	Analyze data patterns and trends using statistical and machine learning methods.
CO5	Evaluating	Evaluate data-driven solutions by assessing models and interpret the results effectively.
CO6	Creating	Create basic data science projects that demonstrate data analysis and model-building skills.

Course Objectives

1. To introduce students to the fundamentals of data science and its applications.

2. To familiarize students with data science tools, techniques, and workflows.
3. To provide hands-on experience with data analysis and basic machine learning techniques.

Course Modules

Module	Topic	60hrs
Module I	Introduction to Data Science – Overview of data science – Tools used in data science (R, Python, Jupyter, etc.) – Data collection techniques and sources – Introduction to structured, semi-structured, and unstructured data – Key applications of data science across industries – Case studies of real-world data science applications	12hrs
Module II	Data Collection and Cleaning – Methods of data collection – Primary vs. secondary data – Types of data: numerical, categorical, time-series – Data cleaning techniques: handling missing values, outliers, and inconsistencies – Data preprocessing and transformation – Data integration and preparation for analysis	12hrs
Module III	Data Analysis and Statistics – Introduction to descriptive statistics: measures of central tendency and dispersion – Inferential statistics: confidence intervals and hypothesis testing – Correlation and regression analysis – Basics of probability theory – Application of statistical tools for data interpretation – Real-world examples using financial and business data	12hrs
Module IV	Introduction to Machine Learning – Definition and types of machine learning: supervised, unsupervised, and reinforcement learning – Key algorithms: linear regression, decision trees, K-means clustering, etc. – Overfitting and underfitting – Model evaluation techniques: accuracy, precision, recall, F1 score – Case studies of machine learning in finance and marketing	12hrs
Module V	Data Visualization and Communication – Principles of effective data visualization – Visualization tools: Tableau, Power BI, Matplotlib, Seaborn – Types of charts and when to use them – Communicating insights through dashboards and reports – Storytelling with data – Ethical issues in data presentation – Case studies showcasing impactful visualizations	12hrs

Books for Study:

1. Data Science from scratch, Joel Grus, 2nd Edition, 2019.
2. Python Data Science Handbook, Jake VanderPlas, 1st Edition, 2016.

3. Doing Data Science, Cathy O'Neil and Rachel Schutt, 1st Edition, 2013.

Books for Reference:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, 2nd Edition, 2019.
2. Python for Data Analysis, Wes McKinney, 2nd Edition, 2017.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
2	25-922-0202	Object Oriented Programming in JAVA	2	2	0	4	60

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Remember and understand fundamentals of object oriented programming(OOP).
CO2	Understanding	Understand OOP concepts
CO3	Applying	Apply OOP concepts to design and implement JAVA programs using classes and interfaces.

CO4	Analyzing	Analyze JAVA programs to optimize code reusability, maintainability and performance using advanced OOP principles.
CO5	Evaluating	Compare and evaluate different OOP based JAVA design patterns and best practices in software development.
CO6	Creating	Develop JAVA applications using exception handling, multithreading and file handling.

Course Objectives

1. To introduce the principles of Object-Oriented Programming and their application in Java.
2. To enable students to design and develop software using OOP concepts.
3. To provide practical experience in creating robust and reusable code through Java programming.

Course Modules

Module	Topic	60hrs
Module I	Introduction to Java and OOPs Java Essentials, JVM, Java Features, Creation and Execution of Programs, Data Types, Type Conversion, Casting, Conditional Statements, Loops, Branching Mechanism, Classes, Objects, Class Declaration, Abstraction, Polymorphism, Inheritance, Encapsulation, Method Declaration and Invocation, Method Overloading.	12hrs
Module II	Core OOP Principles in Java Constructors : Parameterized Constructors - Constructor Overloading - Garbage Collection –Static Members - Access Control – Nested of methods – this keyword. Inheritance : Defining Inheritance – Types of Inheritance – Extends Keyword, Overriding methods –super, final keyword, Abstract	12hrs

	classes, Interfaces, Abstract Class versus Interfaces. Packages: Creating and Using Packages, Access Protection, Wrapper Classes, String Class, String Buffer Class.	
Module III	<p>Exception Handling Introduction - Limitations of Error handling – Advantages of Exception Handling – Types of Errors – Exception Handling Techniques, User-Defined Exceptions.</p> <p>Multithreading : Creating Threads – Life of a Thread – Defining & Running Thread – Thread Methods – Thread Priority - synchronization – Implementing Runnable Interface – Thread Scheduling.</p>	12hrs
Module IV	<p>I/O Streams File – Streams – Advantages – The stream classes – Byte streams – Character streams. Applet: Life cycle – Creating & Executing an Applet – Applet tags in HTML – Parameter tag – Aligning the display – Common Methods Used in Displaying the Output</p>	12hrs
Module V	<p>Event Handling Introduction, Types of Events – Example. AWT : Introduction- Components – Containers - Labels – Buttons – Check Boxes –Radio Buttons – Scroll Bars - Layouts.DatabaseHandling Using JDBC: Introduction, Types of JDBC Drivers, Load the Driver, Establish Connection, Create Statement, Execute Query, Iterate Resultset, Scrollable Resultset, Developing a JDBC Application.</p>	12hrs

Books for Study:

1. Java: The Complete Reference, Herbert Schildt, 11th Edition, 2018.
2. Core Java Volume I – Fundamentals, Cay S. Horstmann and Gary Cornell, 10th Edition, 2016.
3. Head First Java, Kathy Sierra and Bert Bates, 2nd Edition, 2005.

Books for Reference:

1. Java: How to Program, Paul Deitel and Harvey Deitel, 10th Edition, 2017.
2. Effective Java, Joshua Bloch, 3rd Edition, 2017.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
2	25-922-0203	Lab - Object-Oriented Programming Java	0	0	8	4	60

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Define key Object-Oriented Programming (OOP) concepts and terminology, such as classes, objects, inheritance, and polymorphism.
CO2	Understanding	Describe how OOP principles are applied in Java to create modular, reusable, and efficient code.
CO3	Applying	Implement OOP principles by writing Java programs with classes, methods, and inheritance.
CO4	Analyzing	Analyze code to understand the interaction between objects and evaluate object-oriented design.
CO5	Evaluating	Evaluate different OOP approaches for solving real-world problems effectively.
CO6	Creating	Develop Java applications that demonstrate OOP principles in solving practical problems.

Course Objectives

1. To introduce the principles of Object-Oriented Programming and their application in Java.
2. To enable students to design and develop software using OOP concepts.
3. To provide practical experience in creating robust and reusable code through Java programming.

Course Modules

Module	Topic	60hrs
Module I	<ol style="list-style-type: none"> 1. Write a Java program to print Fibonacci series using loops. 2. Write a Java program to check for prime number. 3. Write a Java program to find the factorial of a number using recursion. 	12hrs
Module II	<ol style="list-style-type: none"> 1. Write a Java program to demonstrate conditional statements and loops. 2. Write a Java program to demonstrate array operations (1D and 2D arrays). 3. Write a Java program to demonstrate classes and objects. 	12hrs
Module III	<ol style="list-style-type: none"> 1. Write a Java program to implement constructor overloading. 2. Write a Java program to implement method overloading and overriding. 3. Write a Java program to demonstrate use of this, super, final, and static keywords. 	12hrs
Module IV	<ol style="list-style-type: none"> 1. Write a Java program to implement inheritance (single and multilevel). 2. Write a Java program to implement abstract class and interface. 3. Write a Java program to implement multiple inheritance using interfaces. 	12hrs
Module V	<ol style="list-style-type: none"> 1. Write a Java program to demonstrate exception handling using try-catch-finally. 2. Write a Java program to create and throw user-defined exception. 3. Write a Java program to create a file, write data, and read it. 	12hrs

Books for Study:

1. Java: The Complete Reference, Herbert Schildt, 11th Edition, 2018.

2. Core Java Volume I – Fundamentals, Cay S. Horstmann and Gary Cornell, 10th Edition, 2016.
3. Head First Java, Kathy Sierra and Bert Bates, 2nd Edition, 2005.

Books for Reference:

1. Java: How to Program, Paul Deitel and Harvey Deitel, 10th Edition, 2017.
2. Effective Java, Joshua Bloch, 3rd Edition, 2017.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
2	25-922-0204	Computer Networks	2	2	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Describe the fundamental concepts of data communication and network models.
CO2	Analyzing	Analyze IP addressing, subnetting, and protocol operations in TCP/IP networks.
CO3	Applying	Apply various routing and congestion control algorithms
CO4	Analyzing	Compare and contrast different transmission media and network devices
CO5	Evaluating	Explain the principles of wireless networking, network security, and recent trends.

Course Objectives

1. To understand the basics of data communication and layered network architecture.
2. To gain knowledge about various transmission media and switching techniques.
3. To explore different protocols used in network communication.

4. To understand IP addressing, routing algorithms, and transport layer protocols.
5. To introduce concepts of network security, wireless networks, and emerging technologies.

Course Modules

Module	Topic	60hrs
Module I	Introduction to Networks and Layered Architecture Components of a data communication system. Types of networks: LAN, MAN, WAN. OSI and TCP/IP models. Protocols, standards, and standards organizations. Transmission modes: Simplex, Half Duplex, Full Duplex	12hrs
Module II	Physical Layer and Transmission Media Data and signal transmission. Analog and digital signals. Guided media: Twisted pair, coaxial cable, fiber optics. Unguided media: Radio, microwave, infrared. Multiplexing: FDM, TDM, WDM	12hrs
Module III	Data Link Layer & MAC Error detection and correction: CRC, Hamming Code. Flow control and error control: Stop and Wait, Sliding Window. MAC protocols: CSMA/CD, CSMA/CA. Ethernet: Standards and operation. Switching: Circuit, Packet, Message	12hrs
Module IV	Network Layer Logical addressing: IPv4, IPv6. Subnetting, Supernetting, CIDR. Routing algorithms: Distance vector, Link state. Protocols: IP, ICMP, ARP, RARP. Congestion control techniques	12hrs
Module V	Transport Layer, Security, and Emerging Technologies UDP and TCP: Features and comparison. Socket programming basics. Flow control, congestion control in TCP. Basics of cryptography and network security. Overview of Wireless Networks, IoT, Cloud networking	12hrs

Books for Study:

1. Data Communications and Networking, Behrouz A. Forouzan, 5th Edition, 2017.

2. Computer Networks, Andrew S. Tanenbaum, 5th Edition, 2011.
3. Data and Computer Communications, William Stallings, 10th Edition, 2014.

Books for Reference:

1. Computer Networking: A Top-Down Approach, Kurose & Ross, 7th Edition, 2017.
2. Computer Networks: Principles, Technologies and Protocols, James F. Kurose, 2013.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
2	25-922-0205	Statistics for Data Science	2	1	0	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall basic statistical concepts, including descriptive statistics, probability distributions, and sampling.
CO2	Understanding	Understand the role of statistics in data science, including data summarization and exploration techniques.
CO3	Applying	Apply statistical measures and probability models to analyze data and interpret findings.
CO4	Analyzing	Analyze datasets using statistical methods to identify trends, relationships, and outliers.
CO5	Evaluating	Evaluate data-driven solutions by applying hypothesis testing and inferential statistics methods.
CO6	Creating	Develop predictive models based on statistical inferences for real-world data science applications.

Course Objectives

1. To introduce students to statistical techniques relevant to data science.
2. To develop skills in descriptive and inferential statistics for effective data analysis.
3. To enable students to apply probability and sampling methods in analyzing and interpreting data.
4. To prepare students for advanced topics in predictive modeling and hypothesis testing.
5. To build a foundation in statistical software and tools used in data science.

Course Modules

Module	Topic	45hrs
Module I	<p>Introduction to Statistics</p> <p>Nature and Scope of Statistics. Scales of Measurement. Types of Data: Structured and Unstructured. Descriptive Statistics: Mean, Median, Mode, Range, Variance, Standard Deviation. Data Visualization: Histograms, Boxplots, Scatter Plots</p>	9hrs
Module II	<p>Probability Theory</p> <p>Classical and Empirical Probability. Conditional Probability and Bayes' Theorem. Independent and Dependent Events. Random Variables: Discrete and Continuous. Applications in ML: Naive Bayes Classifier</p>	9hrs
Module III	<p>Probability Distributions</p> <p>Binomial, Poisson, Uniform, Normal, and Exponential Distributions. Central Limit Theorem. Z-score and Probability Estimations. Sampling Techniques: Random, Stratified, Cluster. Applications in Feature Engineering and Outlier Detection</p>	9hrs
Module IV	<p>Statistical Inference and Hypothesis Testing</p> <p>Point and Interval Estimation. Null and Alternative Hypotheses. Type I and Type II Errors. t-test, Chi-square test, ANOVA. Confidence Intervals. Application in Model Comparison and Validation</p>	9hrs

Module V	Regression and Correlation Linear and Multiple Regression. Pearson and Spearman Correlation. Residual Analysis. Statistical Measures in Model Performance: R^2 , Adjusted R^2 , AIC, BIC. Feature Importance and Multicollinearity	9hrs
-----------------	--	-------------

Books for Study:

1. Introduction to Probability and Statistics Using R, G. Jay Kerns, 1st Edition, 2010.
2. Introductory Statistics, Sheldon Ross, 5th Edition, 2017.
3. Statistics, James T. McClave and Terry Sincich, 13th Edition, 2018.

Books for Reference:

1. Statistical Methods for the Social Sciences, Alan Agresti and Barbara Finlay, 5th Edition, 2017.
2. All of Statistics: A Concise Course in Statistical Inference, Larry Wasserman, 1st Edition, 2013.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
2	25-922-0206	Interpersonal and Essential Skills - II	2	1	0	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall effective communication techniques, collaboration skills, and team dynamics concepts.
CO2	Understanding	Explain the principles of interpersonal skills, including emotional intelligence, active listening,

		and feedback.
CO3	Applying	Apply effective communication, conflict resolution, and negotiation skills in team environments.
CO4	Analyzing	Analyze team roles, dynamics, and cultural sensitivity factors in collaborative work.
CO5	Evaluating	Evaluate personal strengths and areas for improvement in teamwork and communication skills.
CO6	Creating	Create solutions for interpersonal challenges, enhancing team productivity and cohesion.

Course Objectives

1. To enhance students' communication and interpersonal skills for professional environments.
2. To develop self-awareness, empathy, and emotional intelligence in diverse team settings.
3. To strengthen skills in collaboration, conflict resolution, and cultural sensitivity.
4. To prepare students for effective team dynamics and leadership roles.
5. To foster critical thinking and problem-solving skills in interpersonal contexts.

Course Modules

Module	Topic	45hrs
Module I	Advanced Communication Skills - Verbal and non-verbal communication - Active listening techniques and empathy - Communicating effectively in multicultural settings	9hrs
Module II	Emotional Intelligence and Self-Awareness - Recognizing and managing emotions - Building empathy and resilience - Techniques for self-regulation and motivation	9hrs
Module III	Conflict Resolution and Negotiation - Identifying sources of conflict - Conflict management styles and strategies - Basics of negotiation and compromise	9hrs

Module IV	Teamwork and Collaboration - Understanding team roles and responsibilities - Principles of collaboration - Building trust and rapport in teams	9hrs
Module V	Professional Etiquette and Networking - Basics of professional etiquette in workplace settings - Networking skills and relationship building - Managing social media for professional presence	9hrs

Books for Study:

1. Emotional Intelligence: Why It Can Matter More Than IQ, Daniel Goleman, **1st Edition**, 2005.
2. How to Win Friends and Influence People, Dale Carnegie, **Revised Edition**, 2009.
3. The 7 Habits of Highly Effective People, Stephen R. Covey, **Anniversary Edition**, 2004.

Books for Reference:

1. Talking from 9 to 5: Women and Men at Work, Deborah Tannen, **1st Edition**, 2001.
2. Hostage at the Table: How Leaders Can Overcome Conflict, Influence Others, and Raise Performance, George Kohlrieser, **1st Edition**, 2006.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
2	25-922-0207	Environmental Studies	3	0	0	3	45

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Recognize and classify various types of ecosystems and natural resources..

CO2	Applying	Apply knowledge of pollution control and waste management in real life.
CO3	Analyzing	Analyze biodiversity issues and propose conservation strategies.
CO4	Evaluating	Evaluate environmental policies and sustainability practices.
CO5	Creating	Design and present innovative green projects or awareness campaigns.

Course Objectives

1. To instill environmental consciousness and sustainability principles among students.
2. To enable students to critically evaluate environmental issues through real-world case studies.
3. To encourage hands-on environmental practices and community engagement.
4. To foster the skills necessary to become environmentally responsible citizens.

Course Modules

Module	Topic	45hrs
Module I	Introduction to environmental science and sustainability. Components of the environment. Interdependency in ecosystems. Case study: Urban ecological footprint	9hrs
Module II	Renewable vs. Non-renewable resources. Overexploitation: Deforestation, mining, water depletion. Carbon footprint and lifestyle choices. Water and energy conservation techniques	9hrs

Module III	Types of pollution and their effects. Solid waste: Types, segregation, and management. E-waste and plastic waste concerns. Pollution control techniques and sustainable alternatives	9hrs
Module IV	Biodiversity hotspots and endangered species (focus on India). Causes and consequences of biodiversity loss. In-situ and ex-situ conservation. Role of youth in conservation movements	9hrs
Module V	UN SDGs and their relevance. Climate change, global warming, and environmental ethics. Green buildings, sustainable cities, and eco-friendly technologies. National and international environmental policies	9hrs

Student Deliverables

1. Weekly Reflective Journal (Individual)

Purpose: To help students reflect on weekly topics, activities, and personal environmental practices.

Requirements:

- Maintain a handwritten or digital journal.
- Weekly entries should include:
 - Summary of concepts learned.
 - Personal reflections and insights.
 - Real-life connections or behavioral changes inspired.
- Minimum 1 page per week.

2. Campus/Home Environmental Audit Report (Group/Individual)

Purpose: To evaluate and document environmental practices in a familiar setting.

Focus Areas:

- Energy consumption
- Water usage and wastage
- Waste generation and segregation practices
- Plastic use and alternatives
- Green cover (trees/plants on campus or neighborhood).

3. Awareness Campaign or Creative Media Project

Purpose: To spread environmental awareness through creative or digital expression.

Options:

- Design posters, infographics, or short videos on environmental issues (pollution, climate change, conservation, etc.).
- Create social media campaigns (Instagram reels, Twitter threads, or YouTube shorts).
- Develop a short skit or street play.

4. Field Visit and Reflection Report

Purpose: To observe real-world environmental efforts.

Examples of Sites:

- Waste management or recycling plant
- Renewable energy plant (solar, wind)
- Biodiversity park or forest reserve
- Water treatment plant

Requirements:

- Prepare a visit diary with:
 - Overview of the site
 - Key processes or technologies
 - Environmental significance
 - Student observations and suggestions

5. Environmental Problem Solving Project

Purpose: To apply environmental knowledge in solving a local issue.

Themes:

- Reducing plastic usage on campus
- Rainwater harvesting models
- Composting organic waste
- Creating a green corner using upcycled materials
- Water/energy saving awareness drives

6. Sustainable Behaviour Tracker

Purpose: To build personal accountability for environmentally friendly habits.

Activity:

- Track your daily/weekly efforts like:
 - Using public transport/cycling
 - Carrying reusable water bottles and bags
 - Segregating waste at home
 - Participating in plantation or cleanup drives.

7. Final Presentation

Purpose: Showcase the culmination of all activities.

Format:

- Summary of your learnings.
- Highlights of your audit/project/campaign.
- Personal commitment to sustainability..

Overall Evaluation Criteria (CA)

Component	Marks
Weekly Journal	6
Environmental Audit Report	3
Awareness Campaign/Poster/Video	3
Field Visit Report	3
Final Project & Presentation	12
Participation and Peer Feedback	3
Total	30

Semester III

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
3	25-922-0301	Data Structures and Algorithms	2	2	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Explain the fundamental concepts of data structures and their applications
CO2	Understanding	Implement searching, sorting, and basic data structures such as arrays, linked lists, stacks, and queues.
CO3	Applying	Analyze algorithm efficiency using time and space complexity.
CO4	Analyzing	Implement advanced data structures such as trees and graphs, and perform traversal operations.
CO5	Evaluating	Evaluate and optimize algorithmic performance using different strategies.

Course Objectives

1. Introduce basic data structures such as arrays, linked lists, stacks, and queues.
2. Introduce algorithm design strategies like divide-and-conquer, dynamic programming, and greedy algorithms.
3. Understand and implement common searching and sorting algorithms.
4. Evaluate time and space complexity for these techniques.
5. Implement traversal algorithms such as BFS, DFS, and shortest path algorithms.

Course Modules

Module	Topic	60hrs
Module I	Arrays Abstract Data Types (ADTs)- List ADT-array-based implementation - Definition - Terminology - One dimensional array - Multi dimensional arrays. Linked lists: Definition - Circular linked lists - Double linked lists - Circular double linked lists.	12hrs
Module II	Stacks Definition - Representation of a Stack - operations on Stacks - Evaluation of Arithmetic expressions. Queues: Definition – Representation of Queues - various queue structures.	12hrs
Module III	Trees and Graphs Basic terminologies - Definition and concepts - Representation of Binary tree - Binary tree traversal. Graph: Definition- Representation of Graph- Types of graph-Breadth first traversal – Depth first traversal-Topological sort- Bi-connectivity – Cut vertex- Euler circuits-Applications of graphs.	12hrs
Module IV	Sorting Terminologies – Techniques – Bubble sort – Insertion sort – Quick sort – Radix sort – Searching – Terminologies - Linear search with arrays – Binary Search.	12hrs
Module V	Algorithm Development Basic Steps. Algorithm Design Methods: Sub goals - Hill Climbing - Working Backward - Heuristics - Backtrack Programming – Branch and Bound – Recursion.	12hrs

Books for Study:

1. Classic Data Structures, D. Samanta, 2nd Edition, 2009.
2. Introduction to the Design and Analysis of Algorithms, S. E. Goodman & S. T. Hedetniemi, 1st Edition, 1988.
3. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, 4th Edition, 2014.

Books for Reference:

1. Fundamentals of Data Structure, Ellis Horowitz & Sartaj Sahni, 1st Edition, 1985.
2. Data Structures with Pascal, A. M. Tanenbaum & M. J. Auguestein, 1st Edition, 1985.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
3	25-922-0302	Data Visualization	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall key concepts and techniques in data visualization and their role in data analysis.
CO2	Understanding	Understand the principles behind effective data visualization and its importance in data storytelling.
CO3	Applying	Apply visualization techniques to represent and analyze data using tools like Matplotlib, Seaborn, and Tableau.
CO4	Analyzing	Analyze data from different perspectives and create visualizations that communicate insights clearly.
CO5	Evaluating	Evaluate the effectiveness of various visualization methods for different types of data and communication goals.
CO6	Creating	Create complex and interactive visualizations using advanced tools and techniques to represent multi-dimensional data.

Course Objectives

1. To introduce the fundamentals of data visualization and its significance in data science.
2. To develop skills in visualizing data using various tools and techniques.

3. To teach students how to choose appropriate visualizations for different data types and analysis goals.
4. To enable students to use tools like Python libraries (Matplotlib, Seaborn), Tableau, and Power BI for effective data visualization.
5. To guide students in interpreting data through visual storytelling and presenting actionable insights.

Course Modules

Module	Topic	60hrs
Module I	Overview of R for Data Visualization - Basics of R environment and RStudio. Installing and using packages: ggplot2, plotly, lattice, gridExtra. plot(), hist(), boxplot(), barplot(), pie(), lines(), points(). Grammar of Graphics concept. Aesthetic mappings and geometric objects. Layers, scales, themes, and facets. Customizing plots (legends, labels, colors)	12hrs
Module II	Introduction to Data Visualization - Overview of Data Visualization - Importance of Data Visualization in Data Science - Principles of Effective Visualization	12hrs
Module III	Basic Visualization Techniques - Understanding Data Types (Quantitative, Categorical) - Types of Charts: Bar, Line, Pie, Scatter Plots - Visualization using Python Libraries (Matplotlib, Seaborn)	12hrs
Module IV	Advanced Visualization Techniques - Heatmaps, Box Plots, Pair Plots, Violin Plots - Geospatial Visualizations - Time-Series Data Visualization	12hrs
Module V	Interactive Data Visualizations - Introduction to Interactive Visualizations - Creating Dashboards using Tableau - Creating Interactive Plots using Plotly	12hrs

Books for Study:

1. The Functional Art: An Introduction to Information Graphics and Visualization, Alberto Cairo, 1st Edition, 2012.
2. Storytelling with Data: A Data Visualization Guide for Business Professionals, Cole Nussbaumer Knaflic, 1st Edition, 2015.

- ggplot2: Elegant Graphics for Data Analysis, Hadley Wickham, 2nd Edition, 2016.

Books for Reference:

- Data Visualization: A Practical Introduction, Kristen Sosulski, 1st Edition, 2017.
- Visualize This: The FlowingData Guide to Design, Visualization, and Statistics, Nathan Yau, 1st Edition, 2011.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
3	25-922-0303	Security and Cryptography	2	2	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Describe the principles of computer security, types of attacks, and security goals.
CO2	Understanding	Understand the architecture and protocols of networking, security principles, and different network security mechanisms.
CO3	Applying	Apply classical and modern cryptographic techniques.
CO4	Analyzing	Analyze symmetric and asymmetric cryptographic algorithms
CO5	Evaluating	Evaluate network security protocols and security practices.

Course Objectives

1. To understand the fundamentals of security principles and threats in computer systems.
2. To explore classical and modern cryptographic techniques.
3. To analyze symmetric and asymmetric encryption algorithms.
4. To learn about cryptographic hash functions, digital signatures, and certificates.
5. To introduce network security mechanisms, protocols, and emerging security trends.

Course Modules

Module	Topic	60hrs
Module I	Introduction to Security Security goals: Confidentiality, Integrity, Availability. Types of threats and attacks: Passive, Active, Insider, Outsider. Security services and mechanisms. Model for network security. Basics of authentication, authorization, and access control	12hrs
Module II	Classical and Modern Cryptography Substitution and transposition techniques. Caesar cipher, Playfair cipher, Vigenère cipher. One-time pad. Introduction to modern cryptography. Block and stream ciphers	12hrs
Module III	Symmetric and Asymmetric Encryption DES, Triple DES, AES: Architecture and operations. Public-key cryptography: RSA algorithm. Key distribution and management. Diffie–Hellman key exchange. Elliptic Curve Cryptography (ECC) – basics.	12hrs
Module IV	Hash Functions, Digital Signatures & Authentication Cryptographic hash functions: MD5, SHA family. Message Authentication Codes (MAC). Digital signature schemes: RSA, DSA. Public Key Infrastructure (PKI) and certificates. Kerberos, X.509 authentication service	12hrs
Module V	Network and System Security Firewalls and Intrusion Detection Systems (IDS). Secure Email: PGP and S/MIME. Secure Web: HTTPS, SSL/TLS protocols. Wireless	12hrs

	security: WEP, WPA, WPA2. Emerging trends: Blockchain security, Zero Trust Model, IoT security.	
--	---	--

Books for Study:

1. Cryptography and Network Security, William Stallings, 7th Edition, 2017.
2. Cryptography and Network Security, Behrouz A. Forouzan, 2nd Edition, 2011.
3. Network Security: Private Communication in a Public World, Charlie Kaufman, Radia Perlman, Mike Speciner, 2nd Edition, 2002.

Books for Reference:

1. Applied Cryptography: Protocols, Algorithms, and Source Code in C, Bruce Schneier, 2nd Edition, 1996.
2. Cryptography and Network Security, Atul Kahate, 3rd Edition, 2018.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
3	25-922-0304	Database Management Systems	0	0	8	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall key concepts of database management, including database models, relational algebra, and SQL.
CO2	Understanding	Understand the importance of data modeling, normalization, and transactions in database systems.

CO3	Applying	Apply SQL queries and relational database concepts to solve problems related to database management.
CO4	Analyzing	Analyze complex database systems, including data retrieval, manipulation, and optimization techniques.
CO5	Evaluating	Evaluate database performance and integrity through the application of normalization techniques and query optimization.
CO6	Creating	Design and create relational databases, construct ER models, and implement normalization and query optimization.

Course Objectives

1. To introduce the fundamental concepts of database management systems (DBMS), including data models, database design, and querying techniques.
2. To teach students how to design and implement relational databases using various database management systems (DBMS).
3. To provide hands-on experience with Structured Query Language (SQL) for data manipulation, querying, and transaction management.
4. To enable students to understand normalization, database indexing, and query optimization to enhance database efficiency and performance.
5. To equip students with the skills required to design and manage large-scale database systems for real-world applications.

Course Modules

Module	Topic	60hrs
Module I	Data Management and Modelling Information Systems and Databases – SQL Databases – Big Data – No SQL Databases – Organizing Data Management-From Data Analysis to Database – The Entity-Relationship Model – Implementation in the Relational Model - Relational Algebra and Relational Calculus - Integrity Constraints	12hrs
Module II	Relational Database Design	12hrs

	Structure of Relational Database. – Objectives – Tools – Redundancy and Data Anomaly – Functional Dependency - Normalization –1NF – 2NF – 3NF – BCNF. Transaction Processing – Concurrency Control, and Recovering	
Module III	NoSQL Systems Processing of Homogeneous and Heterogeneous Data – Storage and Access Structure – Translation and Optimization of Relational Queries – Parallel Processing with MapReduce – Layered Architecture – NoSQL Databases: Development of Non-relational Technologies – Key- value stores – Column- Family Stores – Document Stores – XML Databases – Graph Database.	12hrs
Module IV	SQL Commands Data types – DDL - Selection, Projection, Join and Set Operations – Aggregate Functions – DML – Modification - Truncation - Constraints – Subquery.	12hrs
Module V	PL/SQL Structure - Elements – Operators Precedence – Control Structure – Iterative Control -Cursors – Procedure - Function - Packages – Exceptional Handling – Triggers.	12hrs

Text books to study:

1. Silberschatz, A., Korth, H. F., & Sudarshan, S. (2020). Database system concepts (7th ed.). McGraw-Hill Education.
2. Ramakrishnan, R., & Gehrke, J. (2003). Database management systems (3rd ed.). McGraw-Hill.
3. Sullivan, D. (2015). NoSQL for mere mortals. Apress.

Reference Textbooks:

1. Elmasri, R., & Navathe, S. B. (2016). Fundamentals of database systems (7th ed.). Pearson.
2. Desai, B. C. (1990). An introduction to database systems. Galgotia Publications.
3. Ullman, J. D. (1988). Principles of database and knowledge-base systems (Vol. 1). Computer Science Press.
4. W. Gilmore, Beginning PHP and PostgreSQL 8: From Novice to Professional, Goels Computer Hut (2007), ISBN: 9788181286000

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
3	25-922-0305	Introduction to Forecasting models	2	1	0	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understand the basic concepts and importance of time series data
CO2	Performing	Perform exploratory analysis of time series data.
CO3	Applying	Apply statistical methods for time series modeling and forecasting
CO4	Using	Use machine learning techniques to analyze time series data.
CO5	Evaluating	Evaluate and optimize time series models.

Course Objectives

1. To introduce time series data and its applications.
2. To teach methods for analyzing and visualizing time series data.
3. To provide knowledge of statistical models for time series forecasting.
4. To explore machine learning methods for temporal data.
5. To enable students to work on real-world time series problems.

Course Modules

Module	Topic	45hrs
Module I	Introduction to Time Series Definition and examples of time series data. Characteristics of time series: trend, seasonality, and noise. Applications of time series analysis in various domains. Introduction to time series datasets and tools	9hrs
Module II	Exploratory Data Analysis for Time Series Visualizing time series data. Identifying patterns, trends, and seasonality. Decomposing time series. Handling missing data and outliers	9hrs
Module III	Statistical Models for Time Series Moving average and exponential smoothing. Autoregressive (AR), Moving Average (MA), and ARIMA models. Stationarity and differencing. Evaluating model performance using metrics like MSE and RMSE	9hrs
Module IV	Machine Learning for Time Series Introduction to supervised learning for time series. Feature engineering for temporal data. Time series forecasting using regression and tree-based methods. Comparing statistical and machine learning approaches	9hrs
Module V	Advanced Applications and Case Studies Real-world applications of time series forecasting. Implementing time series analysis using Python (pandas, statsmodels, scikit-learn). Case studies in finance, healthcare, and energy sectors. Best practices and challenges in time series analysis	9hrs

Books for Study:

1. *Time Series Analysis and Forecasting*, N.P. Agarwal & K.K. Gupta, 1st Edition, 2010.
2. *Introductory Time Series with R*, Paul S.P. Cowpertwait and Andrew V. Metcalfe, 1st Edition, 2009.
3. *Time Series Analysis and Its Applications with R Examples*, Robert H. Shumway & David S. Stoffer, 4th Edition, 2017.

Books for Reference:

1. *Business Forecasting*, J.K. Das, 1st Edition, 2012.

Course Overview]

Semester	Course Code	Course Title	L	T	P	C	Total Hours
3	25-922-0306	Analytical Reasoning and Problem Solving - II	2	1	0	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall fundamental concepts of analytical reasoning and apply them to real-world scenarios.
CO2	Understanding	Understand various problem-solving strategies and techniques for efficient solution design.
CO3	Applying	Apply problem-solving methods in complex real-world scenarios, utilizing logical reasoning and creative thinking.
CO4	Analyzing	Analyze complex problems, break them down into simpler components, and identify the most efficient solutions.
CO5	Evaluating	Evaluate the effectiveness of different problem-solving approaches and select the most optimal solution.
CO6	Creating	Create innovative solutions and strategies for new problems using advanced analytical reasoning skills.

Course Objectives

1. To develop and strengthen students' logical thinking and analytical reasoning skills.

2. To improve problem-solving abilities, focusing on structuring problems and deriving solutions.
3. To introduce various problem-solving techniques and algorithms for effective decision-making.
4. To enhance the application of analytical reasoning to real-world challenges in computing and beyond.
5. To foster critical thinking in mathematical and computational problem-solving scenarios.

Course Modules

Module	Topic	45hrs
Module I	Logical Reasoning and Problem Analysis - Introduction to logical reasoning - Types of reasoning: Deductive, Inductive, and Abductive - Problem analysis techniques	9hrs
Module II	Advanced Algorithms and Strategies - Divide and conquer algorithms - Dynamic programming techniques - Greedy algorithms and backtracking	9hrs
Module III	Pattern Recognition and Problem Decomposition - Identifying patterns in data - Decomposing complex problems into smaller tasks - Heuristic methods in problem-solving	9hrs
Module IV	Critical Thinking and Decision Making - Decision trees and probabilistic reasoning - Risk assessment and decision-making under uncertainty - Evaluating alternatives and trade-offs	9hrs
Module V	Complex Problem Solving and Creativity - Techniques for creative problem solving - Solving computational problems with multiple constraints - Applying lateral thinking in complex scenarios	9hrs

Books for Study:

1. How to Solve It: A New Aspect of Mathematical Method, George Polya, 2nd Edition, 2004.
2. Probabilistic Reasoning in Expert Systems: Theory and Algorithms, Richard E. Neapolitan, 1st Edition, 1990.
3. Introduction to Algorithms, Thomas H. Cormen et al., 3rd Edition, 2009.

Books for Reference:

1. Thinking, Fast and Slow, Daniel Kahneman, 1st Edition, 2011.
2. Lateral Thinking: Creativity Step by Step, Edward de Bono, 1st Edition, 1970.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
1	25-922-0307	Data Structures and Algorithms Certification	0	0	6	3	45

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Explain basic data structures and their applications.
CO2	Applying	Implement and analyze searching and sorting algorithms.
CO3	Analyzing	Design and develop efficient algorithms for solving problems using data structures.
CO4	Evaluating	Evaluate the complexity of algorithms and optimize solutions.
CO5	Applying	Apply recursive and dynamic data structures in practical applications.

Course Objectives

1. Understand fundamental data structures such as arrays, stacks, queues, linked lists, trees, and graphs.

2. Analyze and implement searching, sorting, and traversal algorithms efficiently.
3. Develop problem-solving skills by applying appropriate data structures and algorithms.
4. Learn to evaluate algorithm complexity and optimize code performance using Big O notation.
5. Design and implement dynamic data structures and recursive algorithms for real-world problems.

Course Modules

Module	Topic
Module I	<p>The Value Added Course (VAC) in Data Structures and Algorithms (DSA) is meticulously crafted to build a strong foundation in computational problem-solving and algorithmic thinking. The primary purpose of this VAC is to ensure that students not only understand the theoretical aspects of DSA but also gain substantial hands-on experience in implementing efficient algorithms to solve real-world problems.</p> <p>As part of this course, each student must solve 200 structured and graded problem statements that span across various core topics such as arrays, strings, linked lists, stacks, queues, trees, graphs, hash maps, heaps, recursion, dynamic programming, greedy algorithms, sorting and searching techniques, and algorithmic complexity. These problems are to be solved in the student's preferred programming language (Java or Python), utilizing online competitive coding platforms such as HackerRank and even local environments for compilation and debugging. The structured progression of problems from easy to complex ensures continuous learning and improvement.</p> <p>After successfully completing the problem-solving component, students are required to work on a capstone project related to DSA. The project should demonstrate the practical application of one or more data structures and algorithms in solving a comprehensive and meaningful problem. Example projects include building a graph-based route finder, memory-efficient search engines, customized file compression software, or implementing a mini compiler or cache system. Students are expected to document the entire process, including the problem definition, algorithmic approach, code explanation, complexity analysis, and</p>
Module II	
Module III	
Module IV	
Module V	

outcomes. A final demo video is recommended for visual demonstration and review.

The **importance of this VAC lies in developing critical thinking, algorithmic efficiency, and optimal coding practices**, which are indispensable for acing technical interviews, succeeding in competitive programming contests, and excelling in real-world software development. Regular practice on diverse problems also nurtures resilience, analytical skills, and confidence, transforming students from passive learners into active problem solvers.

Upon submission and evaluation of the completed problems and final project, students will be awarded **2 academic credits**. This credit-based system acknowledges their practical competence, consistent effort, and the application of DSA concepts in innovative ways. Ultimately, the VAC in DSA serves as a rigorous, self-driven learning path that enhances employability, prepares students for advanced coursework in algorithms, and positions them for success in data-centric and performance-oriented computing careers.

Mandatory Components for Successful Completion

To qualify for VAC credits or institutional recognition, **students must submit the following three key deliverables**:

1. Course Completion Certificate (Proof of Learning)

- A valid **course completion certificate** from a recognized online platform, institution, or faculty-guided program.
- **Must Include:**
 - Student's Full Name
 - Course Title
 - Instructor/Institution Name
 - Duration/Number of Hours
 - Date of Completion
 - Unique ID or QR verification (if available)

Accepted Platforms: HackerRank, FACE Prep, Infosys Springboard, Microsoft, LinkedIn.

2. Demo / Practical Implementation or Mini Project

Students must submit a **project, case study, simulation, or implementation** based on the course content. This demonstrates the ability to apply learned knowledge.

Expected Submission Format:

- **Title** and Objective of the Project
- **Tools / Languages / Platforms Used**
- Description of **Implementation Steps**
- **Code Files**, Dataset, Screenshots or Working Link
- **GitHub Repository Link** (if applicable)
- **Demo Video (3–5 mins)** uploaded via YouTube/Google Drive (optional but encouraged)

3. Final Presentation or Viva

Students must deliver a **structured presentation** or attend a viva session explaining their learning and project.

Presentation Format:

- 6–10 Slides (PPT/PDF)
 - Slide 1: Introduction to the Course
 - Slide 2: Key Takeaways / Concepts Learned
 - Slide 3–6: Project Description and Demo
 - Slide 7: Tools & Technologies Used
 - Slide 8: Challenges & Solutions
 - Slide 9: Learning Outcome
 - Slide 10: Future Scope / Industry Relevance
- Optional: Include graphs, screenshots, or metrics
- **Presentation Duration:** 5–10 mins
- Mode: In-person / Online (Zoom/Google Meet)

Submission Guidelines

- All deliverables must be submitted in a single ZIP folder or through a submission portal (LMS or department email).

- Folder Naming Convention:
VAC_<CourseName>_<StudentRollNo>_<Name>
- Late submissions will be subject to departmental approval.

Evaluation Rubric (Out of 100 Marks)

Component	Mark	Evaluation Criteria
Course Certificate	20	Authenticity, completeness, platform reputation
Project / Demo / Implementation	50	Relevance, functionality, innovation, code quality, documentation
Presentation / Viva	30	Clarity, articulation, understanding, creativity

Minimum pass requirement: 40/100 overall, and at least 40% in each component.

Professional Benefits

- **Enhanced Resume & Portfolio**
- **Improved Industry Readiness**
- **Eligible for Academic Credits / Internal Assessment Weightage**
- **Opportunity to showcase during campus placements**

Semester IV

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
4	25-922-0401	Data Warehousing and Mining	2	1	0	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall fundamental concepts of data warehousing and data mining, including various techniques used for data storage and analysis.
CO2	Understanding	Understand data warehousing concepts, such as ETL processes, data modeling, and the role of OLAP and OLTP systems.
CO3	Applying	Apply data mining techniques, including clustering, classification, and association rule mining, to solve real-world problems.
CO4	Analyzing	Analyze the effectiveness of various data mining algorithms and their application in data-driven decision making.
CO5	Evaluating	Evaluate the performance of data warehouse models and mining algorithms based on criteria like efficiency and accuracy.
CO6	Creating	Create a complete data warehouse solution and perform data mining tasks to extract useful insights.

Course Objectives

1. To introduce students to the concepts of data warehousing and data mining, their principles, and methodologies.
2. To provide a thorough understanding of the architecture and design of data warehouses, along with the processes involved in data warehousing.
3. To teach various data mining techniques and algorithms, with hands-on experience in applying these methods to solve problems in various domains.
4. To enable students to design, implement, and analyze data warehouse and mining projects using real-world data.

Course Modules

Module	Topic	45hrs
Module I	<p>Introduction to Data Warehousing</p> <p>Overview of Data Warehousing: Definition, importance, and architecture. Components of Data Warehousing: Data sources, staging, data warehouse, and data marts. Data Warehouse Design: Dimensional modeling, star schema, snowflake schema, and fact tables. OLAP vs. OLTP: Differences in processing and use cases. Hands-on: Basic data warehouse design using tools like MySQL or Microsoft SQL Server.</p>	9hrs
Module II	<p>ETL Process and Data Integration</p> <p>Extract, Transform, Load (ETL): Understanding the ETL process for data integration. Data Quality: Importance of data cleaning and transformation. ETL Tools: Overview of ETL tools like Talend, Apache Nifi, and Informatica. Data Transformation Techniques: Aggregation, filtering, and cleaning. Hands-on: Using an ETL tool to design a simple ETL pipeline.</p>	9hrs
Module III	<p>Introduction to Data Mining</p> <p>What is Data Mining?: Concepts, applications, and the difference from traditional statistics. Data Mining Process: Data collection, preprocessing, model building, evaluation, and deployment. Types of Data Mining: Supervised learning, unsupervised learning, and semi-supervised learning. Data Preprocessing: Handling missing data, normalization, and feature selection. Hands-on: Preprocessing a dataset using Python (Pandas, NumPy).</p>	9hrs

Module IV	<p>Data Mining Techniques and Algorithm</p> <p>Classification Algorithms: Decision trees, k-Nearest Neighbors (k-NN), Naive Bayes, and Support Vector Machines (SVM). Clustering Algorithms: K-means, hierarchical clustering, DBSCAN. Association Rule Mining: Apriori algorithm and FP-growth algorithm. Regression Analysis: Linear and logistic regression. Evaluation Metrics: Accuracy, precision, recall, F1 score, ROC curves. Hands-on: Implementing classification and clustering algorithms in Python (using Scikit-learn).</p>	9hrs
Module V	<p>Advanced Data Mining Techniques and Application</p> <p>Text Mining and Sentiment Analysis: Using NLP techniques to mine unstructured data. Time Series Mining: Techniques for forecasting and analyzing time-based data. Anomaly Detection: Identifying unusual patterns or outliers in data. Big Data and Data Mining: Techniques for mining data in distributed environments (e.g., Hadoop, Spark). Applications of Data Mining: Fraud detection, customer segmentation, recommendation systems. Hands-on: Applying data mining algorithms on a real-world dataset to solve business problems.</p>	9hrs

Books for Study:

1. Building the Data Warehouse, William H. Inmon, 4th Edition, 2005.
2. Data Warehousing, Data Mining, & OLAP, Alex Berson, Stephen J. Smith, 1st Edition, 2009.
3. Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber, Jian Pei, 3rd Edition, 2012.

Books for Reference:

1. Data Preparation for Data Mining, Dorian Pyle, 1st Edition, 1999.
2. Data Mining for Business Intelligence, Galit Shmueli et al., 2nd Edition, 2016.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
4	25-922-0402	Business Analytics	2	1	0	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understand the basic concepts and techniques of business analytics, including descriptive and predictive analytics.
CO2	Applying	Apply statistical and analytical methods to business data for decision-making processes.
CO3	Analyzing	Analyze business problems using data-driven approaches and statistical tools to generate actionable insights.
CO4	Evaluating	Evaluate business performance using key performance indicators (KPIs), metrics, and data visualization techniques.
CO5	Creating	Create data models, dashboards, and business reports that support strategic decision-making in business operations.
CO6	Reflecting	Reflect on ethical considerations and the implications of data-driven decisions in the business context.

Course Objectives

1. To introduce students to the field of business analytics and its importance in data-driven decision-making.

2. To provide hands-on experience with business analytics tools and techniques, such as regression analysis, time series analysis, and forecasting.
3. To equip students with the skills necessary to analyze and interpret business data and apply these insights to improve business performance.
4. To enhance students' ability to use analytical methods for problem-solving in various business domains, including marketing, finance, and operations.
5. To develop students' understanding of the ethical implications of business analytics and data privacy concerns.

Course Modules

Module	Topic	45hrs
Module I	Introduction to Business Analytics Fundamentals of business analytics – Scope and applications across sectors – Types of analytics: descriptive, predictive, prescriptive – Business analytics lifecycle: from problem definition to decision implementation – Overview of tools: Excel, SQL, Tableau, Python, and R – Ethical considerations and privacy concerns in data analytics	10hrs
Module II	Data Management and Preparation Data types and sources: structured vs. unstructured – Techniques for data cleaning and handling missing data – Data integration and transformation – Principles of data visualization – Exploratory Data Analysis (EDA) – Practical challenges in managing large-scale data	10hrs
Module III	Statistical Analysis and Modeling Descriptive statistics: mean, median, mode, variance – Probability distributions and their applications in business – Hypothesis testing and confidence intervals – Regression modeling: linear and logistic – Time series forecasting methods – Real-world applications of statistical modeling in business decisions	10hrs
Module IV	Advanced Analytics and Machine Learning Machine learning concepts: supervised, unsupervised, reinforcement learning – Predictive modeling: decision trees, random forests, neural networks – Clustering techniques: K-means, hierarchical – Optimization and decision-making tools – Model validation and performance metrics – Industry applications of machine learning	8hrs
Module V	Applications and Emerging Trends in Business Analytics Use cases in marketing, human resources, finance, and supply chain – Big data platforms: Hadoop and Spark – Cloud computing in data analytics – Artificial Intelligence in business decision-making – Data storytelling, ethical AI, and augmented analytics – Innovations shaping the future of analytics	7hrs

--	--	--

Books for Study:

1. Business Dynamics: Systems Thinking and Modeling for a Complex World, J. W. Forrester, 1st Edition, 2007.
2. Business Analytics, B. K. S. Gupta and A. S. Gupta, 1st Edition, 2017.
3. Competing on Analytics: The New Science of Winning, T. H. Davenport, 1st Edition, 2007.

Books for Reference:

1. Practical Business Analytics, E. J. L. Gaebelein, 1st Edition, 2015.
2. Business Analytics with R, F. H. Allen and A. K. Jain, 1st Edition, 2016.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
4	25-922-0403	Machine Learning Fundamentals	2	1	0	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall fundamental concepts and algorithms in machine learning.
CO2	Understanding	Understand the key types of machine learning (supervised, unsupervised, reinforcement learning) and their applications.

CO3	Applying	Apply machine learning techniques to real-world data using appropriate algorithms and frameworks.
CO4	Analyzing	Analyze datasets, select appropriate models, and evaluate the performance of machine learning models.
CO5	Evaluating	Evaluate the effectiveness and accuracy of machine learning models using appropriate metrics (e.g., precision, recall).
CO6	Creating	Create machine learning solutions for complex problems, integrating multiple techniques to develop robust models.

Course Objectives

1. To provide an introduction to machine learning concepts and algorithms.
2. To develop proficiency in applying machine learning techniques to real-world problems.
3. To teach students how to preprocess data and evaluate machine learning models.
4. To introduce students to the key differences between supervised, unsupervised, and reinforcement learning.
5. To foster hands-on experience with popular machine learning frameworks and libraries.

Course Modules

Module	Topic	45hrs
Module I	Introduction Machine Learning Foundations – Overview – Design of a Learning System – Types of Machine. Learning – Supervised Learning and Unsupervised Learning – Applications of Machine. Learning – Tools Overview for ML	9hrs
Module II	Supervised Learning – I Simple Linear Regression – Multiple Linear Regression – Polynomial Regression – Ridge. Regression – Lasso Regression – Evaluating Regression Models – Model Selection – Bagging – Ensemble Methods.	9hrs

Module III	Supervised Learning – II Classification – Logistic Regression – Decision Tree Regression and Classification – Random. Forest Regression and Classification – Support Vector Machine Regression and Classification – Evaluating Classification Models.	9hrs
Module IV	Unsupervised Learning Clustering – K-Means Clustering – Density-Based Clustering – Hierarchical Clustering-Dimension reduction: Principal Component Analysis, Linear Discriminant Analysis.	9hrs
Module V	Modelling and Evaluation Building the model, training a model, evaluating a model, improving a model. Performance metrics - accuracy, precision, recall, sensitivity, specificity, AUC, RoC, Bias Variance decomposition.	9hrs

Books for Study:

1. Machine Learning, Tom M. Mitchell, 1st Edition, 1997.
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, 2nd Edition, 2019.
3. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, 1st Edition, 2016.

Books for Reference:

1. Machine Learning Mastery, Jason Brownlee, 1st Edition, 2017.
2. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, 1st Edition, 2012.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
4	25-922-0404	Operating Systems	2	1	0	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Explaining	Explain the fundamental concepts and functions of an operating system.
CO2	Implementing	Implement and analyze process scheduling and synchronization techniques.
CO3	Applying	Assess security mechanisms and modern trends in operating system development.
CO4	Analyzing	Analyze memory management strategies, including paging, segmentation, and virtual memory.
CO5	Evaluating	Evaluate file systems, disk scheduling algorithms, and access control mechanisms.

Course Objectives

1. Explain the role, functions, and types of operating systems.
2. Understand process scheduling algorithms such as FCFS, SJF, Round Robin, and Priority Scheduling.
3. Learn memory allocation strategies like paging, segmentation, and virtual memory.
4. Discuss demand paging, page replacement algorithms, and thrashing.
5. Understand file system structures, file allocation methods, and disk scheduling algorithms.

Course Modules

Module	Topic	45hrs
Module I	Operating System Overview Introduction-Objectives and functions–Evolution of operating system- Operating System Structure and Operations-System calls – System programs, Operating-System Design and Implementation, Operating- System Debugging.	9hrs
Module II	Process Management Processes: Process concept – Process scheduling – Operations on processes – Interprocess communication. Threads: Overview –	9hrs

	Multithreading models – Thread issues. CPU Scheduling: FCFS, SJF, Priority, Round robin scheduling. Process synchronization – Critical section problem –Mutex locks – Semaphores, Deadlocks – Avoidance – Prevention – Detection and Recovery.	
Module III	Memory Management Main Memory: Contiguous memory allocation – Segmentation – Paging. Virtual Memory: Demand paging – Page replacement algorithms – Allocation of Frames – Thrashing.	9hrs
Module IV	Storage Management Mass Storage Structure: Overview – Disk scheduling and management. File System Storage: File concepts– Directory and disk structure – Sharing and protection. File System Implementation: File system structure– Directory structure – Allocation methods – Free space management	9hrs
Module V	I/O Systems and Security Overview - I/O Hardware - Application I/O Interface - Kernel I/O Subsystem –Transforming I/O Requests to Hardware Operations - System Protection: Goals -Domain - Access matrix. System Security: The Security Problem - Threats – Encryption- User Authentication.	9hrs

Books for Study:

1. Operating System Concepts, Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 9th Edition, 2018.
2. Operating Systems: Internals and Design Principles, William Stallings, 9th Edition, 2018.
3. Modern Operating Systems, Andrew S. Tanenbaum, Herbert Bos, 4th Edition, 2014.

Books for Reference:

1. Operating Systems: A Spiral Approach, Ramez Elmasri, A. Gil Carrick, David Levine, 1st Edition, 2010.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
4	25-922-0405	Cloud Computing	2	2	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall key concepts and terminology in cloud computing, including cloud service models and deployment models.
CO2	Understanding	Understand the architecture and components of cloud computing environments and platforms.
CO3	Applying	Apply cloud computing principles to design, develop, and deploy applications on cloud platforms.
CO4	Analyzing	Analyze the different service models (IaaS, PaaS, SaaS) and deployment models (private, public, hybrid) to choose the appropriate solution.
CO5	Evaluating	Evaluate cloud computing tools and platforms for their suitability in various use cases and application scenarios.
CO6	Creating	Design and implement a cloud-based system, including integration with cloud storage, computing, and networking services.

Course Objectives

1. To introduce students to cloud computing concepts and architectures.
2. To provide knowledge on cloud service and deployment models (IaaS, PaaS, SaaS, public, private, hybrid).

3. To explore popular cloud platforms like AWS, Microsoft Azure, and Google Cloud Platform.
4. To enable students to deploy and manage cloud applications and services.
5. To develop skills in utilizing cloud-based storage, computing resources, and networking services.

Course Modules

Module	Topic	60hrs
Module I	Introduction to Cloud Computing - Definition of cloud computing - Cloud service models: IaaS, PaaS, SaaS - Cloud deployment models: Public, Private, Hybrid - Benefits and challenges of cloud computing	12hrs
Module II	Cloud Computing Architecture - Cloud components and infrastructure - Virtualization in cloud computing - Hypervisors, Virtual Machines, and Containers - Cloud network architecture	12hrs
Module III	Cloud Platforms and Services - Overview of AWS, Microsoft Azure, Google Cloud - Cloud storage solutions - Cloud computing in practice: Setting up cloud instances	12hrs
Module IV	Cloud Security and Compliance - Cloud security principles - Data encryption, access control, and identity management - Compliance standards (GDPR, HIPAA, etc.) - Cloud security challenges and risk management	12hrs
Module V	Cloud Applications and Development - Cloud application architecture - Serverless computing and microservices in the cloud - Developing and deploying applications on cloud platforms - Monitoring and scaling cloud applications	12hrs

Books for Study:

1. Cloud Computing: Concepts, Technology & Architecture, Thomas Erl, 1st Edition, 2013.

2. Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS), Michael J. Kavis, 1st Edition, 2014.
3. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg, and Andrzej Goscinski, 1st Edition, 2011.

Books for Reference:

1. Cloud Computing: Implementation, Management, and Security, John W. Rittinghouse and James F. Ransome, 1st Edition, 2016.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
4	25-922-0406	Full Stack Development	0	0	8	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall the fundamentals of full stack development, including the technologies used for front-end and back-end development.
CO2	Understanding	Understand how different components of full stack development (front-end, back-end, and databases) interact with each other.
CO3	Applying	Apply tools and techniques for building dynamic web applications using modern frameworks and

		databases.
CO4	Analyzing	Analyze the architecture of full-stack applications and optimize for performance and scalability.
CO5	Evaluating	Evaluate and troubleshoot issues in full stack applications, including front-end, back-end, and database interactions.
CO6	Creating	Create, deploy, and maintain a full-stack web application with a working front-end, back-end, and database.

Course Objectives

1. To provide students with a comprehensive understanding of the full stack development process.
2. To develop hands-on skills in building modern web applications from both the front-end and back-end.
3. To introduce students to industry-standard frameworks and tools for web development (e.g., React, Node.js, Express, MongoDB).
4. To teach students how to integrate and deploy web applications with a complete back-end and front-end architecture.
5. To enable students to develop solutions for real-world web application problems by building complete applications.

Course Modules

Module	Topic	60hrs
Module I	Introduction to Web Development Basics of the Internet, HTTP/HTTPS, and Web Architecture. Introduction to HTML, CSS, JavaScript. DOM Manipulation, Event Handling. Git and Version Control.	12hrs
Module II	Front-End Development Advanced JavaScript. Front-end Frameworks (React.js/Angular). State Management (Redux, Context API). Responsive Design with Bootstrap. Handling API Calls and Asynchronous Programming.	12hrs

Module III	Back-End Development Introduction to Server-Side Programming (Node.js with Express.js). RESTful API Development Middleware and Authentication Techniques (JWT, OAuth). Error Handling and Logging WebSockets and Real-time Communication	12hrs
Module IV	Database Management SQL (MySQL/PostgreSQL) vs NoSQL (MongoDB, Firebase). CRUD Operations in Databases. ORM. Database Security and Indexing	12hrs
Module V	Deployment, Performance, and Security Hosting Web Applications (AWS, Heroku, Vercel, Netlify). CI/CD Pipelines. Web Security (CORS, CSRF, XSS Prevention). Performance Optimization Techniques (Lazy Loading, Code Splitting). Introduction to Progressive Web Apps (PWA)	12hrs

Books for Study:

1. JavaScript: The Definitive Guide, David Flanagan, 7th Edition, 2020.
2. Mastering Node.js, Mosh Hamedani, 1st Edition, 2020.
3. Learning React: Functional Web Development with React and Redux, Raymond Camden, 2nd Edition, 2018.

Books for Reference:

1. Web Development with Node and Express: Leveraging the JavaScript Stack, Ethan Brown, 2nd Edition, 2019.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
4	25-922-0407	Virtual Internship	0	0	6	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Applying	Apply theoretical knowledge to real-world industry problems through remote work and virtual collaboration.
CO2	Analyzing	Analyze industry practices, project management techniques, and software development lifecycles in a virtual environment.
CO3	Creating	Create and develop solutions for tasks assigned during the internship, using professional-grade tools and methodologies.
CO4	Evaluating	Evaluate industry tools, platforms, and technologies to identify the most appropriate solutions for given challenges.
CO5	Communicating	Effectively communicate ideas, progress, and results with colleagues and mentors using virtual collaboration tools.
CO6	Reflecting	Reflect on the internship experience to identify key learning outcomes, challenges, and areas for future growth.

Course Objectives

1. To provide students with an opportunity to gain hands-on experience by working on real-world projects through a virtual internship.
2. To help students apply and integrate the knowledge gained in previous courses (such as programming, data science, etc.) into practical work scenarios.
3. To introduce students to the professional work environment, project management tools, and virtual collaboration platforms.
4. To develop students' communication, problem-solving, and teamwork skills in a remote work setting.

Course Modules

Module	Topic	45hrs
---------------	--------------	--------------

Module I	<p>Introduction to Virtual Internship</p> <ul style="list-style-type: none"> - Understanding the structure and goals of a virtual internship - Tools and platforms for virtual collaboration and project management - Communication expectations in a remote setting 	9hrs
Module II	<p>Project Work and Problem Solving</p> <ul style="list-style-type: none"> - Working on industry-assigned projects - Problem-solving and task execution - Collaborating with mentors and team members remotely 	9hrs
Module III	<p>Virtual Teamwork and Collaboration</p> <ul style="list-style-type: none"> - Building effective virtual teams - Conflict resolution and decision-making in virtual teams - Use of virtual collaboration tools (Slack, Teams, Zoom, etc.) 	9hrs
Module IV	<p>Professional Development</p> <ul style="list-style-type: none"> - Adapting to industry standards and practices - Time management and productivity in a virtual work environment - Ethical practices and professionalism in a virtual setting 	9hrs
Module V	<p>Reflection and Presentation</p> <ul style="list-style-type: none"> - Final project presentation to mentors and peers - Reflecting on the virtual internship experience - Preparing a report summarizing the internship tasks, solutions, and key learning outcomes 	9hrs

Books for Study: The Future of Virtual Work, Gartner, No edition specified, 2020.

1. The Long-Distance Leader: Rules for Remarkable Remote Leadership, Wayne Turmel, No edition specified, 2020.

Books for Reference:

1. The Handbook of Research on Virtual Workplaces and the New Workplace, Steven G. Rogelberg, No edition specified, 2015.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
4	25-922-0408	The Indian Knowledge Systems	2	1	0	3	45

Course Outcomes

Upon successful completion of the course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Identify key contributions of Indian traditional sciences and arts.
CO2	Applying	Integrate concepts from Indian epistemology with modern scientific methods.
CO3	Analyzing	Analyze the relevance of Indian Knowledge Systems in modern contexts.
CO4	Evaluating	Critically evaluate the impact of Indian Knowledge Systems on culture and society.
CO5	Understanding	Explain the core principles and scope of Indian Knowledge Systems.

Course Objectives

1. Understand the fundamental concepts and philosophies underlying Indian Knowledge Systems.

2. Explore traditional Indian sciences, arts, literature, and their contributions to global knowledge.
3. Analyze the role of Indian knowledge in contemporary education, science, and technology.
4. Appreciate the integration of ancient wisdom with modern scientific thought.
5. Develop critical thinking skills through the study of Indian epistemology and methodologies.

Course Modules

Module	Topic
Module I	<p>The Indian Knowledge Systems (IKS) VAC aims to familiarize students with India's rich heritage of knowledge in various disciplines including philosophy, science, arts, architecture, health, agriculture, governance, and education. This course promotes holistic education rooted in Indian traditions while enhancing cultural awareness, critical thinking, and ethical reasoning.</p> <p>The course will cultivate national pride and encourage students to explore how ancient Indian systems can contribute to modern innovations and interdisciplinary research. Students will submit presentations, participate in interactive sessions, and explore original texts, translations, and commentaries.</p> <p>Weekly Reflection Journals</p> <ul style="list-style-type: none"> ● Description: After the completion of each unit, students will submit a 500–700 word reflection summarizing their understanding, key insights, and personal takeaways. ● Expected Output: <ul style="list-style-type: none"> ○ Summary of the unit ○ Reflections on values/ideas that impacted them ○ Connections to modern life or profession ○ Optional: Short quotes from ancient texts ● Purpose: Develop critical thinking, cultural introspection, and value-based interpretation. <p>Topic Presentation / Seminar (Individual or Group)</p> <ul style="list-style-type: none"> ● Description: Students will select a topic related to any domain of Indian Knowledge Systems (science, philosophy, medicine, language, art, architecture, etc.) and deliver a 10–12 minute presentation. ● Guidelines: <ul style="list-style-type: none"> ○ Groups of up to 3 students
Module II	
Module III	
Module IV	
Module V	

- Should include historical context, core concepts, relevance, and impact
- Use of visual aids (PPT, infographics, audio/video clips)
- **Evaluation Criteria:**
 - Clarity and depth of understanding
 - Research and originality
 - Presentation skills

3. Mini Research Report (Individual Submission)

- **Topic:** "The Relevance of Ancient Indian Knowledge in Today's World"
- **Format:**
 - Word count: 1500–2000 words
 - Proper referencing (APA/MLA)
 - Inclusion of modern examples and comparisons
- **Objective:** Encourage independent research and practical relevance.

Quiz / MCQ-based Assessment (After Each Unit)

- **Description:** At the end of every unit, students will take a short quiz (10–15 MCQs or short answer questions).
- **Purpose:** Ensure conceptual clarity and retention.

Creative Assignment (Optional but Encouraged)

- **Description:** Submit a creative output based on any IKS concept such as:
 - A short poem or verse inspired by Indian philosophy
 - A sketch or infographic illustrating a Yogic concept
 - A short video explaining an Ayurvedic principle
- **Purpose:** Foster engagement beyond academic learning and promote expression.

Final Project / Practical Demonstration

- **Description:** Submission of a **final project** that applies or analyzes a specific aspect of IKS. This could be:
 - A comparative study (e.g., Ancient Indian Mathematics vs Modern Approaches)
 - A translated or analyzed ancient shloka with explanation
 - A yoga routine based on classical texts with health applications
 - A tech-based project inspired by ancient engineering (e.g., water harvesting systems)
- **Format:** Written report (2000+ words) + demonstration or visual component
- **Deadline:** Final week of the course
- **Marks Weightage:** 30–40% of total course score

Portfolio Compilation & Submission

- **Description:** Students must maintain a digital/physical portfolio including:
 - Reflection journals

	<ul style="list-style-type: none"> ○ Presentation materials ○ Quiz scores ○ Mini research report ○ Creative assignment (if any) ○ Final project <ul style="list-style-type: none"> ● Purpose: Track progress, facilitate review, and serve as a personal knowledge archive. <p>Presentation Day / Symposium Participation</p> <ul style="list-style-type: none"> ● At the end of the course, students will participate in a showcase event or symposium where selected projects and presentations will be displayed or discussed.
--	--

Component(CA)	Marks
Reflection Journals	3
Quizzes	4
Seminar Presentation	5
Mini Research Report	5
Final Project	10
Participation/Portfolio	3

Semester V

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
5	25-922-0501	Capstone Projects	0	0	8	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Applying	Apply all learned skills from previous courses in real-world, industry-relevant projects.
CO2	Analyzing	Analyze complex problems and propose innovative solutions in the form of a project.
CO3	Creating	Create an end-to-end solution based on the project's objectives, from problem identification to solution implementation.
CO4	Evaluating	Evaluate and assess the success of the project, identifying areas for improvement and possible future developments.
CO5	Communicating	Effectively communicate project goals, progress, results, and challenges with the mentor, industry professionals, and peers.
CO6	Reflecting	Reflect on the project's outcomes and personal growth through the execution of the capstone project.

Course Objectives

1. To provide students an opportunity to integrate and apply their learning through a comprehensive, real-world project.

2. To develop problem-solving, critical thinking, and innovation skills by tackling complex, open-ended challenges.
3. To improve teamwork, communication, and leadership skills through collaborative project work.
4. To provide practical experience with industry-standard tools, methodologies, and practices.
5. To develop skills in presenting and reporting on technical projects to stakeholders, including mentors and professionals.

Course Modules

Module	Topic	60hrs
Module I	Project Selection and Planning - Identifying project goals, objectives, and scope - Developing a project plan - Understanding timelines, deliverables, and resources required	12hrs
Module II	Problem Solving and Solution Development - Defining the problem - Researching potential solutions - Developing a solution using relevant technologies and methodologies	12hrs
Module III	Implementation and Execution - Building and implementing the solution - Iterative development and testing - Documenting the progress and changes made during implementation	12hrs
Module IV	Project Evaluation and Testing - Testing the solution against project requirements - Identifying gaps and addressing issues - Preparing for project delivery and final review	12hrs
Module V	Presentation and Reporting - Preparing a project presentation for stakeholders - Writing a comprehensive project report - Reflecting on project learning and outcomes	12hrs

Books for Study:

1. Software Engineering: A Practitioner's Approach, W. Royce, 6th Edition, 2004.
2. Project Management for the 21st Century, G. Deaton, 2nd Edition, 2009.

Books for Reference:

1. Software Engineering Economics, B. Boehm, 1st Edition, 1981.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
5	25-922-0502	Deep Learning	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understand the core concepts and techniques in Deep Learning, including neural networks and backpropagation.
CO2	Applying	Apply deep learning algorithms to solve real-world problems in image recognition, speech processing, and natural language processing.
CO3	Analyzing	Analyze and evaluate the performance of deep learning models using various metrics and techniques.
CO4	Evaluating	Evaluate the use of deep learning models for different types of problems, including the trade-offs between accuracy and computational complexity.
CO5	Creating	Create deep learning models using popular frameworks like TensorFlow and PyTorch, and train them on real datasets.
CO6	Reflecting	Reflect on the ethical implications of deploying deep learning models in real-world applications and ensure fairness and transparency.

Course Objectives

1. To introduce students to the foundational principles of deep learning.
2. To equip students with hands-on experience in building, training, and evaluating deep learning models.
3. To provide insights into the practical applications of deep learning across different domains such as computer vision, NLP, and speech recognition.
4. To explore advanced techniques in deep learning, including convolutional neural networks (CNNs) and recurrent neural networks (RNNs).
5. To understand the challenges in deploying deep learning models and ensure their ethical use in real-world systems.

Course Modules

Module	Topic	60hrs
Module I	<p>Introduction to Deep Learning</p> <p>Overview of Machine Learning vs. Deep Learning. Basics of Neural Networks and Backpropagation. Activation Functions (ReLU, Sigmoid, Tanh, Softmax). Optimization Techniques (Gradient Descent, Adam, RMSProp). Introduction to Deep Learning Frameworks: TensorFlow and PyTorch</p>	12hrs
Module II	<p>Deep Learning Architectures</p> <p>Multi-Layer Perceptrons (MLPs) and Feedforward Networks. Convolutional Neural Networks (CNNs) for Image Processing. CNN Architectures: LeNet, AlexNet, VGG, ResNet. Transfer Learning and Fine-tuning. Recurrent Neural Networks (RNNs) for Sequential Data. LSTMs and GRUs for Time Series and NLP Tasks. Autoencoders and Dimensionality Reduction Techniques</p>	12hrs
Module III	<p>Training and Optimization of Deep Learning Models</p> <p>Loss Functions (Cross-Entropy, MSE, Huber Loss). Regularization Techniques (Dropout, Batch Normalization, L2 Regularization). Hyperparameter Tuning and Model Selection. Handling Overfitting and</p>	12hrs

	Underfitting. Distributed and Parallel Training Techniques	
Module IV	<p>Advanced Deep Learning Models</p> <p>Generative Adversarial Networks (GANs). Vanilla GANs, DCGANs, Conditional GANs. Transformers and Attention Mechanisms. Self-Attention and Multi-Head Attention. BERT, GPT, Vision Transformers (ViTs). Reinforcement Learning with Deep Q-Networks (DQN)</p>	12hrs
Module V	<p>Applications of Deep Learning</p> <p>Computer Vision. Image Classification, Object Detection, and Image Segmentation. Applications in Medical Imaging and Autonomous Vehicles. Natural Language Processing (NLP). Sentiment Analysis, Chatbots, Text Summarization, Machine Translation. Speech and Audio Processing. Speech Recognition, Music Generation, Speaker Identification. Healthcare and Bioinformatics. Disease Prediction, Drug Discovery, Personalized Medicine.</p>	12hrs

Books for Study:

1. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, 1st Edition, 2016.
2. Deep Learning with Python, Francois Chollet, 1st Edition, 2017.
3. Neural Networks and Deep Learning, Michael Nielsen, 1st Edition, 2015.

Books for Reference:

1. Python Machine Learning, Sebastian Raschka, 1st Edition, 2015.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
5	25-922-0503	Big Data Analytics	2	1	0	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understand the concepts of big data, the challenges involved, and the importance of big data analytics in modern computing.
CO2	Applying	Apply big data analytics techniques to process large datasets using Hadoop, Spark, and other big data tools.
CO3	Analyzing	Analyze big data using various tools and techniques, including data wrangling, clustering, and regression.
CO4	Evaluating	Evaluate the performance of different big data analytics algorithms and techniques for solving real-world problems.
CO5	Creating	Create big data pipelines and develop applications that can handle and process large datasets efficiently.
CO6	Reflecting	Reflect on the ethical and social implications of big data analytics in real-world applications, including data privacy.

Course Objectives

1. To introduce students to the concepts and tools used in big data analytics.

2. To provide hands-on experience with big data frameworks such as Hadoop, Spark, and NoSQL databases.
3. To develop skills in processing, analyzing, and interpreting large datasets.
4. To explore the challenges and opportunities of big data analytics in different domains, including healthcare, finance, and e-commerce.
5. To understand the ethical issues and challenges related to big data analytics, including data privacy and security.

Course Modules

Module	Topic	45hrs
Module I	<p>INTRODUCTION TO BIG DATA Dawn of the Big Data Era, Definition and Features of Big Data, Big Data Value, The Development of Big Data, Challenges of Big Data.</p> <p>RELATED TECHNOLOGIES: Cloud Computing - Cloud Computing Preliminaries, Relationship Between Cloud Computing and Big Data, IoT - IoT Preliminaries, Relationship Between IoT and Big Data, Data Centre, Hadoop - Hadoop Preliminaries, Relationship between Hadoop and Big Data</p>	9hrs
Module II	<p>BIG DATA GENERATION AND ACQUISITION Big Data Generation-Enterprise Data, IoT Data, Internet Data, Biomedical Data, Data Generation from Other Fields, Big Data Acquisition - Data Collection, Data Transportation, Data Pre-processing.</p>	9hrs
Module III	<p>HDFS (Hadoop Distributed File System) A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem (Pig, Hive, HBase and Big SQL) The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces. Analysing Data with Hadoop, Scaling Out, Hadoop Streaming, Hadoop Pipes. Data Storage and Analysis, Comparison with Other Systems.</p>	9hrs
Module IV	<p>Map Reduce Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.</p>	9hrs

Module V	BIG DATA ANALYSIS Traditional Data Analysis, Big Data Analytic Methods, Architecture for Big Data Analysis - Real-Time vs. Offline Analysis, Analysis at Different Levels, Analysis with Different Complexity, Tools for Big Data Mining and Analysis.	9hrs
-----------------	--	-------------

Books for Study:

1. Hadoop: The Definitive Guide, Tom White, 4th Edition, 2015.
2. Learning Spark: Lightning-Fast Big Data Analysis, Matei Zaharia et al., 1st Edition, 2016.
3. The Analytics Revolution: How to Improve Your Business by Making Analytics Operational in the Big Data Era, Bill Franks, 1st Edition, 2014.

Books for Reference:

1. Big Data: A Revolution That Will Transform How We Live, Work, and Think, Viktor Mayer-Schönberger, Kenneth Cukier, 1st Edition, 2013.
2. Information Technology Project Management, Kathy Schwalbe, 7th Edition, 2015.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
5	25-922-0504	Natural Language Processing	0	0	8	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall basic concepts of natural language processing (NLP), including text processing and the role of linguistic structures in NLP.

CO2	Understanding	Understand NLP tasks such as tokenization, part-of-speech tagging, named entity recognition, and sentiment analysis.
CO3	Applying	Apply NLP techniques to preprocess and analyze text data, including stemming, lemmatization, and feature extraction.
CO4	Analyzing	Analyze text data using machine learning models and NLP tools, such as Word2Vec and BERT, to extract meaningful insights.
CO5	Evaluating	Evaluate the effectiveness of various NLP models in terms of accuracy, precision, recall, and F1-score.
CO6	Creating	Create NLP-based applications, such as chatbots, sentiment analysis tools, and document classification systems.

Course Objectives

1. To introduce students to the fundamental concepts of natural language processing and its applications.
2. To provide hands-on experience with key NLP techniques, such as tokenization, part-of-speech tagging, named entity recognition, and text classification.
3. To explore advanced NLP models, including deep learning techniques for language modeling and text generation.
4. To apply NLP methods to solve real-world problems in areas such as sentiment analysis, machine translation, and document summarization.

Course Modules

Module	Topic	60hrs
Module I	INTRODUCTION TO NLP Introduction to NLP - Text pre-processing: Regular Expression, tokenization, Stemming, Minimum Edit distance. N-Gram Language Model - N-Gram probability estimation and perplexity - Smoothing techniques (Laplace/good Turing/Kneser-Ney/Interpolation)	12hrs

Module II	TEXT REPRESENTATION Bag-of-words:Tf/IDF, Count Vector - Vector space Model - Latent semantic Analysis - Word embedding - Word2Vec - Glove - fastText - Sentence embedding Technique: Doc2Vec	12hrs
Module III	TEXT CLASSIFICATION AND CLUSTERING The text classification problem - Feature Selection - Naive Bayes text classification - k- nearest neighbors - Support vector Machine - Flat Clustering - K-means algorithm - Hierarchical clustering	12hrs
Module IV	MORPHOLOGY AND PART OF SPEECH TAGGING Morphology - Part of speech Tagging - Rule-Based Part of Speech Tagging - Markov Models - Hidden Markov Models - Viterbi algorithms - Maximum Entropy Models.	12hrs
Module V	SEQUENCE PROCESSING WITH RECURRENT NETWORKS Simple Recurrent Neural Networks - Applications of Recurrent Neural Networks - Deep Networks: Stacked and Bidirectional RNNs - Managing Context in RNNs: LSTMs and GRUs - NLP Applications: Information Extraction, Named Entity Recognition and Relation Extraction, Question Answering, Text Summarization, Dialog System, Machine Translation	12hrs

Books for Study:

1. Foundations of Statistical Natural Language Processing, Christopher D. Manning and Hinrich Schütze, 1st Edition, 1999.
2. Speech and Language Processing, Daniel Jurafsky and James H. Martin, 3rd Edition (Draft), 2019.
3. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, 1st Edition, 2016.

Books for Reference:

1. An Overview of Transfer Learning in NLP, Sebastian Ruder, arXiv preprint (no edition), 2017.
2. Natural Language Processing with Python, Steven Bird and Edward Loper, 1st Edition, 2009.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
5	25-922-0505	Introduction to Internet of Things (IoT)	2	1	0	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understand the core concepts of the Internet of Things, including its components, architecture, and communication protocols.
CO2	Applying	Apply IoT concepts to real-world applications, such as smart homes, healthcare, and industrial automation.
CO3	Analyzing	Analyze the challenges and security issues associated with IoT systems and their applications.
CO4	Evaluating	Evaluate the design and implementation of IoT systems, including sensors, actuators, and cloud integration.
CO5	Creating	Design and develop IoT-based projects using sensors, microcontrollers, and cloud services.
CO6	Reflecting	Reflect on the societal and ethical implications of IoT technologies in daily life and industries.

Course Objectives

1. To introduce students to the fundamentals of the Internet of Things (IoT), including its components and architecture.
2. To provide hands-on experience with IoT devices, sensors, and actuators, and their integration with cloud services.

3. To teach the design and development of IoT-based applications for various sectors such as smart homes, healthcare, and industrial automation.
4. To understand the challenges of IoT systems, including data security, privacy concerns, and network reliability.
5. To explore the future trends and potential impact of IoT on society and various industries.

Course Modules

Module	Topic	45hrs
Module I	Fundamentals of IoT and AI Introduction to IoT: Architecture, Protocols, and Communication Models. Overview of AI and Machine Learning in IoT. IoT Hardware Platforms: Raspberry Pi, Arduino, ESP32. IoT Communication Protocols: MQTT, CoAP, HTTP, LoRaWAN. Cloud vs. Edge vs. Fog Computing in IoT	9hrs
Module II	IoT Data Analytics and AI Models Data Acquisition, Storage, and Preprocessing in IoT. AI Models for IoT: Supervised, Unsupervised, and Reinforcement Learning. Real-time Data Processing with Edge AI and TinyML. AI for Sensor Data Fusion and Anomaly Detection. Case Studies: Predictive Maintenance, Smart Grids, and Industrial IoT	9hrs
Module III	IoT Security, Privacy, and Ethics Security Challenges in IoT Networks. AI-Powered Threat Detection and Cybersecurity Measures Blockchain for IoT Data Integrity and Security. Data Privacy Regulations (GDPR, PDPB) in AI-IoT Systems. Ethical Concerns in AI-driven IoT Applications	9hrs
Module IV	Cloud and Edge AI for IoT Cloud Platforms for IoT: AWS IoT, Google Cloud IoT, Microsoft Azure IoT Hub. Edge Computing for Low Latency AI Inference. Federated Learning in IoT Networks. AI Model Deployment on IoT Devices (TensorFlowLite, OpenVINO). Case Studies: AI on Wearables, Smart Cameras, and Connected Vehicles	9hrs

Module V	Applications and Future Trends Smart Cities and AI-powered Traffic Management. AI-driven Healthcare IoT Systems (Wearables, Remote Patient Monitoring). IoT in Precision Agriculture and Environmental Monitoring. Future of AI-IoT Integration: 6G, Neuromorphic Computing, and Digital Twins. Hands-on Project: Building an AI-powered IoT Prototype	9hrs
-----------------	--	-------------

Books for Study:

1. Internet of Things: A Hands-On Approach, Jan H. Lee, 1st Edition, 2017.
2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, 1st Edition, 2017.
3. Internet of Things (IoT): Architecture, Protocols and Applications, Rajesh Singh, 1st Edition, 2018.

Books for Reference:

1. Internet of Things: A Hands-On Approach, Arshdeep Bahga and Vijay Madisetti, 1st Edition, 2015.
2. The Internet of Things: A Guide to the Intelligent Connected World, IoT World, 1st Edition, 2020.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
5	25-922-0506	Recruitment Essentials	2	1	0	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description

CO1	Understanding	Understand the recruitment process, including sourcing, screening, and selection methods.
CO2	Applying	Apply various recruitment strategies and tools to attract and select suitable candidates for different job roles.
CO3	Analyzing	Analyze job requirements and assess candidates' qualifications, skills, and cultural fit within an organization.
CO4	Evaluating	Evaluate recruitment techniques, tools, and strategies for optimizing hiring decisions and improving recruitment processes.
CO5	Creating	Design recruitment strategies for specific roles and organizational needs, ensuring alignment with company goals and values.
CO6	Reflecting	Reflect on the legal and ethical implications of recruitment practices and the impact of hiring decisions on diversity and inclusion.

Course Objectives

1. To provide an understanding of the recruitment process from job analysis to the final hiring decision.
2. To teach students how to identify and use appropriate recruitment channels, such as online platforms, job fairs, and networking.
3. To develop the skills necessary for assessing candidates effectively through resumes, interviews, and psychometric tests.
4. To provide knowledge of the legal, ethical, and diversity considerations involved in the recruitment process.
5. To explore the role of recruitment in promoting organizational culture and achieving strategic workforce objectives.

Course Modules

Module	Topic	45hrs
Module I	Introduction to Recruitment - Overview of the recruitment process - Types of recruitment (internal vs. external) - Recruitment lifecycle and stages	9hrs

Module II	Job Analysis and Role Definition - Conducting job analysis - Creating job descriptions and specifications - Identifying key skills and competencies for recruitment	9hrs
Module III	Sourcing and Attracting Candidates - Sourcing methods: job portals, social media, and headhunting - Writing effective job advertisements - Employer branding and attracting talent	9hrs
Module IV	Screening and Interviewing Candidates - Reviewing resumes and applications - Types of interviews (structured, unstructured, panel) - Behavioral and competency-based interview techniques	9hrs
Module V	Selection and Onboarding - Selection methods: psychometric tests, background checks, and reference verification - Making the offer and negotiating salary - Onboarding process and its importance for employee retention	9hrs

Books for Study:

1. The Recruitment and Selection Handbook, Herman, M., 1st Edition, 2016.
2. Human Resource Information Systems, Kavanagh, M. & Thite, M., 3rd Edition, 2015.
3. Human Resource Management, Torrington, D., Hall, L., & Taylor, S., 9th Edition, 2017.

Books for Reference:

1. Recruitment and Selection in Human Resource Management: Sourcing, Screening, and Selecting Talent, McGraw-Hill, 1st Edition, 2017.
2. Recruitment Essentials: A Practical Guide, K. P. M. Shreya, 1st Edition, 2018.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
5	25-922-0507	Career Competency Enhancement	0	0	6	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understand the key competencies required for career development, including personal, professional, and technical skills.
CO2	Applying	Apply career development strategies to enhance employability, including resume writing, interview techniques, and networking.
CO3	Analyzing	Analyze the demands of the job market and align personal competencies with industry requirements and career opportunities.
CO4	Evaluating	Evaluate various career growth strategies, job search techniques, and self-assessment tools to optimize career progression.
CO5	Creating	Create a comprehensive career development plan that includes goal setting, skill improvement, and strategies for long-term professional growth.
CO6	Reflecting	Reflect on personal career growth and development, incorporating feedback and experience to make informed decisions.

Course Objectives

1. To equip students with the essential skills for career development, including resume writing, job interviews, and networking.
2. To develop self-assessment techniques for identifying strengths, weaknesses, and areas for professional growth.
3. To enhance employability by focusing on industry-specific competencies, soft skills, and professional etiquette.
4. To guide students in creating a structured career development plan tailored to their professional goals.
5. To increase awareness of job market trends, industry expectations, and strategies for personal branding.

Course Modules

Module	Topic	45hrs
Module I	Introduction to Career Competencies - Understanding career competencies - Personal vs. professional competencies - Importance of soft skills and technical skills in career success	9hrs
Module II	Self-Assessment and Goal Setting - Tools for self-assessment - Identifying personal strengths and areas for growth - Setting SMART career goals	9hrs
Module III	Resume Writing and Job Search Techniques - Creating an effective resume and cover letter - Job search strategies: networking, job boards, and internships - Tailoring applications for specific job roles	9hrs
Module IV	Interview Skills and Professional Etiquette - Preparing for interviews: mock interviews, common questions, and responses - Professional etiquette: workplace behavior, communication skills, and conflict resolution	9hrs
Module V	Career Development Plan - Creating a personalized career development plan - Continuous learning and skill development - Preparing for career growth and transitions	9hrs

Books for Study:

1. Strategic Human Resource Management, J.A. Mello, Edition not specified, 2014.
2. What Color Is Your Parachute?, R.N. Bolles, Edition not specified, 2020.
3. Emotional Intelligence, D. Goleman, Edition not specified, 2006.

Books for Reference:

1. How to Write the Perfect Resume, B. Kaufman, Edition not specified, 2015.
2. HBR Guide to Getting the Right Job, Harvard Business Review, Edition not specified, 2017.

Semester VI

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
6	25-922-0601	Industry Internship Program	0	0	4	2	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Outcome (CO)	Cognitive Ability	Description
CO1	Applying	Apply theoretical knowledge from coursework to real-world industry scenarios and problems.
CO2	Analyzing	Analyze real-world business and technical challenges within the context of industry work, recognizing the scope and constraints.
CO3	Evaluating	Evaluate industry processes, tools, and methodologies, and suggest improvements based on the experience gained during the internship.
CO4	Creating	Contribute to industry-specific projects by creating solutions, coding, or building prototypes based on the work environment.
CO5	Reflecting	Reflect on the internship experience and integrate lessons learned into personal and professional growth strategies.
CO6	Communicating	Communicate effectively in a professional environment, presenting technical and non-technical content to both peers and supervisors.

Course Objectives

1. To provide students with the opportunity to gain practical experience in the industry, applying academic knowledge to real-world scenarios.
2. To expose students to the professional work environment, helping them develop essential workplace skills such as communication, teamwork, and problem-solving.

3. To allow students to explore their career interests and build networks within the industry.
4. To enable students to contribute to industry projects, gaining valuable insights into project management, deadlines, and collaborative work.
5. To evaluate and enhance students' technical skills through hands-on experience in relevant industry tools and practices.
6. To prepare students for employment by improving their professional demeanor, work ethics, and career readiness.

Course Modules

Module	Topic	60hrs
Module I	Introduction to the Internship Program - Overview of internship expectations - Preparing for the industry work environment - Professional conduct and ethics	12hrs
Module II	Workplace Integration and Skill Application - Applying academic knowledge to industry tasks - Shadowing industry professionals - Hands-on technical work and project participation	12hrs
Module III	Project Work and Problem Solving - Working on industry-specific projects - Identifying challenges and proposing solutions - Developing technical and non-technical solutions	12hrs
Module IV	Communication and Collaboration in the Workplace - Communicating effectively in team settings - Reporting work progress to mentors and supervisors - Cross-functional collaboration	12hrs
Module V	Reflection and Career Development - Reflecting on personal and professional growth - Creating a post-internship career plan - Leveraging internship experience for career opportunities	12hrs

Books for Study:

1. Young, R., *"Internships: A Guide to Building Your Career," McGraw-Hill, 2017.*
2. DeBrock, R., *"The Internship Bible," Princeton Review, 2015.*

3. Robinson, M., *"The Professional Intern: How to Make the Most of Your Internship Experience," Pearson Education, 2016.*

Books for Reference:

1. Krosnick, M., *"Successful Internships: A Complete Guide to Internships in Business and Industry," Wiley, 2018.*

Evaluation Methods for Continuous Internal Evaluation (CIE)

1. **Assignments and Quizzes** (20% of total marks)
 - **Assignments:** Regular assignments that assess the application of theoretical knowledge to practical scenarios. These assignments can include problem-solving tasks, case studies, research papers, or reflective essays.
 - **Quizzes:** Short, time-bound quizzes covering the key concepts of the course. They can be conducted online or in-class, testing both recall and understanding of the subject matter.
2. **Project Work / Case Studies** (30% of total marks)
 - **Project Reports:** Involves group or individual projects where students apply the concepts learned during the course to real-world problems or scenarios. The project report should include research, data analysis, findings, and recommendations.
 - **Case Studies:** Critical analysis of real-world business or technical problems, focusing on their solutions and the application of course concepts. Students are required to submit a detailed report or make a presentation.
3. **Class Participation and Discussions** (10% of total marks)
 - Active participation in class discussions, debates, and brainstorming sessions related to course topics. This may include sharing ideas, asking questions, and contributing to group discussions.
 - Engagement during guest lectures, workshops, and seminars.
4. **Presentations and Demo Sessions** (20% of total marks)
 - Students will be required to present their findings from projects, case studies, or research papers. Presentations should be structured, clear, and should reflect an in-depth understanding of the subject.
 - Demo sessions can be conducted for practical-based subjects (such as in software development, engineering, or fintech) where students demonstrate their practical skills.
5. **Mid-term/Periodical Tests** (20% of total marks)
 - A test conducted during the middle of the semester to assess students' understanding and retention of the first half of the syllabus. This test will focus on conceptual and applied knowledge.

Evaluation Methods for End-Semester Examination (ESE)

1. Theory Examination (70% of total marks)

- **Comprehensive Exam:** A written exam covering the entire syllabus of the course. The exam will typically consist of:
 - **Objective-type questions:** Multiple-choice questions (MCQs), true/false, fill-in-the-blanks.
 - **Short-answer questions:** Testing basic understanding and key concepts.
 - **Long-answer questions:** Testing in-depth knowledge, critical thinking, and the ability to apply learned concepts.
 - **Case Study Questions:** For applied courses, students may be required to analyze a case study and provide a detailed response based on course learning.

2. Practical Examination (30% of total marks)

- For subjects that involve practical learning (e.g., programming, lab work, project management), a practical exam will be conducted.
- Students will be required to demonstrate their skills in real-time using software tools, programming languages, or lab equipment.
- Evaluation will be based on the correctness of the output, problem-solving approach, and the efficiency of the solution.

Grading and Marking Scheme

- **CA (30 Marks) :** Marks for CIE will be awarded based on the student's consistent performance in assignments, participation, projects, and mid-term tests. A minimum score (typically 40%) is required in CIE to be eligible for the ESE.
- **Final Exam (70 Marks) :** The ESE is a summative assessment that will carry a significant weight towards the final grade. A minimum score (typically 40%) is required in the final exam to pass the course.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
6	25-922-0602	Entrepreneurship in AI and Data Science	2	1	0	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall key concepts of entrepreneurship, AI, and Data Science, including the challenges and opportunities in this domain.
CO2	Understanding	Understand the intersection between entrepreneurship and emerging technologies like AI and Data Science.
CO3	Applying	Apply entrepreneurial thinking and strategies to create and scale AI-driven solutions in business contexts.
CO4	Analyzing	Analyze the business viability of AI and Data Science innovations, identifying the competitive landscape and market opportunities.
CO5	Evaluating	Evaluate business models, funding strategies, and product-market fit for AI-driven startups.
CO6	Creating	Create a business plan or prototype for a start-up focused on AI or Data Science, addressing customer needs and technological solutions.

Course Objectives

1. To introduce students to the fundamental principles of entrepreneurship and how they apply to AI and Data Science.
2. To help students understand the challenges and opportunities in creating AI-powered businesses.
3. To provide students with the skills necessary to assess market opportunities and customer needs in AI and Data Science.
4. To guide students through the process of developing business plans, pitching ideas, and securing funding for AI-based startups.
5. To foster a mindset of innovation and problem-solving, encouraging students to think critically about new applications of AI and Data Science in business.
6. To prepare students to develop their own AI-driven ventures or contribute to existing ones.

Course Modules

Module	Topic	45hrs
Module I	Introduction to Entrepreneurship - Key principles of entrepreneurship - The role of innovation in business - Types of business models for AI and Data Science	9hrs
Module II	Identifying Opportunities in AI and Data Science - Market research and customer needs - Spotting trends in AI and Data Science - Competitive analysis and niche targeting	9hrs
Module III	Business Models for AI and Data Science Startups - Developing AI-driven business models - Product-market fit and value proposition - Scaling and sustainability in AI ventures	9hrs
Module IV	Funding and Scaling AI Ventures - Sources of funding: Venture capital, angel investors, crowdfunding - Pitching ideas and securing investment - Scaling AI-driven products and services	9hrs
Module V	Building an AI-Driven Product - Prototype development using AI and Data Science - Collaborating with technical teams to bring ideas to life - User feedback, iteration, and final product launch	9hrs

Books for Study:

1. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company, Blank, S. & Dorf, B., 1st Edition, 2012.
2. Open Business Models: How to Thrive in the New Innovation Landscape, Chesbrough, H., 1st Edition, 2010.
3. The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies, Brynjolfsson, E. & McAfee, A., 1st Edition, 2014.

Books for Reference:

1. Data-Driven: Creating a Data Culture, Marr, B., 1st Edition, 2018.
2. The AI Spring: A New Era for Startups and Entrepreneurs, O'Reilly, T. & Batelle, J., 1st Edition, 2016.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
6	25-922-0603	Robotic Process Automation	2	1	0	3	45

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Explain the fundamental concepts, benefits, and challenges of RPA.
CO2	Applying	Demonstrate proficiency in using RPA tools to create simple automation workflows.
CO3	Analyzing	Develop and deploy RPA bots to automate business processes.
CO4	Analyzing	Analyze and optimize business processes for RPA implementation.
CO5	Evaluating	Evaluate security, governance, and future trends in RPA technology.

Course Objectives

1. Learn the basic concepts, benefits, and limitations of RPA.
2. Understand the architecture, components, and workflow of RPA tools.
3. Learn about bots, workflows, and automation scripts.
4. Optimize workflows using RPA and measure performance improvements.
5. Learn about security risks, compliance, and governance in RPA implementations

Course Modules

Module	Topic	45hrs
Module I	Introduction to Robotic Process Automation (RPA) Scope and techniques of automation - What RPA can do and its benefits - Components and platforms of RPA (focus on UiPath) - RPA basics: What is RPA? RPA vs Automation - Types of bots and processes that can be automated - RPA development methodologies and differences from SDLC, RPA Risks, challenges, and the future of RPA.	9hrs
Module II	RPA Tool Introduction and Basics Introduction to RPA Tool - User Interface - Managing Variables (Text, Number, Array, Date, Data Table) - Managing Arguments - Control Flow: If Else, Loops, Sequences, Flowcharts, Activities (Assign, Delay, Do While, If, Switch, For Each, Break) - Data Manipulation: Scalar Variables, Collections, Text Manipulation, Assembling Data.	9hrs
Module III	Advanced Automation Concepts & Techniques Recording: Basic and Desktop Recording, Web Recording - Input/Output Methods - Screen and Data Scraping - Selectors: Defining, Assessing, and Dynamic Selectors - Debugging - Image & Text Automation: Image-based, Keyboard-based, Citrix Automation - Best Practices for Image Automation - Excel Data Tables: Data Manipulation in Excel, Extracting Data from PDF.	9hrs
Module IV	Handling User Events & Assistant Bots, Exception Handling What are assistant bots? - Monitoring system event triggers: Hotkey, Mouse, System, Image, and Element triggers - Example of monitoring email and blocking copying event - Launching an assistant bot on a keyboard event - Exception handling: Debugging and exception handling tools, strategies for solving issues, catching errors.	9hrs
Module V	Deploying and Maintaining the Bot Publishing using publish utility - Creation of Server - Using Server to control the bots - Creating and connecting a provision Robot to Server - Deploying the Robot to Server - Publishing and managing updates - Managing packages: Uploading and deleting packages	9hrs

Books for Study:

1. Learning Robotic Process Automation, Alok Mani Tripathi, 1st Edition, 2018.

2. Robotic Process Automation using UiPath StudioX, Adeel Javed, Anum Sundrani, Nadia Malik, 1st Edition, 2021.

Books for Reference:

1. Introduction to Robotic Process Automation: A Primer, Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, 1st Edition, 2015.

Semester VII

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
7	25-922-0701	Capstone Project/Research	0	0	12	6	180

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall previous knowledge and methodologies acquired throughout the program to identify and refine research questions.
CO2	Understanding	Understand the process of conducting research or a capstone project, including planning, execution, and reporting.
CO3	Applying	Apply research methods, data analysis techniques, and AI/Data Science methodologies to a real-world problem.
CO4	Analyzing	Analyze collected data and draw meaningful conclusions that contribute to the field of study.
CO5	Evaluating	Evaluate research outcomes and assess the effectiveness of the methodologies and tools used in the project.
CO6	Creating	Create a detailed report or research paper presenting the results of the project or research in a professional format.

Course Objectives

1. To allow students to apply their learning in a practical, real-world context through a comprehensive project or research.
2. To guide students in solving complex problems or conducting original research in the fields of AI, Data Science, or related technologies.
3. To help students develop critical thinking, problem-solving, and project management skills through their capstone project.
4. To foster creativity, innovation, and independence in addressing challenges using AI/Data Science methods.
5. To provide an opportunity for students to engage with current industry trends or academic research and contribute new insights.

References

- **Books and Journals:** Students are expected to refer to academic journals, books, and papers related to their chosen project or research topic.
- **Online Databases:** Access to research databases like IEEE Xplore, Springer, and others may be provided by the institution.
- **Software and Tools:** Depending on the project, students may need to use software tools like Python, R, MATLAB, SQL, etc., for research or development.

Electives

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
7	25-922-0702	Generative AI	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall the fundamental concepts of generative AI, such as neural networks, generative models, and architectures.

CO2	Understanding	Understand how generative models work, including their application in real-world scenarios such as content generation and image synthesis.
CO3	Applying	Apply generative techniques to solve complex problems in areas like image, text, and music generation.
CO4	Analyzing	Analyze the performance of different generative AI models, such as GANs and VAEs, and identify the strengths and limitations of each.
CO5	Evaluating	Evaluate and compare the results of generative AI models in producing realistic and meaningful outputs.
CO6	Creating	Design and create original generative models using AI technologies to generate new content based on data.

Course Objectives

1. To introduce students to the field of generative AI and its applications.
2. To teach the underlying mathematics and algorithms that power generative AI models.
3. To provide hands-on experience in implementing generative AI models such as GANs, VAEs, and other neural networks.
4. To demonstrate the practical uses of generative AI in fields like art, media, and data augmentation.
5. To encourage critical thinking about the ethical implications and challenges in generative AI.

Course Modules

Module	Topic	60hrs
Module I	Introduction to Generative AI Definition of Generative AI. Definition and importance. Difference between discriminative and generative models. Overview of key generative AI algorithms (GANs, VAEs, Diffusion Models).	12hrs

	Applications of generative AI in real-world industries: Art, Music, Text, Healthcare, etc. Ethical challenges in generative AI: Deepfakes, AI bias, content ownership	
Module II	<p>Generative Adversarial Networks (GANs)</p> <p>Introduction to GANs: Generator and Discriminator. The theory behind adversarial training and loss functions. Training a GAN model: Challenges and techniques. Variations of GANs: DCGAN, WGAN, CycleGAN. Hands-on: Building a simple GAN for image generation (using TensorFlow/PyTorch)</p>	12hrs
Module III	<p>Variational Autoencoders (VAEs)</p> <p>Basics of autoencoders: Encoder, Decoder, and Latent Space. Introduction to Variational Autoencoders (VAEs). The theory behind probabilistic autoencoders and latent variables. Applications of VAEs in data generation and anomaly detection. Hands-on: Building a VAE for image generation or reconstruction</p>	12hrs
Module IV	<p>Diffusion Models and Advanced Generative Techniques</p> <p>Introduction to Diffusion Models and how they generate data. How diffusion models work: Forward and reverse processes. Applications of diffusion models in text-to-image synthesis (e.g., DALL-E, Stable Diffusion). Other generative models: Flow-based models and Neural Ordinary Differential Equations (ODEs). Hands-on: Implementing a diffusion model for simple image generation</p>	12hrs
Module V	<p>Applications of Generative AI</p> <p>Introduction to Prompt Engineering. Definition and Scope. Importance of Prompt Design in AI (especially LLMs like GPT, PaLM, Claude, etc.). Types of Prompting Techniques. Basic Prompting. Instruction-based Prompting. Contextual Prompting. Text Generation: Overview of GPT-based models (GPT-3, GPT-4, T5) for natural language processing. Image Generation: Using GANs and diffusion models for creative design, art, and photo-realistic images. Music Composition:</p>	12hrs

	Applying generative models to compose original music.	
--	---	--

Books for Study:

1. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, 1st Edition, 2016.
2. Neural Networks and Deep Learning, Michael Nielsen, 1st Edition, 2015.

Books for Reference:

1. Deep Learning, Yann LeCun, Yoshua Bengio, Geoffrey Hinton, Article in Nature, 2015.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
7	25-922-0703	Optimization Techniques	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Explain the fundamental concepts and applications of optimization techniques.
CO2	Applying	Solve linear programming problems using graphical, simplex, and duality methods..
CO3	Analyzing	Analyze constrained and unconstrained optimization problems using classical techniques.
CO4	Evaluating	Evaluate and apply optimization algorithms in machine learning and engineering problems.
CO5	Creating	Implement metaheuristic optimization techniques for real-world applications.

Course Objectives

1. Learn the basic principles of optimization, including problem formulation and classification.
2. Understand the role of optimization in decision-making and problem-solving.
3. Study graphical and simplex methods for solving linear programming problems.
4. Understand gradient-based and gradient-free optimization techniques.
5. Apply multi-objective optimization techniques to real-world applications

Course Modules

Module	Topic	60hrs
Module I	Introduction to Optimization Optimization Problem Formulation. Classification of Optimization Problems (Linear, Non-Linear, Discrete, Continuous). Applications of Optimization in Engineering, Management, and Data Science. Convex and Non-Convex Optimization.	12hrs
Module II	Linear Programming and Integer Programming Formulation of Linear Programming Problems (LPP). Graphical Method and Simplex Method Duality in Linear Programming. Integer Linear Programming (Branch and Bound, Cutting Plane Methods). Applications of Linear Programming in Supply Chain and Finance.	12hrs
Module III	Non-Linear and Constrained Optimization Unconstrained Optimization: Gradient Descent, Newton's Method. Constrained Optimization: Lagrange Multipliers, Karush-Kuhn-Tucker (KKT) Conditions. Quadratic Programming. Multi-objective Optimization and Pareto Efficiency.	12hrs
Module IV	Advanced Optimization Techniques Metaheuristic Optimization: Genetic Algorithms, Simulated Annealing, Particle Swarm Optimization. Evolutionary Algorithms and Swarm Intelligence. Stochastic Optimization Methods. Constraint Handling in Metaheuristics.	12hrs

Module V	Optimization and Engineering Applications Loss Functions, Backpropagation, Hyperparameter Tuning, Operations Research Applications in Scheduling, Transportation, and Resource Allocation. Case Studies: Energy Optimization, Robotics, Financial Modeling.	12hrs
----------	---	--------------

Books for Study:

1. Optimization for Engineering Design: Algorithms and Examples, Kalyanmoy Deb, 2nd Edition, 2012.
2. Engineering Optimization: Theory and Practice, S. S. Rao, 4th Edition, 2009.
3. An Introduction to Optimization, Edwin K. P. Chong, Stanislaw H. Zak, 4th Edition, 2013.

Books for Reference:

1. Introduction to Optimization: Operations Research, J. C. Pant, 3rd Edition, 2012.
2. Operations Research: An Introduction, H. A. Taha, 9th Edition, 2010.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
7	25-922-0704	Data Ethics and Privacy	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Explain the fundamental ethical theories and challenges in data ethics.

CO2	Understanding	Understanding the fundamental ethical theories and challenges in data ethics.
CO3	Applying	Apply ethical frameworks to assess fairness, bias, and transparency in AI systems.
CO4	Analyzing	Analyze global and national data privacy laws and their implications.
CO5	Evaluating	Evaluate cybersecurity risks and privacy-preserving techniques in data handling.
CO6	Creating	Develop ethical data governance policies for organizations and individuals.

Course Objectives:

1. Learn the fundamental principles of ethics in data collection, processing, and analysis.
2. Examine ethical dilemmas in data-driven decision-making.
3. Explore compliance requirements for organizations handling sensitive data.
4. Study methods to ensure fairness, transparency, and accountability in AI and data science.
5. Assess risks related to bias, misinformation, and algorithmic discrimination.

Course Modules

Module	Topic	60hrs
Module I	Introduction to Data Ethics Ethics in Data Science: Principles and Challenges. Theories of Ethics: Utilitarianism, Deontology, Virtue Ethics. Responsible AI and the Role of Ethics in Automation. Ethical Issues in Big Data and Cloud Computing	12hrs
Module II	Privacy Laws and Regulatory Frameworks Overview of Data Protection Laws: GDPR (Europe), CCPA (USA), PDPB (India). Right to Privacy: Legal and Philosophical Perspectives.	12hrs

	Data Ownership and User Consent Mechanisms. Ethical Considerations in Government Surveillance and Data Collection	
Module III	Ethical Challenges in AI Bias and Fairness in Machine Learning Algorithms. Algorithmic Accountability and Explainability. Ethical Implications of Facial Recognition and Biometric Data. Case Studies: AI Ethics Failures and Controversies	12hrs
Module IV	Data Protection Introduction to Cybersecurity and Ethical Hacking. Encryption Techniques and Secure Data Transmission. Data Anonymization and Privacy-Preserving Data Sharing. Case Studies: Data Breaches and Their Ethical Implications	12hrs
Module V	Future Trends in Data Ethics and Governance Emerging Technologies and Their Ethical Implications. Ethics in IoT, Blockchain, and Quantum Computing. Corporate Social Responsibility in Data Management. Developing an Ethical Code of Conduct for Data Professionals	12hrs

Books for Study:

1. Law Relating to Computers, Internet & E-Commerce, Nandan Kamath, 1st Edition, 2018.
2. Cyber Laws and IT Protection, P. K. Sinha, 1st Edition, 2018.

Books for Reference:

1. Data Governance and Privacy in India, Anirudh Burman, 1st Edition, 2020.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
7	25-922-0705	Reinforcement Learning	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall the fundamental concepts and terminologies used in reinforcement learning, including agents, environments, rewards, and actions.
CO2	Understanding	Understand key reinforcement learning algorithms, such as Q-learning and policy gradient methods, and their applications.
CO3	Applying	Apply reinforcement learning algorithms to solve real-world decision-making problems in environments like robotics, gaming, and autonomous systems.
CO4	Analyzing	Analyze the strengths and weaknesses of different reinforcement learning approaches, and identify suitable models for various applications.
CO5	Evaluating	Evaluate the performance of reinforcement learning models using metrics such as reward maximization, convergence, and stability.
CO6	Creating	Design and implement reinforcement learning models, and enhance them by incorporating advanced techniques like deep reinforcement learning and multi-agent systems.

Course Objectives

1. To introduce students to the principles and fundamentals of reinforcement learning.
2. To teach the key algorithms used in reinforcement learning, including Q-learning, SARSA, and Policy Gradient methods.
3. To provide hands-on experience in implementing and experimenting with reinforcement learning algorithms in various environments.
4. To explore the use of deep learning in reinforcement learning (deep reinforcement learning) for complex decision-making problems.

- To evaluate the ethical considerations and challenges in deploying reinforcement learning models in real-world applications.

Course Modules

Module	Topic	60hrs
Module I	<p>Introduction to Reinforcement Learning</p> <p>Overview of Reinforcement Learning and its difference from supervised and unsupervised learning. Key components: Agent, environment, states, actions, rewards, and policies. The RL framework: Markov Decision Process (MDP), states, actions, rewards, and transition dynamics. Exploration vs. exploitation trade-off: Epsilon-greedy strategy and Softmax action selection. Hands-on: Setting up a simple RL environment (e.g., GridWorld or FrozenLake using OpenAI Gym).</p>	12hrs
Module II	<p>Dynamic Programming and Value Iteration</p> <p>Introduction to Dynamic Programming in RL: Bellman equations and Bellman Optimality Equation. Solving MDPs using value iteration and policy iteration. Value functions and optimal policies. Hands-on: Implementing value iteration and policy iteration algorithms for simple MDPs.</p>	12hrs
Module III	<p>Model-Free Prediction and Control</p> <p>Model-free methods: Temporal Difference (TD) learning and Monte Carlo methods. Q-Learning: An off-policy algorithm for learning optimal policies. SARSA (State-Action-Reward-State-Action): An on-policy algorithm. Exploration strategies: epsilon-greedy, Boltzmann exploration, and Upper Confidence Bound (UCB). Hands-on: Implementing Q-learning and SARSA for simple RL tasks (e.g., GridWorld).</p>	12hrs
Module IV	<p>Policy Gradient Methods</p> <p>Introduction to Policy Gradient Methods: The concept of directly</p>	12hrs

	learning a policy. The REINFORCE algorithm: Monte Carlo policy gradient method. Actor-Critic Methods: Combining value-based and policy-based methods. Exploration techniques in policy-based RL: Entropy regularization and noise injection. Hands-on: Implementing the REINFORCE algorithm for continuous action spaces.	
Module V	<p>Advanced Topics in Reinforcement Learning</p> <p>Deep Reinforcement Learning: Combining deep learning with RL (e.g., Deep Q-Networks, DQN). Multi-agent Reinforcement Learning: Cooperative and competitive environments. Model-based RL: Building models of the environment to improve exploration. Inverse Reinforcement Learning: Learning from demonstrations and imitation learning. Applications of RL: Robotics, game playing (e.g., AlphaGo), autonomous driving, and recommendation systems. Hands-on: Implementing a deep Q-network (DQN) for game playing (e.g., CartPole, Atari).</p>	12hrs

Books for Study:

1. Reinforcement Learning: An Introduction, Richard S. Sutton & Andrew G. Barto, 2nd Edition, 2018.
2. Algorithms for Reinforcement Learning, Csaba Szepesvári, 1st Edition, 2010.

Books for Reference:

1. Reinforcement Learning: State-of-the-Art, Marco Wiering & Martijn van Otterlo, 1st Edition, 2012.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
7	25-922-0706	Geospatial Data Science	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understand the fundamentals of geospatial data and its applications.
CO2	Applying	Apply geospatial tools and techniques for data acquisition and visualization.
CO3	Analyzing	Analyze and interpret spatial data using statistical and computational methods.
CO4	Evaluating	Evaluate different geospatial data sources and processing techniques.
CO5	Creating	Design and implement geospatial applications in real-world scenarios.

Course Objectives

1. To introduce fundamental concepts and importance of geospatial data science.
2. To develop skills in spatial data processing, visualization, and analysis.
3. To explore geospatial technologies such as GIS, remote sensing, and GPS.
4. To apply machine learning and statistical techniques for spatial data analysis.
5. To implement real-world applications in geospatial data science using programming tools.

Course Modules

Module	Topic	60hrs
Module I	Introduction to Geospatial Data Science Definition and Scope of Geospatial Data Science. Spatial Data Types: Vector and Raster Data. Geospatial Data Formats: Shapefiles, GeoJSON, KML. Applications of Geospatial Data Science in Various Fields	12hrs
Module II	Geographic Information Systems (GIS) and Remote Sensing Basics of GIS and Spatial Databases. Coordinate Systems and Map Projections. Remote Sensing Fundamentals: Satellite Imagery and Sensors. Georeferencing and Image Processing	12hrs
Module III	Spatial Data Analysis and Visualization Spatial Data Preprocessing and Cleaning. Spatial Statistics: Spatial Autocorrelation, Kriging, and Interpolation. Data Visualization Techniques: Heatmaps, Choropleth Maps, and 3D Maps. Web Mapping Technologies: Google Maps API, Leaflet, and OpenStreetMap	12hrs
Module IV	Machine Learning and AI for Geospatial Analysis Introduction to Spatial Machine Learning. Supervised and Unsupervised Learning for Geospatial Data. Object Detection in Satellite Images using Deep Learning. Spatial Data Clustering and Classification Techniques.	12hrs
Module V	Applications and Case Studies in Geospatial Data Science Urban Planning and Smart Cities. Disaster Management and Climate Change Analytics. Transportation and Logistics Optimization. Environmental Monitoring and Agriculture Analytics	12hrs

Books for Study:

1. Remote Sensing and GIS, B. Bhatta, 2nd Edition, 2011.
2. Principles of Geographical Information Systems, P. A. Burrough & R. A. McDonnell, 2nd Edition, 1998.

3. Geographic Information Systems and Science, Longley, Goodchild, Maguire & Rhind, 3rd Edition, 2010.

Books for Reference:

1. Python Scripting for ArcGIS, Paul Zandbergen, 1st Edition, 2013.
2. Digital Analysis of Remotely Sensed Imagery, Jay Gao, 1st Edition, 2009.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
7	25-922-0707	AI Analytics in Internet Of Things	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Explain the architecture and key technologies of IoT.
CO2	Understanding	Analyze various data acquisition and communication protocols used in IoT systems.
CO3	Applying	Apply AI and machine learning techniques for IoT data analytics.
CO4	Analyzing	Use cloud platforms to store, process, and analyze IoT data in real time.
CO5	Evaluating	Assess privacy, security, and ethical concerns in AI-powered IoT systems

Course Objectives

1. To understand the fundamentals of IoT and its architecture.
2. To explore the integration of AI and analytics within IoT environments.

3. To apply machine learning techniques on IoT-generated data.
4. To utilize cloud platforms for real-time analytics in IoT.
5. To evaluate security, privacy, and ethical issues in intelligent IoT applications.

Course Modules

Module	Topic	60hrs
Module I	<p>Introduction to IoT</p> <p>Overview of IoT and its ecosystem, IoT architecture: perception, network, and application layers, IoT communication models: MQTT, CoAP, HTTP, Sensor networks and IoT devices, Edge, Fog, and Cloud Computing in IoT</p>	12hrs
Module II	<p>Data Acquisition and Communication in IoT</p> <p>Data sensing and transmission, Protocols for wireless communication: Zigbee, LoRa, NB-IoT, Data formats: JSON, XML, Data ingestion pipelines, Real-time vs batch processing</p>	12hrs
Module III	<p>AI and Machine Learning for IoT Analytics</p> <p>Supervised and unsupervised learning in IoT, Time series analysis and anomaly detection, Predictive maintenance using ML, AI algorithms for smart devices: Decision Trees, k-NN, SVM, Case studies: Smart homes, healthcare, transportation</p>	12hrs
Module IV	<p>Cloud & Edge-based Analytics Platforms</p> <p>Cloud computing platforms: AWS IoT, Azure IoT Hub, Google IoT Core, IoT Analytics as a Service (AaaS), Edge AI – processing at the device level, Data lakes, data streaming (Kafka, Spark), Visualization dashboards (Grafana, Power BI)</p>	12hrs
Module V	<p>Security, Privacy, and Ethics in AIoT</p> <p>IoT security challenges and cryptographic solutions, Secure device</p>	12hrs

	authentication and data integrity, Ethical AI frameworks for IoT, Privacy regulations: GDPR, HIPAA in IoT context, Responsible AI and sustainability in IoT	
--	---	--

Books for Study:

1. Digitising the Industry – Internet of Things Connecting the Physical, Digital and Virtual Worlds, Ovidiu Vermesan & Peter Friess, 1st Edition, 2016.
2. From Machine-to-Machine to the Internet of Things, Jan Holler & Vlasios Tsiatsis, 1st Edition, 2014.

Books for Reference:

1. Security and Privacy in Cyber-Physical Systems: Foundations and Challenges, Mian Ahmad Jan, 1st Edition, 2021.
2. Building Blocks for IoT Analytics, John Soldatos, 1st Edition, 2016.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
7	25-922-0708	Robotics and AI	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Remembering	Recall key concepts of robotics, including robot design, sensors, actuators, and control systems.
CO2	Understanding	Understand the integration of AI with robotics, including perception, reasoning, and decision-making processes.
CO3	Applying	Apply algorithms in robotics, such as path planning, localization, and object recognition, in practical scenarios.
CO4	Analyzing	Analyze the challenges of robotics systems in real-world applications and evaluate the performance of various AI models used in robotics.

CO5	Evaluating	Evaluate the effectiveness of robotic AI systems in dynamic environments using metrics like efficiency and adaptability.
CO6	Creating	Design and implement intelligent robotic systems capable of solving complex tasks in uncertain environments.

Course Objectives

1. To provide foundational knowledge on robotics and how AI is applied in robotics for decision-making and autonomous behavior.
2. To teach key robotic algorithms for motion planning, navigation, and control.
3. To develop skills in integrating AI techniques, such as computer vision and reinforcement learning, with robotic systems.
4. To explore the ethical implications of robotics and AI in real-world applications.
5. To provide hands-on experience in building and programming robots for different tasks.

Course Modules

Module	Topic	60hrs
Module I	Introduction to Robotics and AI: Overview of robotics, AI, and their convergence. Basic concepts in robot design, sensors, actuators, and control systems.	12hrs
Module II	Robot Kinematics and Motion Planning: Understanding forward and inverse kinematics. Algorithms for robot motion planning, path finding, and obstacle avoidance.	12hrs
Module III	AI for Robotics: Introduction to AI algorithms used in robotics. Machine learning, computer vision, and reinforcement learning for autonomous robots.	12hrs
Module IV	Robotics Perception and Decision-Making: Techniques for perception, including vision-based object recognition, sensor fusion, and decision-making algorithms.	12hrs
Module V	Applications of Robotics and AI: Practical applications of robotics and AI in fields such as healthcare, manufacturing, autonomous vehicles, and service robots.	12hrs

Books for Study:

1. Introduction to Robotics: Mechanics and Control, John J. Craig, 4th Edition, 2017.
2. Robotics: Modelling, Planning, and Control, Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, 1st Edition, 2009.

Books for Reference:

1. Artificial Intelligence: A Modern Approach, Stuart Russell, Peter Norvig, 3rd Edition, 2010.
2. Robot Operating System (ROS) for Absolute Beginners, Lentin Joseph, 1st Edition, 2018.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
7	25-922-0709	Cloud Computing for Data Science	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understand cloud computing concepts, architectures, and deployment models.
CO2	Applying	Use cloud services for data storage, processing, and analytics.
CO3	Analyzing	Implement scalable machine learning models using cloud-based tools.
CO4	Evaluating	Optimize data science workflows using cloud-based automation and orchestration.

CO5	Creating	Secure and manage cloud environments for data science applications.
------------	----------	---

Course Objectives

1. To introduce the fundamentals of cloud computing and its relevance to data science.
2. To equip students with skills for handling big data in the cloud.
3. To provide hands-on experience with cloud platforms for data analytics and machine learning.
4. To develop problem-solving skills for real-world cloud-based data science projects.

Course Modules

Module	Topic	60hrs
Module I	Introduction to Cloud Computing for Data Science Basics of cloud computing: IaaS, PaaS, SaaS models. Public, private, and hybrid cloud models. Key cloud service providers: AWS, Azure, Google Cloud. Benefits of cloud computing for data science	12hrs
Module II	Cloud Infrastructure for Data Science Virtual machines (VMs), containers (Docker, Kubernetes). Cloud storage: S3, Blob Storage, Google Cloud Storage. Data warehousing solutions: Amazon Redshift, Google BigQuery, Azure Synapse. Serverless computing and its role in data science	12hrs
Module III	Cloud-Based Data Processing & Analytics Distributed computing frameworks: Hadoop, Apache Spark. Data pipelines and ETL in the cloud (AWS Glue, Dataflow, Azure Data Factory). Real-time data processing with Kafka, Kinesis, and Pub/Sub. SQL and NoSQL databases in the cloud.	12hrs
Module IV	Machine Learning & AI on Cloud Cloud-based ML services: AWS SageMaker, Azure ML, Google Vertex AI. Training and deploying ML models at scale. Model monitoring and performance optimization. AutoML and cloud-based deep learning frameworks.	12hrs

Module V	Cloud Security & Cost Optimization Cloud security best practices and compliance. Identity and access management (IAM) for cloud services. Cost management strategies for cloud-based data science projects. Case studies and industry applications	12hrs
----------	--	--------------

Books for Study:

1. Cloud Computing: Concepts, Technology & Architecture, Thomas Erl, 1st Edition, 2013.
2. Architecting the Cloud, Michael J. Kavis, 1st Edition, 2014.

Books for Reference:

1. Google Cloud Platform for Data Science, Sanket Thodge, 1st Edition, 2018.
2. AWS Certified Data Analytics Study Guide, Asif Abbasi, 1st Edition, 2020.

Course Overview

Semester	Count Code	Course Title	L	T	P	C	Total Hours
7	25-922-0710	Computer Vision	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understand the concepts and techniques in digital image processing.
CO2	Applying	Apply feature extraction and image segmentation techniques.
CO3	Analyzing	Analyze visual information using machine learning approaches.

CO4	Evaluating	Implement deep learning architectures for image classification and object detection.
CO5	Creating	Design vision-based applications using real-world datasets.

Course Objectives

1. To introduce fundamental concepts of image processing and computer vision.
2. To explore feature detection, object recognition, and motion estimation techniques.
3. To apply machine learning and deep learning models to solve vision tasks.
4. To implement and experiment with computer vision algorithms using tools like OpenCV and TensorFlow.
5. To understand real-world applications such as surveillance, robotics, healthcare, and autonomous vehicles.

Course Modules

Module	Topic	60hrs
Module I	Introduction to OpenCV - Image basics : Technical requirements, Theoretical Introduction to Image basics , Concepts of pixels, colors, channels, images and colorspaces., Accessing manipulating pixels, BGR .	12hrs
Module II	Handling files and images: Technical requirements, Theoretical Introduction to handling files and images, reading and writing images, camera frames , video files; Drawing shapes, writing text, dynamic drawing and advanced drawing.	12hrs
Module III	Image Processing in Opencv: Technical requirements, Image processing techniques, splitting and merging channels, Geometric transformations of images, Image filtering, Arithmetic with images, Morphological transformations, color spaces and color maps; Constructing and building	12hrs

	Histograms: Theoretical Introduction to histogram, Grayscale histograms, color histograms, custom visualization- CLAHE and histogram Equalization	
Module IV	Contour detection, Filtering and Drawing: - Compressing contours, Image moments, Filtering, Recognizing and matching contours; Augmented Reality: Introduction to AR, Markless – based AR, snapchat based AR, QR code detection. Machine learning and Deep learning in Opencv: K- Means clustering and K- Nearest Neighbour, Support Vector Machine.	12hrs
Module V	Machine learning and Deep learning in Opencv :Face detection, Detecting facial landmarks , tracking and recognition.Mobile and web computer vision with python and OpenCV :Introduction to python web frameworks, flask, computer vision applications using flask, Deep learning API using keras and flask, Deploying flask application to the cloud.	12hrs

Books for Study:

Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, 1st Edition, 2016.

1. Practical Python and OpenCV, Adrian Rosebrock, 3rd Edition, 2016.
2. Feature Extraction & Image Processing for Computer Vision, Mark S. Nixon & Alberto S. Aguado, 3rd Edition, 2012.

3. **Books for Reference:**

1. Programming Computer Vision with Python, Jan Erik Solem, 1st Edition, 2012.
2. Digital Image Processing and Analysis, B. Chanda & D. Dutta Majumder, 2nd Edition, 2011.

Semester	Course Code	Course Title	L	T	P	C	Total Hours
7	25-922-0711	Industry Internship Program	0	0	8	4	120

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Applying	Apply theoretical knowledge gained during the program to real-world industry projects or work scenarios.
CO2	Analyzing	Analyze real-world problems encountered in the industry and suggest possible solutions.
CO3	Evaluating	Evaluate business processes, workflows, and technology solutions in the industry setting.
CO4	Creating	Develop new solutions, tools, or processes that can contribute to the industry's operations or research.
CO5	Communicating	Communicate effectively with teams, supervisors, and clients in a professional manner.

Course Objectives

1. To provide students with practical exposure and hands-on experience in their field of study.
2. To enable students to integrate academic learning with real-world industry practices and challenges.
3. To foster problem-solving skills and encourage innovation through the execution of industry-relevant tasks and projects.
4. To enhance professional communication and teamwork skills in a business or research environment.
5. To expose students to industry norms, standards, and technologies used in their field.

Course Modules

Module	Topic	120hrs
Module I	Internship Preparation: Introduction to the internship, industry orientation, understanding the organization's objectives, and setting goals.	24hrs
Module II	Industry Project/Work Experience: Engaging in real-world industry tasks, working on assigned projects, and learning industry-specific tools and processes.	24hrs
Module III	Problem Solving and Implementation: Identifying problems in the industry, applying solutions, working through challenges, and implementing improvements.	24hrs
Module IV	Professional Development and Networking: Building professional relationships, enhancing teamwork, and developing leadership and communication skills.	24hrs
Module V	Internship Review and Reflection: Preparing internship reports, reflecting on the experience, and presenting findings to supervisors or faculty.	24hrs

Books for Study:

1. Business Communication: Building Critical Skills, Kitty Locker and Stephen Kaczmarek, 6th Edition, 2013.

Books for Reference:

1. The Handbook of Work-Based Learning, S. C. Chadwick and E. L. Plumb, 1st Edition, 2005.

Evaluation Methods for Continuous Assessment (CA)

6. **Assignments and Quizzes** (20% of total marks)
 - **Assignments:** Regular assignments that assess the application of theoretical knowledge to practical scenarios. These assignments can include problem-solving tasks, case studies, research papers, or reflective essays.
 - **Quizzes:** Short, time-bound quizzes covering the key concepts of the course. They can be conducted online or in-class, testing both recall and understanding of the subject matter.
7. **Project Work / Case Studies** (30% of total marks)
 - **Project Reports:** Involves group or individual projects where students apply the concepts learned during the course to real-world problems or scenarios. The

project report should include research, data analysis, findings, and recommendations.

- **Case Studies:** Critical analysis of real-world business or technical problems, focusing on their solutions and the application of course concepts. Students are required to submit a detailed report or make a presentation.

8. Class Participation and Discussions (10% of total marks)

- Active participation in class discussions, debates, and brainstorming sessions related to course topics. This may include sharing ideas, asking questions, and contributing to group discussions.
- Engagement during guest lectures, workshops, and seminars.

9. Presentations and Demo Sessions (20% of total marks)

- Students will be required to present their findings from projects, case studies, or research papers. Presentations should be structured, clear, and should reflect an in-depth understanding of the subject.
- Demo sessions can be conducted for practical-based subjects (such as in software development, engineering, or fintech) where students demonstrate their practical skills.

10. Mid-term/Periodical Tests (20% of total marks)

- A test conducted during the middle of the semester to assess students' understanding and retention of the first half of the syllabus. This test will focus on conceptual and applied knowledge.

Evaluation Methods for End-Semester Examination (ESE)

3. Theory Examination (70% of total marks)

- **Comprehensive Exam:** A written exam covering the entire syllabus of the course. The exam will typically consist of:
 - **Objective-type questions:** Multiple-choice questions (MCQs), true/false, fill-in-the-blanks.
 - **Short-answer questions:** Testing basic understanding and key concepts.
 - **Long-answer questions:** Testing in-depth knowledge, critical thinking, and the ability to apply learned concepts.
 - **Case Study Questions:** For applied courses, students may be required to analyze a case study and provide a detailed response based on course learning.

4. Practical Examination (30% of total marks)

- For subjects that involve practical learning (e.g., programming, lab work, project management), a practical exam will be conducted.
- Students will be required to demonstrate their skills in real-time using software tools, programming languages, or lab equipment.

- Evaluation will be based on the correctness of the output, problem-solving approach, and the efficiency of the solution.

Semester VIII

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
8	25-922-0801	Capstone Project/Research	0	0	16	8	120

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Creating	Develop a comprehensive research project or capstone that integrates knowledge from various fields of study.
CO2	Applying	Apply critical thinking and problem-solving skills to real-world industry problems through research or a practical project.
CO3	Analyzing	Analyze data, results, and methodologies in the context of the problem being studied or solved.
CO4	Evaluating	Evaluate the effectiveness of the project or research findings and provide recommendations for future work or applications.
CO5	Communicating	Effectively present research findings, project results, and conclusions through written reports and presentations.

Course Objectives

1. To provide students with an opportunity to apply the theoretical knowledge gained during their coursework to a real-world problem or research question.
2. To encourage critical thinking and independent research.
3. To promote problem-solving skills through hands-on project or research experience.

- To foster effective communication skills, both in written and oral formats, in presenting the results of the project/research.

Course Modules

Module	Topic
Module I	Project/Research Proposal: Introduction to the research process, defining the problem, setting objectives, and identifying resources.
Module II	Research Methodology/Project Planning: Literature review, research design, data collection, and methodology planning.
Module III	Implementation/Experimentation: Conducting experiments, implementing solutions, or applying the research methodology to address the project/research problem.
Module IV	Data Analysis and Evaluation: Analyzing results, interpreting data, identifying patterns, and drawing conclusions.
Module V	Presentation and Reporting: Writing a comprehensive report and presenting the research findings in front of an audience (internal and/or external).

Books for Study:

- The Craft of Research, Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams, 4th Edition, 2016.
- Research Methodology: A Step-by-Step Guide for Beginners, Ranjit Kumar, 5th Edition, 2022.

Books for Reference:

- Writing Research Papers, James D. Lester and James D. Lester Jr., 15th Edition, 2014.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
8	25-922-0802	Industry Internship Program	0	0	12	6	180

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Applying	Apply theoretical knowledge gained during the program to real-world industry projects or work scenarios.
CO2	Analyzing	Analyze real-world problems encountered in the industry and suggest possible solutions.
CO3	Evaluating	Evaluate business processes, workflows, and technology solutions in the industry setting.
CO4	Creating	Develop new solutions, tools, or processes that can contribute to the industry's operations or research.
CO5	Communicating	Communicate effectively with teams, supervisors, and clients in a professional manner.

Course Objectives

6. To provide students with practical exposure and hands-on experience in their field of study.
7. To enable students to integrate academic learning with real-world industry practices and challenges.
8. To foster problem-solving skills and encourage innovation through the execution of industry-relevant tasks and projects.
9. To enhance professional communication and teamwork skills in a business or research environment.
10. To expose students to industry norms, standards, and technologies used in their field.

Course Modules

Module	Topic	180hrs
Module I	Internship Preparation: Introduction to the internship, industry orientation, understanding the organization's objectives, and setting	36hrs

	goals.	
Module II	Industry Project/Work Experience: Engaging in real-world industry tasks, working on assigned projects, and learning industry-specific tools and processes.	36hrs
Module III	Problem Solving and Implementation: Identifying problems in the industry, applying solutions, working through challenges, and implementing improvements.	36hrs
Module IV	Professional Development and Networking: Building professional relationships, enhancing teamwork, and developing leadership and communication skills.	36hrs
Module V	Internship Review and Reflection: Preparing internship reports, reflecting on the experience, and presenting findings to supervisors or faculty.	36hrs

Books for Study:

2. Business Communication: Building Critical Skills, Kitty Locker and Stephen Kaczmarek, 6th Edition, 2013.

Books for Reference:

2. The Handbook of Work-Based Learning, S. C. Chadwick and E. L. Plumb, 1st Edition, 2005.

Evaluation Methods for Continuous Internal Evaluation (CIE)

11. Assignments and Quizzes (20% of total marks)

- **Assignments:** Regular assignments that assess the application of theoretical knowledge to practical scenarios. These assignments can include problem-solving tasks, case studies, research papers, or reflective essays.
- **Quizzes:** Short, time-bound quizzes covering the key concepts of the course. They can be conducted online or in-class, testing both recall and understanding of the subject matter.

12. Project Work / Case Studies (30% of total marks)

- **Project Reports:** Involves group or individual projects where students apply the concepts learned during the course to real-world problems or scenarios. The project report should include research, data analysis, findings, and recommendations.

- **Case Studies:** Critical analysis of real-world business or technical problems, focusing on their solutions and the application of course concepts. Students are required to submit a detailed report or make a presentation.

13. Class Participation and Discussions (10% of total marks)

- Active participation in class discussions, debates, and brainstorming sessions related to course topics. This may include sharing ideas, asking questions, and contributing to group discussions.
- Engagement during guest lectures, workshops, and seminars.

14. Presentations and Demo Sessions (20% of total marks)

- Students will be required to present their findings from projects, case studies, or research papers. Presentations should be structured, clear, and should reflect an in-depth understanding of the subject.
- Demo sessions can be conducted for practical-based subjects (such as in software development, engineering, or fintech) where students demonstrate their practical skills.

15. Mid-term/Periodical Tests (20% of total marks)

- A test conducted during the middle of the semester to assess students' understanding and retention of the first half of the syllabus. This test will focus on conceptual and applied knowledge.

Evaluation Methods for End-Semester Examination (ESE)

5. Theory Examination (70% of total marks)

- **Comprehensive Exam:** A written exam covering the entire syllabus of the course. The exam will typically consist of:
 - **Objective-type questions:** Multiple-choice questions (MCQs), true/false, fill-in-the-blanks.
 - **Short-answer questions:** Testing basic understanding and key concepts.
 - **Long-answer questions:** Testing in-depth knowledge, critical thinking, and the ability to apply learned concepts.
 - **Case Study Questions:** For applied courses, students may be required to analyze a case study and provide a detailed response based on course learning.

6. Practical Examination (30% of total marks)

- For subjects that involve practical learning (e.g., programming, lab work, project management), a practical exam will be conducted.
- Students will be required to demonstrate their skills in real-time using software tools, programming languages, or lab equipment.
- Evaluation will be based on the correctness of the output, problem-solving approach, and the efficiency of the solution.

Electives

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
8	25-922-0803	AI Ethics and Social Implications	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understand the ethical challenges associated with the development and deployment of AI technologies.
CO2	Analyzing	Analyze the social, legal, and cultural implications of AI in various sectors.
CO3	Evaluating	Evaluate the impact of AI decisions on human behavior, privacy, fairness, and accountability.
CO4	Applying	Apply ethical frameworks to real-world AI scenarios, ensuring that AI systems are fair, transparent, and responsible.
CO5	Creating	Develop guidelines, policies, and strategies for ethically designing and deploying AI systems.

Course Objectives

1. To familiarize students with the ethical challenges arising from the use of AI in society.
2. To examine the role of AI in social justice, equality, and fairness.
3. To critically evaluate the societal and human rights impacts of AI systems.
4. To introduce frameworks and ethical guidelines for responsible AI development.
5. To explore the influence of AI on privacy, security, and decision-making.

Course Modules

Module	Topic	60hrs
Module I	Introduction to AI Ethics: Overview of AI technologies and the ethical challenges they present. Key concepts in ethics and AI: fairness, accountability, transparency.	12hrs
Module II	Bias, Fairness, and Discrimination in AI: Identifying and addressing biases in AI systems. Examining the consequences of unfair AI outcomes. Methods to mitigate discrimination and promote fairness.	12hrs
Module III	AI and Social Impacts: Examining how AI affects jobs, privacy, inequality, and democracy. Impact of AI on social structures, economic systems, and governance.	12hrs
Module IV	Ethical AI Development: Ethical principles in AI design and development. Ensuring AI systems align with societal values. Regulatory frameworks and guidelines for responsible AI.	12hrs
Module V	AI and the Future: The future of work in an AI-driven world. Autonomous systems and their social, economic, and ethical implications. Legal frameworks and global policies governing AI.	12hrs

Books for Study:

1. Artificial Intelligence: A Guide for Thinking Humans, Melanie Mitchell, 1st Edition, 2019.
2. Weapons of Math Destruction, Cathy O'Neil, 1st Edition, 2016.

Books for Reference:

1. Ethics of Artificial Intelligence and Robotics, Vincent C. Müller (Ed.), 1st Edition, 2020.
2. AI Superpowers: China, Silicon Valley, and the New World Order, Kai-Fu Lee, 1st Edition, 2018.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total
----------	-------------	--------------	---	---	---	---	-------

							Hours
8	25-922-0804	Principles of Management	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understand key management concepts, including evolution, roles, and functions for organizational effectiveness.
CO2	Applying	Develop skills in strategic planning and informed decision-making using various models.
CO3	Analyzing	Learn to design effective organizational structures and ensure coordination for goal achievement.
CO4	Evaluating	Gain insights into leadership styles and motivational theories to enhance team performance.
CO5	Creating	Examine the influence of corporate culture and ethics on managerial practices.

Course Objectives

1. To provide students with a foundational understanding of management principles, functions, and their application in organizational settings.
2. To develop students' ability to create effective plans and make informed decisions using various decision-making techniques.
3. To equip students with the skills necessary to design organizational structures and ensure coordination for achieving organizational goals.
4. To enhance students' understanding of leadership styles, motivational theories, and their impact on team performance.
5. To familiarize students with contemporary management issues, such as corporate social responsibility, sustainability, and managing organizational change.

Course Modules

Module	Topic	60hrs
--------	-------	-------

Module I	<p>Introduction to Management Definition and Importance of Management - Evolution of Management Thought - Managerial Roles and Skills - Levels of Management - Management Functions - Decision-Making Process - Organizational Structure - Leadership Styles - Communication in Management - Time Management</p>	12hrs
Module II	<p>Planning and Decision Making Planning - Steps and Importance of Planning - Types of Plans: Strategic, Tactical, Operational, Contingency - Decision Making: Definition, Types and Models of Decision - Techniques of Decision Making: SWOT Analysis, Brainstorming, Decision Trees - Barriers to Planning and Decision Making - Overcoming Challenges in Decision Making.</p>	12hrs
Module III	<p>Organizational Structure Organizational Structure: Types and Relevance - Authority and Responsibility - Delegation and Decentralization - Span of Control - Factors Affecting Manager-Subordinate Ratios - Coordination: Techniques for Effective Coordination - Formal vs. Informal Organizations: Features, Advantages, and Limitations.</p>	12hrs
Module IV	<p>Leadership and Motivation Leadership: Styles and Importance (Autocratic, Democratic, Laissez-faire) - Leadership Theories: Trait, Behavioural, Situational - Motivation: Concepts and Its Link to Performance - Motivation Theories: Maslow's, Herzberg's, and McGregor's - Communication in Leadership: Role of Communication in Motivating and Leading Teams.</p>	12hrs
Module V	<p>Controlling and Contemporary Issues Controlling: Definition, Process, and Importance in Management - Types of Control: Pre-Control, Concurrent Control, Post-Control - Tools for Controlling: Budgeting, Performance Appraisals, Balanced Scorecards - Contemporary Issues in Management: CSR, Sustainability, Ethical Management - Challenges in Management: Managing Diversity, Innovation, and Change.</p>	12hrs

Books for Study:

1. Essentials of Management: An International, Innovation, and Leadership Perspective, Harold Koontz and Heinz Weihrich, 11th Edition, 2020.
2. Principles and Practice of Management, L.M. Prasad, 9th Edition, 2021.
3. Principles of Management, P.C. Tripathi and P.N. Reddy, 6th Edition, 2021.

Books for Reference:

1. Principles of Management: Concepts and Cases, T. Ramasamy, 1st Edition, 2019.
2. Management: Text & Cases, R. Satya Raju and A. Parthasarathy, 2nd Edition, 2018.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
8	25-922-0805	Introduction to Cybersecurity	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Explain key concepts, terminologies, and need for cybersecurity.
CO2	Applying	Identify and classify various cyber threats and attacks.
CO3	Analyzing	Demonstrate the use of basic cryptographic techniques.
CO4	Evaluating	Analyze cybersecurity measures in networks and systems.
CO5	Creating	Evaluate ethical, legal, and societal issues related to cybersecurity.

Course Objectives

1. To understand the fundamental concepts of cybersecurity and its key principles.
2. To identify various types of cyber threats, attacks, and vulnerabilities.
3. To introduce cryptographic techniques and authentication methods.
4. To explore cybersecurity in networks, web applications, and cloud systems.
5. To develop awareness of legal, ethical, and professional issues in cybersecurity.

Course Modules

Module	Topic	60hrs
Module I	Fundamentals of Cybersecurity Definition, importance, and scope of cybersecurity, Cybersecurity principles: CIA triad, Types of attackers: Hackers, crackers, insiders, hacktivists, Cybersecurity frameworks and policies, Roles and responsibilities in cybersecurity	12hrs
Module II	Cyber Threats and Attacks Malware: Viruses, worms, Trojans, ransomware, Phishing, spoofing, social engineering, Denial of Service (DoS) and Distributed DoS attacks, Insider threats and Advanced Persistent Threats (APT), Vulnerability assessment and penetration testing basics	12hrs
Module III	Cryptography and Authentication Basics of encryption: symmetric and asymmetric cryptography, Hashing algorithms: MD5, SHA family, Public Key Infrastructure (PKI), Digital signatures and certificates, Authentication methods: passwords, OTP, biometrics	12hrs

Module IV	Network and System Security Network protocols and vulnerabilities, Firewalls, IDS/IPS, and VPNs, Securing wireless networks, Operating system and application security, Introduction to endpoint and cloud security	12hrs
Module V	Legal, Ethical and Emerging Issues Cyber laws in India and globally, IT Act 2000 and amendments, Ethical hacking and cyber forensics, Security compliance: ISO/IEC 27001, GDPR , Trends in cybersecurity: AI in security, IoT security, blockchain	12hrs

Books for Study:

1. Kumar, V., & Prakash, S. (2022). Cyber law and information security. Bharat Law House.
2. Pfleeger, C. P., Pfleeger, S. L., & Margulies, J. (2015). Security in computing (5th ed.). Prentice Hall.
3. Stallings, W. (2020). Cryptography and network security: Principles and practice (8th ed.). Pearson.
4. Stallings, W., & Brown, L. (2018). Computer security: Principles and practice (4th ed.). Pearson.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
8	25-922-0806	Data Privacy, Security, and Compliance	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
---------------------	-------------------	-------------

CO1	Understanding	Understand the principles and importance of data privacy, security, and compliance in today's digital landscape.
CO2	Applying	Apply key concepts in data security and privacy to protect personal and organizational data.
CO3	Analyzing	Analyze the compliance requirements of global data protection laws such as GDPR, CCPA, etc.
CO4	Evaluating	Evaluate risks and vulnerabilities in data security and implement strategies to mitigate them.
CO5	Creating	Develop and implement data protection and security policies and strategies for compliance with relevant laws.

Course Objectives

1. To introduce students to the foundational principles of data privacy, security, and compliance.
2. To equip students with the knowledge and skills to secure sensitive information and ensure regulatory compliance.
3. To provide an understanding of global data protection laws, including GDPR, CCPA, HIPAA, and more.
4. To analyze real-world data breaches and evaluate the effectiveness of security measures.
5. To teach students how to design and implement a compliance framework for organizations.

Course Modules

Module	Topic	60hrs
Module I	Introduction to Data Ethics Ethics in Data Science: Principles and Challenges. Theories of Ethics: Utilitarianism, Deontology, Virtue Ethics. Responsible AI and the Role of Ethics in Automation. Ethical Issues in Big Data and Cloud Computing.	12hrs

Module II	<p>Privacy Laws and Regulatory Frameworks</p> <p>Overview of Data Protection Laws: GDPR (Europe), CCPA (USA), PDPB (India). Right to Privacy: Legal and Philosophical Perspectives. Data Ownership and User Consent Mechanisms. Ethical Considerations in Government Surveillance and Data Collection</p>	12hrs
Module III	<p>Ethical Challenges in AI</p> <p>Bias and Fairness in Machine Learning Algorithms. Algorithmic Accountability and Explainability. Ethical Implications of Facial Recognition and Biometric Data. Case Studies: AI Ethics Failures and Controversies</p>	12hrs
Module IV	<p>Data Protection</p> <p>Introduction to Cybersecurity and Ethical Hacking. Encryption Techniques and Secure Data Transmission. Data Anonymization and Privacy-Preserving Data Sharing. Case Studies: Data Breaches and Their Ethical Implications</p>	12hrs
Module V	<p>Future Trends in Data Ethics and Governance</p> <p>Emerging Technologies and Their Ethical Implications. Ethics in IoT, Blockchain, and Quantum Computing. Corporate Social Responsibility in Data Management. Developing an Ethical Code of Conduct for Data Professionals</p>	12hrs

Books for Study:

1. *Data Privacy and Security*, Robert M. Gellman, 1st Edition, 2017.

2. *GDPR: A Practical Guide*, IT Governance Publishing, 1st Edition, 2018.
3. *The Data Protection Officer: Profession, Rules, and Role*, Paul Lambert, 1st Edition, 2017.

Books for Reference:

1. *Cybersecurity and Data Privacy: Protecting Digital Assets in a Connected World*, Jeffrey J. Schmitt, 1st Edition, 2020.

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
8	25-922-0807	Digital Marketing and E-Commerce	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understanding of digital marketing principles and tool
CO2	Applying	Design and execute SEO, social media, and email marketing campaigns.
CO3	Analyzing	Integrate e-commerce platforms and manage online business operations.
CO4	Evaluating	Evaluate digital campaign performance using analytics and optimization tools.

CO5	Creating	Develop comprehensive marketing strategies for diverse business needs.
------------	----------	--

Course Objectives

1. To understand the principles of digital marketing and e-commerce operations.
2. To develop practical skills in implementing SEO and social media campaigns.
3. To explore tools and strategies for e-commerce success.
4. To analyze the impact of digital marketing trends and technologies.
5. To create innovative digital marketing plans for business growth.

Course Modules

Module	Topic	60hrs
Module I	<p>Introduction to Digital and Services Marketing Overview of digital marketing trends – Evolution and importance of services marketing – Role of technology in marketing strategies – Differences between product and service marketing – Key challenges in digital and services marketing – Impact of globalization and digital transformation on marketing</p>	12hrs
Module II	<p>Digital Marketing Tools and Strategies SEO, SEM, and social media marketing – Email marketing and mobile strategies – Case studies on digital tools' effectiveness – Content marketing and influencer marketing – Performance measurement through analytics – Omni-channel marketing strategies and integration</p>	12hrs
Module III	<p>Customer Experience and Service Quality Service quality models like SERVQUAL – Strategies for managing customer perceptions – Role of technology in service recovery – Importance of customer feedback and complaint management – Personalization in service delivery – Enhancing brand loyalty through superior service experiences</p>	12hrs

Module IV	<p>Data-Driven Marketing and Analytics Importance of KPIs and CRM tools – Predictive analytics for targeted marketing – Case studies on data-driven personalization – Role of big data and machine learning in marketing – Customer segmentation and behavioral analytics – A/B testing and optimization of marketing campaigns</p>	12hrs
Module V	<p>Ethical and Emerging Trends in Digital and Services Marketing Privacy and ethical challenges in digital marketing – AI-driven personalization and chatbots – Sustainability and green marketing initiatives – Regulatory frameworks and compliance in digital advertising – Impact of blockchain on marketing transparency – Future trends in digital consumer behavior and engagement</p>	12hrs

Books for Study:

1. *Digital Marketing*, Seema Gupta, 1st Edition, 2020
2. *Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation*, Damian Ryan, 5th Edition, 2022
3. *E-Commerce and Digital Marketing*, Dr. Rajendra Nargundkar, 1st Edition, 2021

Books for Reference:

1. *The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns*, Ian Dodson, 1st Edition, 2016

Course Overview

Semester	Course Code	Course Title	L	T	P	C	Total Hours
8	25-922-0808	Introduction to Game Design	3	1	0	4	60

Course Outcomes

Upon successful completion of this course, students will be able to:

Course Outcome (CO)	Cognitive Ability	Description
CO1	Understanding	Understand core concepts, types, and components of game design.
CO2	Applying	Apply game mechanics and gameplay principles in designing engaging games
CO3	Analyzing	Design basic game concepts, levels, and characters with narrative elements.
CO4	Evaluating	Develop and evaluate game prototypes through iterative testing.
CO5	Creating	Analyze ethical and cultural implications in game content and player behavior.

Course Objectives

1. To introduce fundamental principles of game design and development.
2. To understand game mechanics, dynamics, and aesthetics (MDA framework).
3. To learn how to design levels, rules, characters, and narratives for games.
4. To explore the use of prototyping, iteration, and user testing in game design.
5. To examine ethical, cultural, and psychological impacts of games.

Course Modules

Module	Topic	60hrs
Module I	Fundamentals of Game Design History and evolution of video games, Types of games: analog, digital, mobile, VR, AR, Core concepts: gameplay, rules, player objectives, Game genres and platforms, Introduction to the Game Development Life Cycle	12hrs
Module II	Game Mechanics, Dynamics, and Aesthetics (MDA Framework) Understanding game mechanics and feedback loops, Game balancing and pacing, Player motivation and engagement models, Dynamics of multiplayer vs single-player games, Visual and audio aesthetics in	12hrs

	games	
Module III	<p>Narrative, Character, and Level Design</p> <p>Storytelling in games: linear, branching, emergent narratives, Character creation: traits, roles, avatars, Environment and level design techniques, Dialogue writing and interactive storytelling, Use of tools like Twine, Unity's storytelling assets</p>	12hrs
Module IV	<p>Game Prototyping and Testing</p> <p>Rapid prototyping: paper and digital methods, Game engines: Unity, Unreal, Godot (intro level), Playtesting methodologies and feedback collection, Iteration cycles and improving user experience, Game documentation and design documents</p>	12hrs
Module V	<p>Game Ethics, Psychology and Industry Practices</p> <p>Psychological impact of games: flow, addiction, behavior, Ethics in game content: violence, gender, diversity, Censorship, rating systems (ESRB, PEGI), Career paths in game design and industry trends, Indie vs AAA development ecosystems</p>	12hrs

Books for Study:

1. Game Design: Theory and Practice, Richard Rouse III, 2nd Edition, 2004.
2. The Art of Computer Game Design, Chris Crawford, 1st Edition, 1984.

Books for Reference:

1. Challenges for Game Designers, Brenda Brathwaite & Ian Schreiber, 1st Edition, 2008.
2. Introduction to Game Development, Steve Rabin, 2nd Edition, 2010.