PRESIDENCY UNIVERSITY

Presidency University Act, 2013 of the Karnataka Act No. 41 of 2013 | Established under Section 2(f) of UGC Act, 1956
Approved by AICTE, New Delhi

PRESIDENCY SCHOOL OF INFORMATION SCIENCE

Program Regulations and Curriculum

2026-2029

BACHELOR OF COMPUTER APPLICATIONS

(Data Science)

based on Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Table of Contents

Clause No.	Contents	Page Number
PART A – PROGRAM REGULATIONS		
1.	Vision & Mission of the University and the School / Department	3
2.	Preamble to the Program Regulations and Curriculum	3
3.	Short Title and Applicability	3
4.	Definitions	4
5.	Program Description	5
6.	Minimum and Maximum Duration	6
7.	Programme Educational Objectives (PEO)	6
8.	Programme outcomes (PO) and Programme Specific outcomes (PSO)	6
9.	Admission Criteria (as per the concerned Statutory Body)	7
10.	Transfer Students requirements	8
11.	Change of Branch / Discipline / Specialization	9
12.	Specific Regulations regarding Assessment and Evaluation	9
13.	Additional clarifications - Rules and Guidelines for Transfer of Credits from MOOC, etc.	11
PART B: PROGRAM STRUCTURE		
14.	Structure / Component with Credit Requirements Course Baskets & Minimum Basket wise Credit Requirements	13
15.	Minimum Total Credit Requirements of Award of Degree	14
16.	Other Specific Requirements for Award of Degree, if any, as prescribed by the Statutory Bodies	14
PART C: CURRICULUM STRUCTURE		
17.	Curriculum Structure – Basket Wise Course List	15
18.	Practical / Skill based Courses – Internships / Thesis / Dissertation / Capstone Project Work / Portfolio / Mini project	16
19.	List of Elective Courses under various Specializations / Stream Basket	19
20.	Recommended Semester Wise Course Structure / Flow including the Program / Discipline Elective Paths / Options	21
21.	Course Catalogue of all Courses Listed including the Courses Offered by other School / Department and Discipline / Program Electives	25

PART A – PROGRAM REGULATIONS

1. Vision & Mission of the University and the School / Department

1.1 Vision of the University

To be a Value-driven Global University, excelling beyond peers and creating professionals of integrity and character, having concern and care for society.

1.2 Mission of the University

- Commit to be an innovative and inclusive institution by seeking excellence in teaching, research and knowledge-transfer.
- Pursue Research and Development and its dissemination to the community, at large.
- Create, sustain and apply learning in an interdisciplinary environment with consideration for ethical, ecological and economic aspects of nation building.
- Provide knowledge-based technological support and services to the industry in its growth and development.
- To impart globally-applicable skill-sets to students through flexible course offerings and support industry's requirement and inculcate a spirit of new-venture creation.

1.3 Vision of Presidency School of Information Science

To be a value based, practice-driven School of Information Science, committed to developing globally-competent Professionals, dedicated to applying Modern Information Science for Social Benefit

1.4 Mission of Presidency School of Information Science

- Cultivate a practice-driven environment with an Information-Technology-based pedagogy, integrating theory and practice.
- Attract and nurture world-class faculty to excel in Teaching and Research, in the Information Science Domain.
- Establish state-of-the-art facilities for effective Teaching and Learning experiences.
- Promote Interdisciplinary Studies to nurture talent for global impact.
- Instil Entrepreneurial and Leadership Skills to address Social, Environmental and Community-needs.

2. Preamble to the Program Regulations and Curriculum

This is the subset of Academic Regulations and it is to be followed as a requirement for the award of BCA degree.

The Curriculum is designed to take into the factors listed in the Choice Based Credit System (CBCS) with focus on Social Project Based Learning, Industrial Training, and Internship to enable the students to become eligible and fully equipped for employment in industries, choose higher studies or entrepreneurship.

In exercise of the powers conferred by and in discharge of duties assigned under the relevant provision(s) of the Act, Statutes and Academic Regulations, of the University, the Academic Council hereby makes the following Regulations.

3. Short Title and Applicability

a. These Regulations shall be called the Bachelor of Computer Applications Degree Program Regulations and Curriculum 2026-29.
b. These Regulations are subject to, and pursuant to the Academic Regulations.
c. These Regulations shall be applicable to the ongoing Bachelor of Computer Applications Degree Programs of the 2026-29 batch, and to all other Bachelor of Computer Applications Degree Programs which may be introduced in future.
d. These Regulations shall supersede all the earlier Bachelor of Computer Applications Program Regulations and Curriculum, along with all the amendments thereto.
e. These Regulations shall come into force from the Academic Year 2025-2026.

4. Definitions

In these Regulations, unless the context otherwise requires:

a. "Academic Calendar" means the schedule of academic and miscellaneous events as approved by the Vice Chancellor;

b. "Academic Council" means the Academic Council of the University;

c. "Academic Regulations" means the Academic Regulations, of the University;

d. "Academic Term" means a Semester or Summer Term;

e. "Act" means the Presidency University Act, 2013;

f. "AICTE" means All India Council for Technical Education;

g. "Basket" means a group of courses bundled together based on the nature/type of the course;

h. "BOE" means the Board of Examinations of the University;

i. "BOG" means the Board of Governors of the University;

j. "BOM" means the Board of Management of the University;

k. "BOS" means the Board of Studies of a particular Department/Program of Study of the University;

l. "CGPA" means Cumulative Grade Point Average as defined in the Academic Regulations;

m. "Clause" means the duly numbered Clause, with Sub-Clauses included, if any, of these Regulations;

n. "COE" means the Controller of Examinations of the University;

o. "Course In Charge" means the teacher/faculty member responsible for developing and organising the delivery of the Course;

p. "Course Instructor" means the teacher/faculty member responsible for teaching and evaluation of a Course;

q. "Course" means a specific subject usually identified by its Course-code and Course-title, with specified credits and syllabus/course-description, a set of references, taught by some teacher(s)/course-instructor(s) to a specific class (group of students) during a specific Academic Term;

r. "Curriculum Structure" means the Curriculum governing a specific Degree Program offered by the University, and, includes the set of Baskets of Courses along with minimum credit requirements to be earned under each basket for a degree/degree with specialization/minor/honours in addition to the relevant details of the Courses and Course catalogues (which describes the Course content and other important information about the Course). Any specific requirements for a particular program may be brought into the Curriculum structure of the specific program and relevant approvals should be taken

from the BOS and Academic Council at that time.

s. "DAC" means the Departmental Academic Committee of a concerned Department/Program of Study of the University;

t. "Dean" means the Dean of the concerned School;

u. "Degree Program" includes all Degree Programs;

v. "Department" means the Department offering the degree Program(s) / Course(s) / School offering the concerned Degree Programs / other Administrative Offices;

w. "Discipline" means specialization or branch of BCA Degree Program;

x. "HOD" means the Head of the concerned Department;

y. "L-T-P-C" means Lecture-Tutorial-Practical-Credit – refers to the teaching – learning periods and the credit associated;

z. "MOOC" means Massive Open Online Courses;

aa. "MOU" means the Memorandum of Understanding;

bb. "NPTEL" means National Program on Technology Enhanced Learning;

cc. "Parent Department" means the department that offers the Degree Program that a student undergoes;

dd. "Program Head" means the administrative head of a particular Degree Program/s;

ee. "Program Regulations" means the Bachelor of Computer Application (DS) Degree Program Regulations and Curriculum, 2026-29;

ff. "Program" means the Bachelor of Computer Application (BCA) Degree Program;

gg. "PSIS" means the Presidency School of Information Science;

hh. "Registrar" means the Registrar of the University;

ii. "School" means a constituent institution of the University established for monitoring, supervising and guiding, teaching, training and research activities in broadly related fields of studies;

jj. "Section" means the duly numbered Section, with Clauses included in that Section, of these Regulations;

kk. "SGPA" means the Semester Grade Point Average as defined in the Academic Regulations;

ll. "Statutes" means the Statutes of Presidency University;

mm. "Sub-Clause" means the duly numbered Sub-Clause of these Program Regulations;

nn. "Summer Term" means an additional Academic Term conducted during the summer break (typically in June-July) for a duration of about eight (08) calendar weeks, with a minimum of thirty (30) University teaching days;

oo. "SWAYAM" means Study Webs of Active Learning for Young Aspiring Minds.

pp. "UGC" means University Grant Commission;

qq. "University" means Presidency University, Bengaluru; and

rr. "Vice Chancellor" means the Vice Chancellor of the University.

5. Program Description

The Bachelor of Computer Applications Program Regulations and Curriculum 2026-29 are subject to, and, pursuant to the Academic Regulations, 2021. These Program Regulations shall be applicable to the following ongoing Bachelor of Computer Applications Degree Programs of 2026-29 offered by the Presidency School of Information Science (PSIS):

1. Bachelor of Computer Applications abbreviated as BCA.

2. Bachelor of Computer Applications in Artificial Intelligence and Machine Learning, abbreviated as BCI.

3. Bachelor of Computer Applications in Data Science, abbreviated as BCD.

5.1 These Program Regulations shall be applicable to other similar programs, which may be introduced in future.

5.2 These Regulations may evolve and get amended or modified or changed through appropriate approvals from the Academic Council, from time to time, and shall be binding on all concerned.

5.3 The effect of periodic amendments or changes in the Program Regulations, on the students admitted in earlier years, shall be dealt with appropriately and carefully, so as to ensure that those students are not subjected to any unfair situation whatsoever, although they are required to conform to these revised Program Regulations, without any undue favour or considerations.

6. Minimum and Maximum Duration

6.1 Bachelor of Computer Applications Degree Program is a Three Year, Full-Time Semester based program. The minimum duration of the BCA Program is three (03) years and each year comprises of two academic Semesters (Odd and Even Semesters) and hence the duration of the BCA program is six (06) Semesters.

6.2 A student who for whatever reason is not able to complete the Program within the normal period or the minimum duration (number of years) prescribed for the Program, may be allowed a period of two years beyond the normal period to complete the mandatory minimum credits requirement as prescribed by the concerned Program Regulations and Curriculum. In general, the permissible maximum duration (number of years) for completion of Program is 'N' + 2 years, where 'N' stands for the normal or minimum duration (number of years) for completion of the concerned Program as prescribed by the concerned Program Regulations and Curriculum.

6.3 The time taken by the student to improve Grades/CGPA, and in case of temporary withdrawal/re-joining (Refer to Clause 16.1 of Academic Regulations), shall be counted in the permissible maximum duration for completion of a Program.

6.4 In exceptional circumstances, such as temporary withdrawal for medical exigencies where there is a prolonged hospitalization and/or treatment, as certified through hospital/medical records, women students requiring extended maternity break (certified by registered medical practitioner), and, outstanding sportspersons representing the University/State/India requiring extended time to participate in National/International sports events, a further extension of one (01) year may be granted on the approval of the Academic Council.

6.5 The enrolment of the student who fails to complete the mandatory requirements for the award of the concerned Degree (refer Section 19.0 of Academic Regulations) in the prescribed maximum duration (Clauses 18.1 and 18.2 of Academic Regulations), shall stand terminated and no Degree shall be awarded.

7 Programme Educational Objectives (PEO)

After four years of successful completion of the program, the graduates shall be able to :

PEO 01: Demonstrate success as a computer professional with innovative skills, having moral and ethical values.

PEO 02: Engage in lifelong learning through software development.

PEO 03: Serve as a leader in the profession through consultancy, extension activities and/ or entrepreneurship.

8 Programme outcomes (PO) and Programme Specific outcomes (PSO)

8.1 Programme outcomes (PO)

On successful completion of the Program, the students shall be able to:

PO 1. Application of Domain Knowledge: Apply the domain knowledge such as mathematics, science and software engineering fundamentals into the Computer Application related professions.

PO 2: Problem Solving & Analysis: Identify, Formulate, Analyse and Solve Complex Scenarios related to Computer Applications.

PO 3: Design/development of Activities: Conceive, Design and Develop various activities of Computer Applications.

PO 4: Conduct Investigations of Events: Carry out Investigation of an event and draw logical conclusions based on critical thinking and analytical reasoning.

PO 5: Modern Tool usage: Effectively apply relevant ICT Tools and digital tools to carry out Computer Application Attributes.

PO 6: Research: Identify suitable Research Methods and report the findings.

PO 7: Profession and Society: Apply the knowledge of the values and beliefs of multicultural society and a global perspective in the profession.

PO 8: Ethics: Identify ethical issues and embrace ethical values in conduct of Profession.

PO 9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Express thoughts and ideas effectively in writing and oral communication

PO 11: Project Management and Finance: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.

PO 12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of societal and technological change.

8.2 Program Specific outcomes (PSOs):

On successful completion of the Program, the students shall be able to:

PSO-1: [Data Analysis]: Demonstrate comprehensive knowledge using statistical and machine learning techniques to analyze data and derive meaningful insights and patterns.

PSO-2: [Design/ development of Solutions]: Identify, formulate and apply the knowledge of Machine learning algorithms, Deep Learning Algorithms and Big data technologies and tools for processing and analysing large datasets.

PSO-3: [Data Science Applications] Students should be able to apply data science techniques, and translate data insights into actionable recommendations in specific domains, such as finance, healthcare, or marketing, etc.,

9 Admission Criteria (as per the concerned Statutory Body)

The University admissions shall be open to all persons irrespective of caste, class, creed, gender or nation. All admissions shall be made on the basis of merit in the qualifying examinations; provided that forty percent of the admissions in all Programs of the University shall be reserved for the students of Karnataka State and admissions shall be made through a Common Entrance Examination conducted by the State Government or its agency and seats shall be allotted as per the merit and reservation policy of the State Government from time to time. The admission criteria to the BCA Program is listed in the following Sub-Clauses:

9.1. An applicant who has successfully completed Pre-University course or Senior Secondary School course (+2) or equivalent such as (11+1), 'A' level in Senior School Leaving Certificate Course from a recognized university of India or outside or from Senior Secondary Board or equivalent, constituted or recognized by the Union or by the State Government of that Country for the purpose of issue of qualifying certificate on successful completion of the course, may apply for and be admitted into the Program.

9.2. Provided further A candidate seeking admission for BCA Program should have passed 10+2 or an equivalent examination from any recognized board with a minimum of 40 % marks in aggregate.

9.3. Reservation for the SC / ST and other backward classes shall be made in accordance with the directives issued by the Government of Karnataka from time to time.

9.4. Admissions are offered to Foreign Nationals and Indians living abroad in accordance with the rules applicable for such admission, issued from time to time, by the Government of India.

9.5. Candidates must fulfil the medical standards required for admission as prescribed by the University.

9.6. If, at any time after admission, it is found that a candidate had not in fact fulfilled all the requirements stipulated in the offer of admission, in any form whatsoever, including possible misinformation and any other falsification, the Registrar shall report the matter to the Board of Management (BOM), recommending revoking the admission of the candidate.

9.7. The decision of the BOM regarding the admissions is final and binding.

10 Transfer Students requirements

Transfer of student(s) from another recognized University to the 2nd year (3rd Semester) of the BCA. Program of the University

10.1 A student who has completed the 1st Year (i.e., passed in all the Courses / Subjects prescribed for the 1st Year) of the BCA Three-Year Degree Program from another recognized University, may be permitted to transfer to the 2nd Year (3rd Semester) of the BCA Program of the University as per the rules and guidelines prescribed in the following.

10.2 The student shall submit the Application for Transfer along with a non-refundable Application Fee (as prescribed by the University from time to time) to the University no later than July 10 of the concerned year for admission to the 2nd Year (3rd Semester) BCA Program commencing on August 1 on the year concerned.

10.3 The student shall submit copies of the respective Marks Cards / Grade Sheets / Certificates along with the Application for Transfer.

10.4 The concerned student fulfils the criteria specified in Clauses 10.2 and 10.3.

10.5 The transfer may be provided on the condition that the Courses and Credits completed by the concerned student in the 1st Year of the BCA. three-year Degree Program from the concerned University, are declared equivalent and acceptable by the Equivalence Committee constituted by the Vice Chancellor for this purpose. Further, the Equivalence Committee may also prescribe the Courses and Credits the concerned students shall have to mandatorily complete, if admitted to the 2nd Year of the BCA Program of the University.

10.6 The Branch / Discipline allotted to the student concerned shall be the decision of the University and binding on the student.

11 Change of Branch / Discipline / Specialization

A student admitted to a particular Branch of the BCA Program will normally continue studying in that Branch till the completion of the program. However, the University reserves the right to provide the option for a change of Branch, or not to provide the option for a change of Branch, at the end of 1st Year of the BCA Program to eligible students in accordance with the following rules and guidelines: framed by the University from time to time.

11.1. Normally, only those students, who have passed all the Courses prescribed for the 1st Year of the BCA Program and obtained a CGPA of not less than 6.50 at the end of the 2nd Semester, shall be eligible for consideration for a change of Branch.

11.2. Change of Branch, if provided, shall be made effective from the commencement of the 3rd Semester of the BCA Program. There shall be no provision for change of Branch thereafter under any circumstances whatsoever.

11.3. The student provided with the change of Branch shall fully adhere to and comply with the Program Regulations of the concerned Branch of the BCA Program, the Fee Policy pertaining to that Branch of the BCA Program, and, all other rules pertaining to the changed Branch existing at the time.

11.4. Change of Branch once made shall be final and binding on the student. No student shall be permitted, under any circumstances, to refuse the change of Branch offered.

11.5. The eligible student may be allowed a change in Branch, strictly in order of inter se merit, subject to the conditions 11.6 and 11.7.

11.6. The actual number of students in the 3rd Semester in any particular Branch to which the transfer is to be made, should not exceed the intake fixed by the University for the concerned Branch; and,

11.7. The actual number of students in any Branch from which transfer is being sought does not fall below 75% of the total intake fixed by the University for the concerned Branch.

11.8. The process of change of Branch shall be completed within the first five days of Registration for the 3rd Semester of the BCA Program.

12. Specific Regulations regarding Assessment and Evaluation (including the Assessment Details of NTCC Courses, Weightages of Continuous Assessment and End Term Examination for various Course Categories)

12.1 The academic performance evaluation of a student in a Course shall be according to the University Letter Grading System based on the class performance distribution in the Course.

12.2 Academic performance evaluation of every registered student in every Course registered by the student is carried out through various components of Assessments spread across the Semester. The nature of components of Continuous Assessments and the weightage given to each component of Continuous Assessments (refer Clause 8.8 of Academic Regulations) shall be clearly defined in the Course Plan for every Course, and approved by the DAC.

12.3 Format of the End-Term examination shall be specified in the Course Plan.

12.4 Grading is the process of rewarding the students for their overall performance in each Course. The University follows the system of Relative Grading with statistical approach to classify the students based on the relative performance of the students registered in the concerned Course except in the following cases:

- Non-Teaching Credit Courses (NTCC)
- Courses with a class strength less than 30

Absolute grading method may be adopted, where necessary with prior approval of concerned DAC.

Grading shall be done at the end of the Academic Term by considering the aggregate performance of the student in all components of Assessments prescribed for the Course. Letter Grades (Clause 8.10) shall be awarded to a student based on her/his overall performance relative to the class performance distribution in the concerned Course. These Letter Grades not only indicate a qualitative assessment of the student's performance but also carry a quantitative (numeric) equivalent called the Grade Point.

12.5 Assessment Components and Weightage

Table 1: Assessment Components and Weightage for different category of Courses		
Nature of Course and Structure	**Evaluation Component**	**Weightage**
Lecture-based Course L component in the L-T-P Structure is predominant (more than 1) (Examples: 3-0-0; 3-0-2; 2-1-0; 2-0-2, 2-0-4 etc.)	Continuous Assessments	50%
	End Term Examination	50%
Lab/Practice-based Course P component in the L-T-P Structure is predominant (Examples: 0-0-4; 1-0-4; 1-0-2; etc.)	Continuous Assessments	75%
	End Term Examination	25%
Skill based Courses like Industry Internship, Capstone project, Research Dissertation, Integrative Studio, Interdisciplinary Project, Summer / Short Internship, Social Engagement / Field Projects, Portfolio, and such similar Non-Teaching Credit Courses, where the pedagogy does not lend itself to a typical L-T-P structure	Guidelines for the assessment components for the various types of Courses, with recommended weightages, shall be specified in the concerned Program Regulations and Curriculum / Course Plans, as applicable.	

The exact weightages of Evaluation Components shall be clearly specified in the concerned PRC and respective Course Plan.

Normally, for Practice/Skill based Courses, without a defined credit structure (L–T–P) [NTCC], but with assigned Credits (as defined in clause 5.2 of the Academic Regulations), the method of evaluation shall be based only on Continuous Assessments. The various components of Continuous Assessments, the distribution of weightage among such components, and the method of evaluation/assessment, shall be as decided and indicated in the Course Plan/PRC. The same shall be approved by the respective DAC.

12.6 Minimum Performance Criteria:

12.6.1. Theory only Course and Lab/Practice Embedded Theory Course

A student shall satisfy the following minimum performance criteria to be eligible to earn the credits towards the concerned Course:

a. A student must obtain a minimum of 30% of the total marks/weightage assigned to the End Term Examinations in the concerned Course.

b. The student must obtain a minimum of 40% of the AGGREGATE of the marks/weightage of the components of Continuous Assessments, Mid Term Examinations and End Term Examinations in the concerned Course.

12.6.2. **Lab/Practice only Course and Project Based Courses**

The student must obtain a minimum of 40% of the AGGREGATE of the marks/weightage of all assessment components in the concerned Course.

12.6.3. A student who fails to meet the minimum performance criteria listed above in a Course shall be declared as "Fail" and given "F" Grade in the concerned Course. For theory Courses, the student shall have to re-appear in the "Make-Up Examinations" as scheduled by the University in any subsequent semester, or, re-appear in the End Term Examinations of the same Course when it is scheduled at the end of the following Semester or Summer Term, if offered. The marks obtained in the Continuous Assessments (other than the End Term Examination) shall be carried forward and be included in computing the final grade, if the student secures the minimum requirements (as per sub-clauses 8.9.1 and 8.9.2 of Academic Regulations) in the "Make-Up Examinations" of the concerned Course. Further, the student has an option to re-register for the Course and clear the same in the summer term/ subsequent semester if he/she wishes to do so, provided the Course is offered.

13. Additional clarifications - Rules and Guidelines for Transfer of Credits from MOOC, etc. – Note: These are covered in Academic Regulations

The University allows students to acquire credits from other Indian or foreign institutions and/or Massive Open Online Course (MOOC) platforms, subject to prior approval. These credits may be transferred and counted toward fulfilling the minimum credit requirements for the award of a degree. The process of transfer of credits is governed by the following rules and guidelines:

13.1 The transfer of credits shall be examined and recommended by the Equivalence Committee (Refer Annexure B of Academic Regulations) and approved by the Dean - Academics.

13.2 Students may earn credits from other Indian or foreign Universities/Institutions with which the University has an MOU, and that MOU shall have specific provisions, rules and guidelines for transfer of credits. These transferred credits shall be counted towards the minimum credit requirements for the award of the degree.

13.3 Students may earn credits by registering for Online Courses offered by *Study Web of Active Learning by Young and Aspiring Minds* (SWAYAM) and *National Program on Technology Enhanced Learning* (NPTEL), or other such recognized Bodies/ Universities/Institutions as approved by the concerned BOS and Academic Council from time to time. The concerned School/Parent Department shall publish/include the approved list of Courses and the rules and guidelines governing such transfer of credits of the concerned Program from time to time. The Rules and Guidelines for the transfer of credits specifically from the Online Courses conducted by SWAYAM/ NPTEL/ other approved MOOCs are as stated in the following Sub-Clauses:

13.3.1. A student may complete SWAYAM/NPTEL/other approved MOOCs as mentioned in Clause 17.3(As per the academic regulations) and transfer equivalent credits to partially or fully complete the mandatory credit requirements of Discipline Elective Courses and/or the mandatory credit requirements of Open Elective Courses as prescribed in the concerned Curriculum Structure. However, it is the sole responsibility of the student to complete the mandatory credit requirements of the Discipline Elective Courses and the Open Elective Courses as prescribed by the Curriculum Structure of the concerned Program.

13.3.2. SWAYAM/NPTEL/ other approved MOOCs as mentioned in Clause 17.3(As per the academic regulations) shall be approved by the concerned Board of Studies and placed (as Annexures) in the concerned PRC.

13.3.3. Parent Departments may release a list of SWAYAM/NPTEL/other approved MOOCs for Pre-Registration as per schedule in the Academic Calendar or through University Notification to this effect.

13.3.4. Students may Pre-Register for the SWAYAM/NPTEL/other approved MOOCs in the respective Departments and register for the same Courses as per the schedule announced by respective Online Course Offering body/institute/ university.

13.3.5. A student shall request for transfer of credits only from such approved Courses as mentioned in Sub-Clause 13.3.2 above.

13.3.6. SWAYAM/NPTEL/other approved MOOCs Courses are considered for transfer of credits only if the concerned student has successfully completed the SWAYAM/NPTEL/other approved MOOCs and obtained a certificate of successful/satisfactory completion.

13.3.7. A student who has successfully completed the approved SWAYAM/NPTEL/ other approved MOOCs and wants to avail the provision of transfer of equivalent credits, must submit the original Certificate of Completion, or such similar authorized documents to the HOD concerned, with a written request for the transfer of the equivalent credits. On verification of the Certificates/Documents and approval by the HOD concerned, the Course(s) and equivalent Credits shall forwarded to the COE for processing of results of the concerned Academic Term.

13.3.8. The credit equivalence of the SWAYAM/NPTEL/other approved MOOCs are based on Course durations and/or as recommended by the Course offering body/institute/university. The Credit Equivalence mapped to SWAYAM/ NPTEL approved Courses based on Course durations for transfer of credits is summarised in Table shown below. The Grade will be calculated from the marks received by the Absolute Grading Table 8.11 in the Academic Regulations.

Table 2: Durations and Credit Equivalence for Transfer of Credits from SWAYAM-NPTEL/ other approved MOOC Courses

Sl. No.	Course Duration	Credit Equivalence
1	4 Weeks	1 Credit
2	8 Weeks	2 Credits
3	12 Weeks	3 Credits

13.3.9. The maximum permissible number of credits that a student may request for credit transfer from MOOCs shall not exceed 20% of the mandatory minimum credit requirements specified by the concerned Program Regulations and Curriculum for the award of the concerned Degree.

13.3.10. The University shall not reimburse any fees/expense; a student may incur for the SWAYAM/NPTEL/other approved MOOCs.

13.4 The maximum number of credits that can be transferred by a student shall be limited to forty percent (40%) of the mandatory minimum credit requirements specified by the concerned Program Regulations and Curriculum for the award of the concerned Degree. However, the grades obtained in the Courses transferred from other Institutions/MOOCs, as mentioned in this Section(13) , shall not be included in the calculation of the CGPA.

13.5 Mandatory Non-Credit Course Completion Requirements: All mandatory non-credit courses shall be satisfactorily completed by the student as part of the degree requirements. These courses will be evaluated and awarded letter grades based on the following criteria:

- S (Satisfactorily Completed): Awarded when the student successfully completes all prescribed course requirements.
- NC (Not Completed): Awarded when the student fails to meet the prescribed course requirements.

A student receiving an NC grade must reappear for and complete the course in accordance with the guidelines prescribed by the University.

In the case of non-taught and non-credited mandatory courses—where students are advised to undertake learning through MOOC platforms—there shall be a clearly defined Course Catalogue and a corresponding Course Plan. The Course Plan shall outline the assessment components, which will form the basis for evaluation.

PART B: PROGRAM STRUCTURE

14. Structure / Component with Credit Requirements Course Baskets & Minimum Basket wise Credit Requirements

The BCA Program Structure (2026-29) totalling 120 credits. Table 3 summarizes the type of baskets, number of courses under each basket and the associated credits that are mandatorily required for the completion of the Degree.

Table 3: BCA 2026-29: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets

Sl. No.	Baskets	Credit Contribution
1	Core Courses	53
2	Ability Enhancement Courses	8
3	Multi-Disciplinary Elective course	3
4	Value added Courses	2
5	Skill Enhancement courses	36
6	Discipline Specific Elective	18
7	Mandatory Courses (MAC)	0
	Total Credits	120

15. Minimum Total Credit Requirements of Award of Degree

As per the AICTE guidelines, a minimum of 120 credits is required for the award of a BCA degree.

16.Other Specific Requirements for Award of Degree, if any, as prescribed by the Statutory Bodies,

16.1 The award of the Degree shall be recommended by the Board of Examinations and approved by the Academic Council and Board of Management of the University**.**

16.2 A student shall be declared to be eligible for the award of the concerned Degree if she/he:

a. Fulfilled the Minimum Credit Requirements and the Minimum Credits requirements under various baskets;

b. Secure a minimum CGPA of 4.50 in the concerned Program at the end of the Semester/Academic Term in which she/he completes all the requirements for the award of the Degree as specified in Sub-Clause of 19.2.1 of Academic Regulations;

c. No dues to the University, Departments, Hostels, Library, and any other such Centers/ Departments of the University; and

d. No disciplinary action is pending against her/him.

PART C: CURRICULUM STRUCTURE

17. Curriculum Structure – Basket Wise Course List

Table 3.1 Ability Enhancement Courses (AEC)						
S.No	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	ENG1902	Foundations of English Communication	3	0	0	3
2	ENG1913	Essentials of Writing Skills	3	0	0	3
3	PPS1001	Introduction to soft skills	0	0	2	1
4	PPS3001	Problem Solving through Aptitude	0	0	2	1
		Total No. of Credits				**8**
Table 3.2 Skill Enhancement Courses (SEC)						
S.No	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSA1500	Problem Solving using C	2	0	0	2
2	CSA1501	Problem Solving using C Lab	0	0	4	2
3	CSA1502	Web Design and Development	1	0	4	3
4	CSA1503	Programming in Python	1	0	4	3
5	CSA1505	Object Oriented Programming using Java	2	0	0	2
6	CSA1506	Object Oriented Programming using Java lab	0	0	4	2
7	CSA2511	Android Mobile Application Development	1	0	4	3
8	CSA2521	Database System Administration lab	0	0	4	2
9	CSA2211	User Interface Design	1	0	4	3
10	CSA2212	Internet of Things	1	0	4	3
11	CSA7002	Mini Project	-	-	-	3
12	CSA7300	Project	-	-	-	8
		Total No. of Credits				**36**

Table 3.3: Core Courses (CC)						
S.No	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	MAT1201	Applied Mathematics	3	0	0	3
2	CSA1200	Digital Computer Fundamentals	3	0	0	3
3	CSA1203	Essentials of Data Science	3	0	0	3
4	MAT1202	Statistical Methods and Techniques	3	0	0	3
5	CSA2500	Data Structures	3	0	0	3
6	CSA2501	Data Structures Lab	0	0	2	1
7	CSA2502	Computer Networks	3	0	0	3
8	CSA1201	Computer Organization	3	0	0	3
9	CSA2503	Relational Database Management Systems	3	0	0	3
10	CSA2504	Relational Database Management Systems Lab	0	0	2	1
11	CSA2515	Data Modelling and Visualization	1	0	4	3
12	CSA2505	Analysis of Algorithms	2	1	0	3
13	CSA2506	Operating Systems and Unix Programming	2	0	0	2
14	CSA2507	Operating Systems and Unix Programming Lab	0	0	2	1
15	CSA1202	Software Engineering	3	0	0	3
16	CSA2517	Machine Learning Algorithms	3	0	0	3
17	CSA2509	Data Management using Cloud	3	0	0	3
18	CSA2518	Machine Learning Algorithms Lab	0	0	2	1

19	CSA1708	Data Mining	2	1	0	3
20	CSA2516	Data Analysis using R Programming	0	0	4	2
21	CSA2520	Virtualization and Cloud Infrastructure	1	0	4	3
		Total No. of Credits				**53**

Table 3.4 Value Added Course (VAC)						
S.No	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSA1204	Design thinking and Innovation	2	0	0	2
		Total No. of Credits				**2**

Table 3.5 List of Mandatory Courses (MAC)						
S.No	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CHE7601	Environmental Studies	-	-	-	-
2	LAW7601	Indian Constitution	1	0	0	0
3	CSA7602	Indian Knowledge System	-	-	-	-

18. Practical / Skill based Courses – Internships / Thesis / Dissertation / Capstone Project Work / Portfolio / Mini project

Practical / Skill based Courses like internship, project work, capstone project, research project / dissertation, and such similar courses, where the pedagogy does not lend itself to a typical L-T-P-C Structure as defined in Clause 5.1 of the Academic Regulations, 2021, are simply assigned the number of Credits based on the quantum of work / effort required to fulfill the learning objectives and outcomes prescribed for the concerned Courses. Such courses are referred to as Non-Teaching Credit Courses (NTCC). These Courses are designed to provide students with hands-on experience and skills essential for their professional development. These courses aim to equip students with abilities in problem identification, root cause analysis, problem-solving, innovation, and design thinking through industry exposure and project-based learning. The expected outcomes are first level proficiency in problem solving and design thinking skills to better equip BCA graduates for their professional careers. The method of evaluation and grading for the Practical / Skill based Courses shall be prescribed and approved by the concerned Departmental Academic Committee (refer Annexure A of the Academic Regulations, 2021). The same shall be prescribed in the Course Handout.

18.1 Internship

A student may opt to undertake Internship for a duration of 6-8 weeks during the 6th semester, while concurrently completing the remaining registered courses for that semester. This project work shall be considered equivalent to an internship, subject to the following conditions:

18.1.1 The Internship shall be in conducted in accordance with the Internship Policy prescribed by the University from time to time.

18.1.2 The selection criteria (minimum CGPA, pass in all Courses as on date, and any other qualifying criteria) as applicable / stipulated by the concerned Industry / Company or academic / research institution for award of the Internship to a student;

18.1.3 The number of Internships available for the concerned Academic Term. Further, the available number of internships shall be awarded to the students by the University on the basis of merit

using the CGPA secured by the student. Provided further, the student fulfils the criteria, as applicable, specified by the Industry / Company or academic / research institution providing the Internship, as stated in Sub-Clause 18.1.2 above.

18.1.4 A student may opt for Internship in an Industry / Company or academic / research institution of her / his choice, subject to the condition that the concerned student takes the responsibility to arrange the Internship on her / his own. Provided further, that the Industry / Company or academic / research institution offering such Internship confirms to the University that the Internship shall be conducted in accordance with the Program Regulations and Internship Policy of the University.

18.1.5 A student selected for an Internship in an industry / company or academic / research institution shall adhere to all the rules and guidelines prescribed in the Internship Policy of the University.

18.2 Project Work

A student may opt to do a Project Work for a period of 10-12 weeks in an Industry / Company or academic / research institution or the University Department(s) as an equivalence of Internship during the 6th Semester as applicable, while concurrently completing the remaining registered courses for that semester. subject to the following conditions:

18.2.1 The Project Work shall be approved by the concerned HOD and be carried out under the guidance of a faculty member.

18.2.2 The student may do the project work in an Industry / Company or academic / research institution of her / his choice subject to the above mentioned condition (Sub-Clause 18.2.1). Provided further, that the Industry / Company or academic / research institution offering such project work confirms to the University that the project work will be conducted in accordance with the Program Regulations and requirements of the University.

18.3 Capstone Project

A student may undergo a Capstone Project for a period of 8-12 weeks in an industry / company or academic / research institution in the 4th Semester as applicable, while concurrently completing the remaining registered courses for that semester. subject to the following conditions:

18.3.1 The Capstone Project shall be in conducted in accordance with the Capstone Project Policy prescribed by the University from time to time.

18.3.2 The selection criteria (minimum CGPA, pass in all Courses as on date, and any other qualifying criteria) as applicable / stipulated by the concerned Industry / Company or academic / research institution for award of the Capstone Project to a student;

18.3.3 The number of Capstone Project available for the concerned Academic Term. Further, the available number of Capstone Project shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student. Provided further, the student fulfils the criteria, as applicable, specified by the Industry / Company or academic / research institution providing the Capstone Project, as stated in Sub-Clause 18.3.2 above.

18.3.4 A student may opt for Capstone Project in an Industry / Company or academic / research institution of her / his choice, subject to the condition that the concerned student takes the responsibility to arrange the I Capstone Project on her / his own. Provided further, that the Industry / Company or academic / research institution offering such Capstone Project confirms to the University that the Capstone Project shall be conducted in accordance with the Program Regulations and Capstone Project Policy of the University.

18.3.5 A student selected for a Capstone Project in an industry / company or academic / research institution shall adhere to all the rules and guidelines prescribed in the Capstone Project Policy of the University.

18.4 Research Project / Dissertation

A student may opt to do a Research Project / Dissertation for a period of 12-14 weeks in an Industry / Company or academic / research institution or the University Department(s) as an equivalence of Capstone Project/Internship/Project, subject to the following conditions:

18.4.1 The Research Project / Dissertation shall be approved by the concerned HOD and be carried out under the guidance of a faculty member.

The student may do the Research Project / Dissertation in an Industry / Company or academic / research institution of her / his choice subject to the above-mentioned condition (Sub-Clause 2.6.4.1). Provided further, that the Industry / Company or academic / research institution offering such Research Project / Dissertation confirms to the University that the Research Project / Dissertation work will be conducted in accordance with the Program Regulations and requirements of the University.

19. List of Elective Courses under various Specialisations / Stream Basket

Table 3.6: Discipline Specific Elective – Minimum of 15 credits is to be earned by the student in a particular track and overall, 18 credits.

Track 1 - Artificial Intelligence and Machine Learning						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSA3501	Natural Language Processing	3	0	0	3
2	CSA3502	Big Data Analytics	2	0	2	3
3	CSA3504	Intelligent Application Development	1	0	4	3
4	CSA3505	Generative AI Applications	1	0	4	3
5	CSA3506	Computer Vision Applications	1	0	4	3
6	CSA3507	Applied AI and Automation for Business Solutions	2	0	2	3
Track 2 - AI and Data Science						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSA3509	Natural Language Processing	3	0	0	3
2	CSA3510	Big Data Analytics	2	0	2	3
3	CSA3511	Data Analytics using Python	2	0	2	3
4	CSA3512	Predictive Analytics	2	0	2	3
5	CSA3513	R Programming for Data Analysis	1	0	4	3
6	CSA3514	Data Visualization and Business Intelligence	1	0	4	3
7	CSA3515	Generative AI Applications	1	0	4	3
Track 3 – Cloud Computing, Big Data & Business Intelligence						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSA3516	Virtualization Technologies	2	0	2	3
2	CSA3517	DevOps and Micro services	2	0	2	3
3	CSA3518	Data Warehousing	3	0	0	3
4	CSA3519	Predictive Analytics	2	0	2	3
5	CSA3520	Data Visualization	1	0	4	3
6	CSA3521	Hadoop Framework	1	0	4	3
7	CSA3522	Social Media Analytics	2	0	2	3

8	CSA3523	Generative AI and Prompt Engineering	2	0	2	3

Track 4 – Cyber Security & Ethical Hacking						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSA3524	Fundamentals of Cyber Security	3	0	0	3
2	CSA3525	Data Ethics & Privacy	3	0	0	3
3	CSA3526	Cloud Security & System Administration	2	0	2	3
4	CSA3527	Digital Forensics	2	0	2	3
5	CSA3528	Cyber Security Tools & Practices	2	0	2	3
6	CSA3529	Ethical Hacking	1	0	4	3
7	CSA3530	Penetration Testing & Vulnerability Assessment	1	0	4	3
8	CSA3531	AI Applications in Cyber Security	2	0	2	3

Track 5 – Web Development & MAD						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSA3532	Fundamentals of Web Technologies	3	0	0	3
2	CSA3533	Progressive Web Application Development	3	0	0	3
3	CSA3534	Front-End Web Development using React	2	0	2	3
4	CSA3535	NoSQL	2	0	2	3
5	CSA3536	Full Stack Web Application Development	1	0	4	3
6	CSA3537	Android Application Development using Kotlin	1	0	4	3
7	CSA3538	Agile Software Development	1	0	4	3
8	CSA3539	DevOps and Micro services	2	0	2	3

Track 6 – Augmented Reality & Virtual Reality						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSA3540	Introduction to 3D graphics, VR workflows and Interactive Technologies	3	0	0	3
2	CSA3541	Introduction to Immersive Technologies	3	0	0	3
3	CSA3543	Character Modelling and Rigging	1	0	4	3
4	CSA3544	Programming using C# for Unity	1	0	4	3
5	CSA3545	Augmented Reality Development	1	0	4	3
6	CSA3546	Virtual Reality Development	1	0	4	3
7	CSA3547	Mixed Reality Development	1	0	4	3

Track 7 – Gaming Technology						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSA3548	Fundamentals of Game Design, Game Mechanics and Dynamics	3	0	0	3
2	CSA3549	Preproduction Techniques and Interactive Media	3	0	0	3
3	CSA3551	Animation for Games	2	0	2	3
4	CSA3544	Programming using C# for Unity	1	0	4	3
5	CSA3543	Character Modelling and Rigging	1	0	4	3
6	CSA3554	2D Game Design and Development	1	0	4	3
7	CSA3555	3D Game Design and Development	1	0	4	3
Track 8 – AI Extra Edge Course						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSA3556	Prompt Engineering and AI Tools for Productivity	3	0	0	3
2	CSA3557	Responsible AI and Bias Auditing	3	0	0	3
3	CSA3558	Project Management and MLOps	3	0	0	3

20. Recommended Semester Wise Course Structure / Flow including the Programme / Discipline Elective Paths / Options

Semester 1								
S. NO.	**COURSE CODE**	**COURSE NAME**	**CREDIT STRUCTURE**					**BASKET**
			L	**T**	**P**	**C**	**CONTACT HOURS**	
1	MAT1201	Applied Mathematics	3	0	0	3	3	CC
2	CSA1500	Problem Solving using C	2	0	0	2	2	SEC
3	CSA1501	Problem Solving using C Lab	0	0	4	2	4	SEC
4	CSA1200	Digital Computer Fundamentals	3	0	0	3	3	CC
5	CSA1502	Web Design and Development	1	0	4	3	5	SEC
6	ENG1902	Foundations of English Communication	3	0	0	3	3	AEC
7	PPS1001	Introduction to soft skills	0	0	2	1	2	AEC
		TOTAL	**12**	**0**	**10**	**17**	**22**	**-**

Semester 2								
S. NO.	**COURSE CODE**	**COURSE NAME**	**CREDIT STRUCTURE**					**BASKET**
			L	**T**	**P**	**C**	**CONTACT HOURS**	
1	CSA1503	Programming in Python	1	0	4	3	5	SEC

2	MAT1202	Statistical Methods and Techniques	3	0	0	3	3	CC
3	CSA2500	Data Structures	3	0	0	3	3	CC
4	CSA2501	Data Structures Lab	0	0	2	1	2	CC
5	ENG1913	Essentials of Writing Skills	3	0	0	3	3	AEC
6	CSA1203	Essentials of Data Science	3	0	0	3	3	CC
7	CSA2502	Computer Networks	3	0	0	3	3	CC
8	CSA1201	Computer Organization	3	0	0	3	3	CC
9	CSA1204	Design thinking and Innovation	2	0	0	2	2	VAC
		TOTAL	**21**	**0**	**6**	**24**	**27**	**-**

Semester 3								
S. NO.	**COURSE CODE**	**COURSE NAME**	**CREDIT STRUCTURE**					**BASKET**
			L	**T**	**P**	**C**	**CONTACT HOURS**	
1	CSA2503	Relational Database Management Systems	3	0	0	3	3	CC
2	CSA2504	Relational Database Management Systems Lab	0	0	2	1	2	CC
3	CSA1505	Object Oriented Programming using Java	2	0	0	2	2	SEC
4	CSA1506	Object Oriented Programming using Java lab	0	0	4	2	4	SEC
5	CSA2515	Data Modelling and Visualization	1	0	4	3	5	CC
6	CSA2505	Analysis of Algorithms	2	1	0	3	3	CC
7	CSA2506	Operating Systems and Unix Programming	2	0	0	2	2	CC
8	CSA2507	Operating Systems and Unix Programming Lab	0	0	2	1	2	CC
9	CSA1202	Software Engineering	3	0	0	3	3	CC
10	CHE7601	Environmental Studies	-	-	-	-	0	MAC
		TOTAL	**13**	**1**	**12**	**20**	**26**	**-**

Semester 4								
S. NO.	**COURSE CODE**	**COURSE NAME**	**CREDIT STRUCTURE**					**BASKET**
			L	**T**	**P**	**C**	**CONTACT HOURS**	
1	CSA2517	Machine Learning Algorithms	3	0	0	3	3	CC
2	CSA2518	Machine Learning Algorithms Lab	0	0	2	1	2	CC
3	CSA2511	Android Mobile Application Development	1	0	4	3	5	SEC
4	CSA2509	Data Management using Cloud	3	0	0	3	3	CC
5	CSA2521	Database System Administration lab	0	0	4	2	5	SEC
6	CSAXXXX	Discipline Specific Elective– I	1	0	4	3	5	DSE
7	CSAXXXX	Discipline Specific Elective– II	3	0	0	3	3	DSE
8	PPS3001	Problem Solving through Aptitude	0	0	2	1	2	AEC
9	LAW7601	Indian Constitution	1	0	0	0	0	MAC
		TOTAL	**12**	**0**	**16**	**19**	**28**	**-**

Semester 5				
S. NO.		**COURSE NAME**	**CREDIT STRUCTURE**	**BASKET**

	COURSE CODE		L	T	P	C	CONTACT HOURS	
1	CSA1708	Data Mining	2	1	0	3	3	CC
2	CSA2516	Data Analysis using R Programming	0	0	4	2	4	CC
3	CSAXXXX	Discipline Specific Elective– III	1	0	4	3	5	DSE
4	CSAXXXX	Discipline Specific Elective– IV	2	0	2	3	4	DSE
5	CSAXXXX	Discipline Specific Elective– V	3	0	0	3	3	DSE
6	CSA2212	Internet of Things	1	0	4	3	5	SEC
7	CSAXXXX	Multi-Disciplinary Elective – I	3	0	0	3	3	MDC
8	CSA7002	Mini Project	-	-	-	3	0	SEC
9	CSA7602	Indian Knowledge System	-	-	-	-	0	MAC
		TOTAL	**12**	**1**	**14**	**23**	**27**	**-**

Semester 6								
S. NO.	**COURSE CODE**	**COURSE NAME**	**CREDIT STRUCTURE**					**BASKET**
			L	**T**	**P**	**C**	**CONTACT HOURS**	
1	CSA2520	Virtualization and Cloud Infrastructure	1	0	4	3	5	CC
2	CSA2211	User Interface Design	1	0	4	3	5	SEC
3	CSAXXXX	Discipline Specific Elective – VI	3	0	0	3	3	DSE
4	CSA7300	Project	-	-	-	8	0	SEC
		TOTAL	**5**	**0**	**8**	**17**	**13**	**-**

23. Course Catalogue

Course Catalogue of all Courses Listed including the Courses Offered by other School / Department and Discipline / Programme Electives – Course Code, Course Name, Prerequisite, Anti-requisite, Course Description, Course Outcome, Course Content (with Blooms Level, CO, No. of Contact Hours), Reference Resources.

Ability Enhancement Courses (AEC)

ENG1902 Foundations of English Communication

<table>
<tr><td>Course Code: ENG 1902</td><td colspan="3">Course Name: Foundations Of English Communication
Type of Course: Theory Course /AEC</td><td>L- T-P- C</td><td>3-0-0-3</td></tr>
<tr><td>Version No.</td><td colspan="5">1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="5">PUC level basic English Language skills</td></tr>
<tr><td>Anti-requisites</td><td colspan="5">NIL</td></tr>
<tr><td>Course Description</td><td colspan="5">This foundational course is designed to develop core English communication skills in learners with beginner proficiency. centred around the LSRW approach—Listening, Speaking, Reading, and Writing—the course introduces students to practical and interactive methods for enhancing their confidence and fluency in English. Through real-life contexts, engaging activities, and multimedia resources, students will build essential skills needed for academic, professional, and everyday communication. The course also fosters collaboration, self-expression, and digital literacy through creative tasks and group exercises.</td></tr>
<tr><td>Course Objective</td><td colspan="5">The objective of the course is skill development of student by using Participative Learning techniques</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">On successful completion of the course the students shall be able to:
• Identify the basics of English communication and gain confidence in using the language in both academic and social contexts. (Remember)
• Recognize active listening skills by engaging with different English accents, tones, and formats to better understand meaning and context. (Understand)
• Demonstrate speaking fluency, correct pronunciation, and clear expression through conversations, role plays, and public speaking. (Understand)
• Classify vocabulary and reading comprehension skills by reading and analysing various texts such as stories, poems, and digital content. (Understand)
• Develop effective writing skills for both academic and creative purposes through activities like writing paragraphs, and short stories. (Understand)</td></tr>
<tr><td colspan="6">Course Content:</td></tr>
<tr><td>Module 1</td><td>Introduction to English Communication</td><td>Communication Skills</td><td>LSRW</td><td colspan="2">06 Sessions</td></tr>
<tr><td colspan="6">Topics:
• Importance of English in academics and career
• Basics of communication (verbal/non-verbal)
• Elements of effective communication
• Barriers to communication
• Activity: Verbal and Nonverbal communication- charades.</td></tr>
<tr><td>Module 2</td><td>Active Listening</td><td>Quiz</td><td>Listening Skills</td><td colspan="2">9 Sessions</td></tr>
<tr><td colspan="6">Topics:
• Listening to conversations,
• Listening for gist and details
• Listening and Note-taking
• Audio Sources: BBC Learning English, TEDx (simplified), Daily conversations
• Activity: Listening quiz</td></tr>
<tr><td>Module 3</td><td>Better Speaking</td><td>Role Play</td><td>Speaking</td><td colspan="2">12Sessions</td></tr>
<tr><td colspan="6">Topics:
• Everyday conversations: shopping, college, travel
• Role plays and dialogues
• Describing people/places
• Activity: Speech on “My Role Model” Extempore (guided)</td></tr>
</table>

Module 4	Reading for Understanding	Comprehension Skills	Reading Skills	12 Sessions

Topics:

- Reading simple paragraphs, short stories, and poetry
- Identifying main ideas and supporting details
- Skimming and scanning
- Reading digital content (tweets, podcasts, blogs)
- Texts:
- The Eyes Are Not Here (Ruskin Bond) Leisure (W.H. Davies)

Module 4	Effective Writing	Writing Skills		6 Sessions

Topics:

- Basics of sentence structure
- Paragraph writing: description, opinion
- Story and dialogue writing
- Using tools like Grammarly for editing
- Activity: Picture-based story writing

Text Book

- Gairns, Ruth, and Stuart Redman. Oxford English for Academic Communication. Oxford UP, 2021.
- Flowerdew, John, and Lindsay Miller. The Routledge Handbook of English for Academic Purposes. 2nd ed., Routledge, 2022.

References

- Richards, Jack C. Key Issues in Language Teaching. 2nd ed., Cambridge UP, 2022.
- Nation, I. S. P., and Averil Coxhead. Teaching Vocabulary: A Vocabulary Research Manual. Routledge, 2022.
- Hyland, Ken. Second Language Writing. 3rd ed., Cambridge UP, 2021.
- Paltridge, Brian, and Sue Starfield. Getting Published in Academic Journals: Navigating the Publication Process. 2nd ed., University of Michigan Press, 2020.

E-Resources

1. BBC Learning English – https://www.bbc.co.uk/learningenglish.
2. TEDx Talks – https://www.ted.com/talks.
3. Grammarly Blog – https://www.grammarly.com/blog/.
4. FutureLearn – Understanding English Language and Culture – https://www.futurelearn.com/courses/explore-english-language-culture
5. Cambridge English Learning Resources – https://www.cambridgeenglish.org/learning-english/

ENG1913 Essentials of Writing Skills

Course Code: ENG1913	Course Name: Essentials of Writing Skills Type of Course: Theory Course /AEC	L- T-P- C	3-0-0-3
Version No.	1		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	In any workplace, people use their computers and mobiles to help them research, compose, design, revise, and deliver information and documents. Networked computers and mobile devices are the central nervous system of the technical workplace, and the course helps students to practice technical communication. The course aims at initiating writing skills in the field of technical communication concentrating product descriptions, letters, emails, memos etc. New media and communication technologies are dramatically altering technical fields at an outstanding rate.		

	Students are prone to work more efficiently, more globally and more visually. These changes are incorporated in the course giving importance to online communication, such as, blog and online content writing.
Course Objective	This course is designed to improve the learners' employability skills by using problem solving methodologies.
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1. Apply strategies and techniques for organizing and drafting descriptions and specifications. [Understand] CO2. Develop skills in writing sentences and paragraphs for content on websites and blogs. [Understand] CO3. Write technical/professional emails, letters and memo [Understand]

Course Content:

Module 1	Technical Descriptions and specifiactions	Assignment	Technical Descriptions and specifiactions	15 Sessions

Topics:

- Technical ICT vocabulary errors/full forms of common ICT words
- Using proper punctuation
- ICT product descriptions
- Writing instructions
- User guides (step-by-step instructions, procedures, manuals)

Module 2	Informative summaries	Quiz/ Assignment	Informative summaries	15 Sessions

Topics:

1: Creating Infographics

2: Creating summary maps

Module 3	Technical Correspondence	Assignment	Technical Correspondence	15 Sessions

Topics:

Business & Official Letters, Memos and Email

Text Book

- Johnson, Richard. Technical Communication Today. Pearson, 2015.
- Felder, Lynda. Writing for the Web Creating Compelling Web Content Using Words, Pictures and Sound. Pearson, 2012.

E-Resources

1. https://www.cambridge.org/core/journals/publications-of-the-astronomical-society-of-australia/article/abs/3-lyman-technical-description/ACBC41A9A302D85C94AFF7CFFD9B0761
2. https://www.cambridge.org/core/books/abs/patent-intensity-and-economic-growth/clustering-procedure-technical-description/173050CAD2CCA6F62B597981B4DB9B0F
3. https://www-jstor-org-presiuniv.knimbus.com/stable/43748770?seq=2
4. Bridgeford, Tracy; Kitalong, Karla Saari; and Selfe, Richard, "Innovative Approaches to Teaching Technical Communication" (2004). All USU Press Publications. 147. https://digitalcommons.usu.edu/usupress_pubs/147

PPS1001 Introduction to soft skills

Course Code: PPS1001	Course Name: Introduction to Soft Skills Type of Course: Lab / Lab Integrated Course/AEC	L- T-P- C	0-0-2-1
Version No.	1		
Course Pre-requisites	1. Students are expected to understand basic English. 2. Students should have desire and enthusiasm to involve, participate and learn.		
Anti-requisites	NIL		
Course Description	This course is designed to enable students to understand the importance of soft skills and improve confidence, communication and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies.		
Course Objective	The objective of the course is skill development of student by using participative & experiential learning techniques		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1** Prepare professional social media profile [Understand] **CO2** Recognize the significance of Soft Skills [Understand] **CO3** List the techniques of unlearning poor habits and forming healthy habits [Understand] **CO4** Demonstrate appropriate team behavior & people management [Understand]		

Course Content:				
Module 1	Introduction to Soft Skills	Assignment	Introduction to Soft Skills	8 Sessions
Topics: Setting Expectations, Ice Breaker, Significance of soft skills.				
Module 2	Professional Brand Building	Assignment	Professional Brand Building	8 Sessions
Topics: Significance of a profile. Creating an online profile. Networking - 100 connections, LinkedIn as a live resume, Create a dashboard.				
Module 3	Habit Formation	Assignment	Habit Formation	8 Sessions
Topics: Professional and personal ethics for success, Identity based habits, Domino effect, Habit Loop, Unlearning, standing up for what is right, New skills acquisition - 10,000 hours' rule for expertise.				
Module 4	Team Synergy & People Management, Adaptability, Effective communication	Assignment	Team Synergy & People Management, Adaptability, Effective communication	6 Sessions
Topics: Importance of team, Get to know team needs (Maslow's Theory of needs), Trust and collaboration, Virtual Team building. Change management: VUCA, adapting to changes, growth and fixed mindset, Continuous Learning Different styles of communication, Difference between hearing and listening, Effective communication for success. Self-introduction framework. Self-awareness, Empathy, Self-management, social awareness, and Relationship management				

Text Book

- The 7 Habits of Highly Effective People, first published in 1989, is a business and self-help book written by Stephen R. Covey – (Module – Habit Formation)
- The Power of Habit: Why We Do What We Do in Life and Business is a book by Charles Duhigg (Module – Habit Formation)

E-Resources

1. How to Write a Blog on LinkedIn
2. 7 steps for successful career planning (naukri.com)

Ted Talk:

- An introvert's guide to networking | Rick Turoczy | TEDxPortland - YouTube (Module: Professional Brand building)
- How to turn a group of strangers into a team | Amy Edmondson - YouTube (Module: Team skills and People Management)
- How Adaptability Will Help You Deal With Change | Jennifer Jones | TEDxNantwich - YouTube (Module: Adaptability)

PPS3001 Problem Solving through Aptitude

Course Code: PPS3001	Course Name: Problem Solving through Aptitude Type of Course: Lab / Lab Integrated Course/AEC	L- T-P- C	0-0-2-1
Version No.	1		
Course Pre-requisites	Students should know the basic Mathematics & aptitude along with understanding of English		
Anti-requisites	NIL		
Course Description	The objective of this course is to prepare the trainees to tackle the questions on various topics and various difficulty levels based on Quantitative Ability, and Logical Reasoning asked during the placement drives. There will be sufficient focus on building the fundamentals of all the topics, as well as on solving the higher order thinking questions. The focus of this course is to teach the students to not only get to the correct answers, but to get there faster than ever before, which will improve their employability factor.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Aptitude and attain Skill Development through Problem Solving techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1** Recall all the basic mathematical concepts they learnt in high school. [Understand] **CO2** Identify the principle concept needed in a question. [Understand] **CO3** Solve the quantitative and logical ability questions with the appropriate concept. [Understand] **CO4** Analyze the data given in complex problems. [Understand]		

Course Content:

Module 1	Quantitative Ability	Assignment	Quantitative Ability	10 Sessions
Topics: Introduction to Aptitude, working of Tables, Squares, Cubes, Number Series, Wrong number series, Letter series.				
Module 2	Logical Reasoning	Assignment	Logical Reasoning	20 Sessions
Topics: Linear & Circular Arrangement Puzzle, Coding & Decoding, Blood Relations, Directions, Ordering and Ranking, Clocks and Calendars				

Text Book

T1. Quantitative Aptitude by R S Aggarwal

T2. Verbal & Non-Verbal Reasoning by R S Aggarwal

E-Resources

1. www.indiabix.com
2. www.youtube.com/c/TheAptitudeGuy/videos
3. Prepinsta.com

Skill Enhancement Courses

CSA1500 Problem solving using C

Course Code: CSA1500	**Course Name:** Problem solving using C **Type of Course:** SEC	L- T-P- C	2-0-0-2
Version No.	1		
Course pre-requisites	NA		
Anti-requisites	NIL		
Course Description	This Course will provide an introduction to foundational concepts of computer programming to students of BCA program. Topics covered in this Course are problem formulation and development of simple programs, Pseudo code, Flow Chart, Algorithms, data types, operators, decision making and branching, looping statements, arrays, functions, structures, Union, File handling and pointers. In the lab session students are required to solve problems based on the above concepts to illustrate the features of the structured programming.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Problem-Solving Using C and attain Skill Development through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain basic concepts of C programming. [Understand] CO2 Apply control statements to solve programming problems. [Apply] CO3 Implement arrays and strings for data manipulation. [Apply] CO4 Use functions for modular program development. [Apply] CO5 Differentiate structures and unions in C programming. [Apply]		
Course Content:			
Module 1	Introduction to C Programming		8 Sessions
Topics: Background, Computer basics, Problem solving techniques, Tokens, Input/ Output statements, Structure of C program.			
Module 2	Control statements in C		8 Sessions
Topics: Type Casting, Expression Evaluation, Conditional and unconditional statement, Looping statements			
Module 3	Arrays and Strings		6 Sessions
Topics: One dimensional Array, Array operations,2D Array, 2D Array operations, Strings and its operations, String manipulation functions.			
Module 4	Functions, Structures and Unions, Pointers		8 Sessions
Topics: Categories of functions, concept of modular programming, user defined datatypes, structures, union, pointers, file handling.			

Text Books

T1 E. Balaguruswamy, "Programming in ANSI C", Eighth Edition - Tata McGraw Hill.

T2 N. Sharma, Programming for Problem Solving Using C. New Delhi, India: BPB Publications, 2021.

Reference Books

R1 Behrouz A Forouzan, Richard F Gilberg, "Computer Science: A structured programming approach using C", Third Edition Cengage Learning.

R2 Brian W. Kernighan / Dennis Ritchie, "The C Programming Language " ,Second Edition, Pearson YashavantKanetkar, "Let Us C", Eighteenth edition , BPB Publications

E-Resources

1. https://nptel.ac.in/courses/106105171
2. https://www.geeksforgeeks.org/c-programming-language/
3. https://www.programiz.com/c-programming

CSA1501 Problem solving using C Lab

Course Code: CSA1501	**Course Name:** Problem solving using C Lab **Type of Course:** Lab/ SEC	L- T-P- C	0-0-4-2
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces the fundamentals of C programming, including data types, control structures, arrays, and strings. Students will analyze problems, draw flowcharts, and implement solutions using modular programming techniques. The course also covers advanced topics such as functions, structures, unions, and pointers for efficient problem-solving.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Problem-Solving Using C and attain Skill Development through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Design a flowchart for a recursive factorial function. [Apply] CO2 Select suitable data types for C programs. [Apply] CO3 Implement branching and looping constructs effectively. [Apply] CO4 Develop programs using arrays and strings. [Apply] CO5 Construct programs using functions, structures, and unions. [Apply] CO6 Develop solutions using pointers and modular programming concepts. [Apply]		

List of Experiments	60 Sessions
1. Write a program to display the basic structure of a C program and execute simple input/output statements. 2. Develop a program to demonstrate the usage of C tokens and different data types. 3. Write a program to perform arithmetic operations using type casting and expression evaluation. 4. Develop programs using conditional statements (if, if-else, nested if). 5. Write a program using switch-case for menu-driven operations. 6. Develop programs using looping statements (for, while, do-while). 7. Write a program to generate number patterns using nested loops. 8. Develop a program using one-dimensional arrays and perform array operations. 9. Write a program to perform operations on two-dimensional arrays (matrix addition/multiplication). 10. Develop programs to perform string input/output and basic string operations. 11. Write a program using string manipulation functions (strlen, strcpy, strcat, strcmp). 12. Develop programs using user-defined functions (with and without arguments, return values). 13. Write a program demonstrating structures and operations on structure variables. 14. Develop a program to demonstrate the use of union and differentiate it from structure. 15. Write programs using pointers and file handling operations (read/write data to file).	

Text Books

T1 E. Balaguruswamy, "Programming in ANSI C", Eighth Edition - Tata McGraw Hill.

T2 N. Sharma, Programming for Problem Solving Using C. New Delhi, India: BPB Publications, 2021.

Reference Books

R1 Behrouz A Forouzan, Richard F Gilberg, "Computer Science: A structured programming approach using C", Third Edition Cengage Learning.

R2 Brian W. Kernighan / Dennis Ritchie, "The C Programming Language " ,Second Edition, Pearson YashavantKanetkar, "Let Us C", Eighteenth edition , BPB Publications

E-Resources

1. https://nptel.ac.in/courses/106105171
2. https://www.geeksforgeeks.org/c-programming-language/
3. https://www.programiz.com/c-programming

CSA1502 Web Design and Development

Course Code: CSA1502	Course Title: Web Design and Development Type of Course: Laboratory integrated		L-T-P-C	1	0	4	3
Version No.	1.0						
Course Pre-requisites	NIL						
Anti-requisites	NIL						
Course Description	This course is designed to build the student's knowledge on web design and development to an intermediate level. Students will learn the fundamental languages and markups for front-end web programming and back-end languages. By the end of this course, students should be able to design, program and publish a working and atheistic website. Students will also go through the process of working in a client/server-side programming and learning skills which is necessary to successfully fulfill each role. The associated laboratory provides a platform to implement the various programming language to design web pages and enhance critical thinking and analytical skills.						
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Web Design and Development and attain Skill Development through Experiential Learning techniques.						
Course Out Comes	On successful completion of this course the students shall be able to: CO1: Design structured webpages using HTML elements effectively [Apply] CO2: Develop styled webpages using CSS properties efficiently [Apply] CO3: Create interactive webpages using JavaScript functions dynamically [Apply] CO4: Implement event handling using JavaScript objects effectively [Apply] CO5: Validate user inputs and implement client-side form validations using JavaScript [Apply] CO6: Design structured webpages and understand Internet basics, WWW, browsers, and client-server concepts effectively [Apply]						
Course Content:							
Module 1	Introduction to HTML	Assignment	Programming activity	05 Sessions			
Topics: Introduction to Web pages: basic concepts of web pages; structure of HTML document; HTML elements - headings, paragraphs, hyperlinks, lists; tables and images; basic page layout, ordered list, unordered list and definition list; unorder list and anchor tags; inserting images and basic multimedia elements; tables and table structure. Creation of simple web pages using HTML.							
Module 2	CSS (Cascading Style Sheets)	Assignment	Programming activity	05 Sessions			
Introduction to CSS and its importance in web design : types of CSS - inline , internal and external ; CSS syntax , selectors and properties ; styling text and fonts - font family , size , color and alignment ; background properties and							

color formatting ; CSS box model - margin , padding , border and spacing ; basic layout techniques using display and positioning ; simple page styling and layout design using CSS.

Module 3	JavaScript	Assignment	Programming activity	05 Sessions

Topics:

Introduction to JavaScript: basic syntax and structure; variables and data types; operators and expressions; control statements - if, switch; looping statements - for, while.

JavaScript functions and arrays: creating and using functions; arrays and basic operations; JavaScript objects; event handling in web pages; simple form validation. Introduction to Document Object Model (DOM) ; event handling in web pages - onclick , onmouseover and form validation

Module 4	Internet Basics	Assignment	Programming activity	05 Sessions

Topics:

Introduction to Internet and basic concepts : evolution of Internet , basic Internet architecture and communication ; World Wide Web (WWW) and its working principles ; web browsers and their functions - browsing , searching and downloading information ; web servers and hosting concepts ; client and server architecture - request and response model ; URL structure and domain names ; introduction to Internet protocols - HTTP , HTTPS and FTP ; basic web security and safe Internet usage ; overview of modern Internet applications and web services.

Lab Experiments:

HTML Programs

1. Design a simple web page with heading tags, paragraph, and an image.
2. Create a web page to display student information using an HTML table.
3. Create a web page using ordered list and unordered list to display course subjects.
4. Design a web page with hyperlinks to navigate between multiple pages.
5. Create a user registration form using HTML form elements (text box, radio button, checkbox, submit button).
6. Design a web page to display college timetable using HTML table.
7. Create a web page to display different text formatting tags such as bold, italic, underline, superscript, and subscript.

CSS Programs

8. Design a web page with background color, text color, and font styles using CSS.
9. Apply inline, internal, and external CSS to format a webpage.
10. Create a web page with borders, padding, and margins using CSS box model.
11. Design a simple navigation menu using CSS styling.
12. Create a web page with image styling and hover effects using CSS.
13. Design a two-column web page layout using CSS formatting.

JavaScript Programs

14. Write a JavaScript program to perform addition, subtraction, multiplication, and division using form inputs.
15. Write a JavaScript program to display squares and cubes of numbers from 1 to 10.
16. Write a JavaScript program to display the current date and time.
17. Write a JavaScript program for form validation (name, email, mobile number).
18. Write a JavaScript program to change background color when a button is clicked.
19. Write a JavaScript program to display text with increasing and decreasing font size.
20. Write a JavaScript program to show an alert message when a user clicks a button.
21. Explore Internet Evolution & Create a Timeline
22. Create a Client-Server Model & Request-Response Simulation
23. Experiment on URL Structure, Domain Names & Protocols (HTTP/HTTPS/FTP)
24. Deploy a webpage on free hosting.
25. Design a Structured Webpage with Security Audit

Targeted Application & Tools that can be used:

Project work/Assignment: Mention the Type of Project /Assignment proposed for this course

Problem Solving: Choose appropriate web concepts to implement the web pages.

Text Book

Jurgen Wolf,HTML and CSS: The Comprehensive Guide, SAP Press; New edition (30 June 2023)

David Flanagan, Shroff/O'Reilly, Javascript The Definite Guide 7/ED, Seventh edition (15 June 2020)
Douglas E. Comer, The Internet Book: Everything You Need to Know About Computer Networking and How the Internet Works, CRC Press, Fifth edition, 2018.

References
Deitel, Deitel, Goldberg,"Internet& World Wide Web How to Program", Fifth Edition, Pearson Education, 2021.
David DuRocher,HTML &CSS QuickStart Guide, ClydeBankMedia,2021.
Behrouz A. Forouzan, Data Communications and Networking, McGraw-Hill, 5th Edition,2012

CSA1503 Programming in Python

Course Code: CSA1503	**Course Name:** Programming in Python **Type of Course:** Integrated / SEC	L- T-P-C	1-0-4-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course provides the opportunity for the students of Computer Science engineering to develop Python scripts using its powerful programming features like lists, sets, tuples, dictionaries and sets. Students will also be introduced to object oriented programming concepts and packages for data visualization. Topics include: Basics of Python programming, operators and expressions, decision statements, loop control statements, functions, strings, lists, list processing : searching and sorting, nested list, list comprehension, tuples and dictionaries, sets, file handling, exception handling, object oriented programming concepts, modules and packages for data visualization		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Problem Solving Using Python and attain Skill Development through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain problem solving techniques and basic Python constructs [Understand] CO2 Implement decision making and loop control statements effectively [Apply] CO3 Design programs using functions, strings, and lists [Apply] CO4 Perform list processing including searching and sorting techniques [Apply] CO5 Utilize data structures, files, and exception handling mechanisms [Apply] CO6 Develop object oriented programs and visualize data effectively [Apply]		
Course Content:			
Module 1	Problem Solving Techniques and Basics of Python Programming		5 Sessions
Topics: Basics of problem solving techniques, Basics of Python programming, operators and expressions, decision statements, loop control statements.			
Module 2	Function, String and List		3 Sessions
Topics: Functions, strings, lists, list processing: searching and sorting, nested list, list comprehension			
Module 3	Data Structures, File and Exception handling		3 Sessions
Topics: Tuples and dictionaries, sets, file handling, exception handling.			
Module 4	Object-Oriented Programming and Data Visualization		4 Sessions
Topics: Object oriented programming concepts, modules and packages for data visualization.			
List of Experiments			60 Sessions
Experiment – 1: Write a Python program to perform basic arithmetic operations (addition, subtraction, multiplication, division) and print results. Experiment – 2: Write a Python program that takes a number as input and checks whether it is positive, negative, or zero.			

Experiment – 3: Implement a Python program to calculate the factorial of a given number using both for and while loops.
Experiment – 4: Write a Python program that checks if a number is prime.
Experiment – 5: Develop a program to print different patterns using nested loops.
Experiment – 6: Write a function to generate the Fibonacci series up to n terms.
Experiment – 7: Write a program to count vowels and consonants in a given string.
Experiment – 8: Implement Bubble Sort and Binary Search on a list of numbers.
Experiment – 9: Write a Python program to perform matrix addition using nested lists.
Experiment – 10: Use list comprehension to separate even and odd numbers from a given list.
Experiment – 11: Create a dictionary to store student names and their marks, then perform add, update, and delete operations.
Experiment – 12: Implement union, intersection, and difference operations on sets.
Experiment – 13: Write a Python program to read from a file and count word occurrences, then write the output to another file.
Experiment – 14: Implement a program that handles the ZeroDivisionError when dividing two numbers.
Experiment – 15: Design a class BankAccount with methods to deposit, withdraw, and display balance.

Text Books

T1 Ashok NamdevKamthane and Amit Ashok Kamthane, "Problem Solving and Python Programming", Tata McGraw Hill Edition, 2018.

T2 Charles Dierbach, "Introduction to Computer Science Using Python", Wiley India Edition, 2015.

Reference Books

R1 Balagurusamy, "Introduction to Computing and Problem-Solving Using Python",Tata McGraw-Hill, 2016 R2. Y. Daniel Liang, "Introduction to Programming Using Python", Pearson, 2017

R2 ReemaThareja, "Python Programming Using Problem Solving Approach", Oxford University Press, 2017.

E-Resources

1. https://www.w3schools.com/python/?utm_source
2. https://in.coursera.org/courses?query=python
3. https://www.udemy.com/topic/python/

CSA1505 Object Oriented Programming using Java

Course Code: CSA1505	**Course Name:** Object Oriented Programming using Java **Type of Course:** SEC	L- T-P- C	2-0-0-2
Version No.	1		
Course pre-requisites	CSA1500		
Anti-requisites	NIL		
Course Description	The main objective is to learn the basic concept and techniques which form the object-oriented programming paradigm. Object-oriented programming is a new way of thinking about problem using models organized around real world concept. It investigates the software engineering principles of encapsulation, information hiding and code reuse, and discusses how these concepts are used to build abstract data types. The object oriented programming features of classes, inheritance, polymorphism and composition are studied, along with constructors and method overloading. Students implement Java programs incorporating features from the Java programming language.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Object Oriented Programming Using Java and attain Skill Development through Experiential Learningtechniques.		

Course Outcomes	**On successful completion of the course the students shall be able to:**		
	CO1	Identify object oriented concepts including classes and objects	[Understand]
	CO2	Develop programs using arrays and string manipulation techniques	[Apply]
	CO3	Implement inheritance and polymorphism using Java constructs effectively	[Apply]
	CO4	Design applications using interfaces, packages, and exception handling	[Apply]
	CO5	Develop multithreaded programs and perform Java file handling	[Apply]
	CO6	Create GUI applications using collections and AWT components	[Apply]

Course Content:

Module 1	Introduction to OOP : Class and Object	8 Sessions

Topics:

Classes, Methods, Objects, Description of data hiding and data encapsulation, Constructors, Use of static Keyword in Java, Use of this Keyword in Java, Array of Objects, Concept of Access Modifiers (Public, Private, Protected, Default).

Module 2	Arrays, Strings , Extending Class, Inheritance	8 Sessions

Topics:

Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array, Strings: Operation on String, Mutable & Immutable String, Creating Strings using String Buffer or StringBuilder. String Constant Pool, String Internal representation, String Application. Tokenizing a String.

Inheritance and Polymorphism: Use and benefits of inheritance in OOP, Types of Inheritance, Method overriding, super keyword, Final, Polymorphism in inheritance, Abstract, this keyword, Exception Handling.

Module 3	Threads, File streams	7 Sessions

Topics:

Introduction to threads, life cycle of a thread, Creating Threads, Extending the Thread Class, Implementing the Runnable interface, priority of a thread, synchronization, Inter communication of Threads.

JAVA File I/O - Byte Stream - InputStream - OutputStream - FileInputStream - FileOutputStream - The Character Streams - Reader - Writer - FileReader - FileWriter

Module 4	Collection & GUI Programming	7 Sessions

Topics:

The Collection Framework : Collections of Objects , Collection Types, Sets , Sequence, Map, Understanding Hashing, Use of ArrayList& Vector

Graphics Programming: Introduction, the abstract window toolkit (AWT), Layout managers, Frames, Panels, Drawing geometric figures, Keyboard Event and Mouse Event.

Creating User Interface: Introduction, describe various user interface Components: button, label, text field, text area, choice, list, check box.

Text Books

T1 Herbert Schildt, Java: The Complete Reference, Eleventh Edition (PROGRAMMING & WEB DEV - OMG), McGraw-Hill Education, 2019.

T2 E Balagurusamy, Programming with Java, 7th Edition, McGraw-Hill Education, 2020

Reference Books

R1 R. Nageswara Rao, Core Java: An Integrated Approach, New: Includes All Versions upto Java 8 2016.

R2 Brett McLaughlin, Head First Object-Oriented Analysis and Design: A Brain Friendly Guide to OOA&D, Dreamtech Press , 2016.

E-Resources

1."Head First Java" by Kathe Siera and Bert Bates, 2nd edition

2.https://www.rcsdk12.org/cms/lib/NY01001156/Centricity/Domain/4951/Head_First_Java_Second_Edition.pdf

CSA1506 Object Oriented Programming using Java Lab

Course Code: CSA1506	**Course Name:** Object Oriented Programming using Java Lab **Type of Course:** SEC	L- T-P-C	0-0-4-2
Version No.	1		
Course pre-requisites	CSA1501		
Anti-requisites	NIL		
Course Description	Focuses on developing object-oriented programming skills in Java through hands-on laboratory exercises covering classes, inheritance, polymorphism, exception handling, multithreading, collections, file handling, and GUI design.		
Course Objective	To enable learners to understand and apply object-oriented programming concepts in Java through practical, experiment-based learning.		
Course Outcomes	**On successful completion of the course the students shall be able to:**		
	CO1	Describe object oriented principles, classes, objects, constructors, and encapsulation	[Understand]
	CO2	Create Java programs utilizing arrays, strings, and object-oriented approaches	[Apply]
	CO3	Apply inheritance, polymorphism, and interfaces for reusable application design	[Apply]
	CO4	Construct applications with effective exception handling techniques	[Apply]
	CO5	Build multithreaded programs and manage file processing operations	[Apply]
	CO6	Develop GUI applications using Swing, collections, and functional features	[Apply]

List of Experiments	60 Sessions

1. Programs using control statements (methods with parameters, methods with control statements)
2. Demonstrations of class, object, constructor, static member, encapsulation, inner class
3. Simple programs for understanding arrays and strings
4. Programs to implement array of objects, passing and returning objects as arguments
5. Programs to demonstrate concepts of constructors and destructors
6. Program to create a bank account database (Name, Account No, Account Type, Balance) using constructor, destructor, and methods for 10 people
7. Programs to implement methods of String and String Buffer class
8. Programs to implement inheritance, polymorphism, and interface
9. Programs to demonstrate exception handlers
10. Programs to implement nested handlers, checked and unchecked exception handlers
11. Programs to implement Thread class and Runnable interface
12. Programs to implement priority and inter-thread communication
13. Programs to implement file handling mechanism
14. Programs to implement collections (List, Set, Map)
15. Programs to implement Comparable and Comparator interface, Lambda notation
16. Programs to implement GUI concepts
17. Program to create a registration form using Swing

Text Books

T1 Herbert Schildt, Java: The Complete Reference, Eleventh Edition (PROGRAMMING & WEB DEV - OMG), McGraw-Hill Education, 2019.

T2 E Balagurusamy, Programming with Java, 7th Edition, McGraw-Hill Education, 2020

Reference Books
R1 R. Nageswara Rao, Core Java: An Integrated Approach, New: Includes All Versions upto Java 8 2016. **R2** Brett McLaughlin, Head First Object-Oriented Analysis and Design: A Brain Friendly Guide to OOA&D, Dreamtech Press , 2016.
E-Resources 1."Head First Java" by Kathe Siera and Bert Bates, 2nd edition 2.https://www.rcsdk12.org/cms/lib/NY01001156/Centricity/Domain/4951/Head_First_Java_Second_Edition.pdf

CSA2211 User Interface Design

Course Code: CSA2211	**Course Name:** User Interface Design **Type of Course:** SEC	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	The UI/UX Design brings a design-centric approach to user interface and user experience design, and offers practical, skill-based instruction centered on a visual communications perspective, rather than on one focused on marketing or programming alone. User interface and user experience design is a high-demand field, but the skills and knowledge you will learn in this Specialization are applicable to a wide variety of careers, from marketing to web design to human-computer interaction. The course is foundational and hands-on learning in using popular design tools such as Figma.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of UI/UX Design and attain Employability Skills through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Implement user experience principles in practical design projects. [Apply] CO2 Utilize user centered design frameworks for product development. [Apply] CO3 Integrate inclusive and accessible design principles effectively. [Apply] CO4 Conduct user research and perform usability testing activities. [Analyze] CO5 Develop wireframes and interactive prototypes using Figma. [Analyze] CO6 Create personas for designing effective user interfaces. [Analyze]		
Course Content:			
Module 1	Introduction to UI/UX		4 Sessions
Topics: Introduction to User Experience, Importance of UX-design, Different sub- disciplines within UX, job opportunities in UX field/domain. RoI, KPI, Stakeholders of UX team, trade-offs, UX Design definition. Basics of Interaction Design, User Research, Visual Design, Motion Design.			
Module 2	Users and User Centered Design		4 Sessions
Topics: Users and end users, User Centered design framework, 7 principles of UX design, 4 stages of user centered design, 5-elements framework. Design thinking process, Lean UX, Double Diamond, designing for the next billion users, designing for multiple platforms, the four Cs of designing for multiple platform			
Module 3	Design methodologies		3 Sessions
Topics:			

Universal design, 7 principles of universal design, inclusive design and accessible design, and equity-focused design. Equality and equity. Designing for accessibility, Lenses of Accessibility, assistive technology, design sprints. Wireframing, importance of wireframing. Compatibility with wearable devices.

Module 4	Personas, developing mockups using Figma	4 Sessions

Topics:

Basics of personas, creating personas, perspectives on personas. Gestalt principles of perception, Usability Testing, acceptance testing, creating mockups and prototypes in Figma.

List of Experiments	60 Sessions

1. Installation and Interface of Balsamiq and/or Figma: Ensure that both Balsamiq and Figma are up and running with user accounts.
2. Installation and Interface of Balsamiq and/or Figma: Download and import design files from internet to familiarize with them.
3. Create wireframe of the login screen of a mobile app: Make first wireframe of one login page.
4. Create wireframe of the login screen of a mobile app: Make two pages that are hyperlinked and critique the design.
5. Final wireframe experiment: Prepare the wireframe of all the pages of a selected website.
6. Final wireframe experiment: Change the wireframe to make the design changes to the website.
7. First Figma experiment: Figma interface, shortcuts and tools.
8. First Figma experiment: Create and move between frames.
9. Design App Screen: Create layout, layers, fill colours.
10. Design App Screen: Set layer opacity, lock and unlock layers.
11. Logo and icon: Boolean operations on shapes, pen tool.
12. Logo and icon: Make smiley face.
13. Create an app face: Insert image, design nav bar using logo and icons.
14. Create an app face: Duplicate frame.
15. Create a prototype: Use designing and prototyping modes.
16. Create a prototype: Create connections between frames and layers.
17. Create prototype of food delivery app: Replicate inner pages of app.
18. Create prototype of food delivery app: Improve the inner page design.
19. Create prototype of a desktop website: Replicate pages on desktop app.
20. Create prototype of a desktop website: Export files and share in LinkedIn.

Text Books

T1 Chesnut D., Nichols K.P., 'UX for Dummies', Wiley Publications, 2021.

T2 Fabio Staiano, "Designing and Prototyping Interfaces with Figma: Learn essential UX/UI design principles", Packt Publishing,

Reference Books

R1 Nick de Voil, 'User Experience Foundations', The Chartered Institute for IT, 2020.

R2 Morris, Jason, 'Hands-On Android UI Development : Design and Develop Attractive User Interfaces for Android Applications', Packt Publishing, 2017.

E-Resources

https://onlinecourses.nptel.ac.in/noc21_ar05/preview

CSA2212 Internet of Things

Course Code: CSA2212	**Course Name:** Internet of Things **Type of Course:** SEC	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	The Internet of Things (IoT) course provides a comprehensive understanding of IoT concepts, architectures, and applications. It covers hardware and software components, communication protocols, data analytics, and security. Learners will gain hands-on experience in building and deploying IoT solutions.		
Course Objective	To understand the fundamental concepts and architecture of IoT. To explore IoT communication protocols and networking technologies. To develop hands-on skills in sensor interfacing, data acquisition, and cloud integration. To implement security measure.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain IoT architecture, components, and communication protocols. [Understand] CO2 Implement IoT networks using various communication protocols. [Apply] CO3 Process and analyze IoT generated data effectively. [Analyze] CO4 Design IoT based solutions for real world applications. [Apply] CO5 Evaluate IoT system performance and optimize configurations. [Apply] CO6 Develop secure IoT applications with optimized performance. [Create]		
Course Content:			
Module 1	Introduction to IoT		5 Sessions
Topics: IoT Fundamentals and Architecture,IoT Components: Sensors, Actuators, and Microcontrollers, IoT Communication Technologies (Wi-Fi, Bluetooth, LoRa, Zigbee),Hands-on: Setting up a Basic IoT System.			
Module 2	IoT Communication and Networking		3 Sessions
Topics: IoT Networking Protocols: MQTT, CoAP, HTTP,Cloud Computing for IoT: AWS, Google Cloud, and Azure IoT,Edge Computing and Fog Computing in IoT,Hands-on: Implementing MQTT for IoT Data Transmission.			
Module 3	IoT Data Processing and Analytics		4 Sessions
Topics: IoT Data Collection and Storage Techniques,Real-time Data Analytics in IoT,AI and Machine Learning for IoT Applications,Hands-on: Building an IoT Dashboard for Data Visualization			
Module 4	IoT Security and Applications		3 Sessions
Topics: Security Challenges in IoT: Authentication, Encryption, and Privacy,Case Studies of IoT in Smart Cities, Healthcare, and Industrial Automation,IoT System Optimization and Power Management, Hands-on: Securing an IoT Network with Encryption Techniques			
List of Experiments			60 Sessions
1. Getting Started with Arduino/Raspberry Pi – Set up and run a simple LED blinking program. 2. Sensor Interfacing – Connect and read data from temperature, humidity, and motion sensors. 3. Actuator Control – Control a servo motor and buzzer based on sensor inputs. 4. Building a Smart Home Automation System – Control lights and fans using IoT-based relays. 5. Connecting IoT Devices to Wi-Fi – Establish communication between a microcontroller and a Wi-Fi module. 6. Data Transmission using MQTT Protocol – Implement a publisher-subscriber model for IoT messaging. 7. HTTP and REST API Integration – Send sensor data to a cloud server and retrieve responses. 8. Bluetooth-based IoT Communication – Transfer data between IoT devices using Bluetooth.			

9. Storing IoT Data on the Cloud – Send real-time sensor data to Firebase/AWS IoT Core. 10. Visualizing IoT Data with Dashboards – Create live data graphs using ThingSpeak or Grafana. 11. Edge Computing for IoT – Process IoT data locally before sending it to the cloud. 12. Securing IoT Communication with Encryption – Implement AES or RSA encryption for IoT data transmission. 13. Building a Smart Surveillance System – Stream live camera feed using Raspberry Pi and OpenCV. 14. Energy Optimization in IoT Devices – Implement sleep modes in IoT devices to save power. 15. Building a Complete IoT Project – Integrate sensors, communication protocols, and cloud storage into a real-world application like a smart agriculture or healthcare monitoring system.
Text Books **T1** A. Bahga and V. Madisetti, Internet of Things: A Hands-on Approach, Universities Press, 2014. **T2** D. Hanes, G. Salgueiro, P. Grossetete, R. Barton, and J. Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, 2017.
Reference Books **R1** C. Pfister, Getting Started with the Internet of Things, O'Reilly Media, 2011. **R2** P. Raj and A. C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press, 2017.
E-Resources https://www.coursera.org/specializations/internet-of-things?utm_source=chatgpt.com

CSA2511 Android Mobile Application Development

Course Code: CSA2511	**Course Name:** Android Mobile Application Development **Type of Course:** SEC	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	CSA1504		
Anti-requisites	NIL		
Course Description	The course provides a basics of android platform and application life cycle. The goal of the course is to develop mobile applications with Android containing at least one of the following phone material components: GPS, accelerometer or phone camera, use simple GUI applications and work with database to store data locally or in a server. Topics include user interface design; user interface building; input methods; data handling; network techniques and URL loading; GPS and motion sensing. Android application framework and deployment. Power management, Screen resolution, Touch interface, Store data on the device.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Android Application Development and attain Skill Development through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain Android architecture, features, and application lifecycle concepts [Understand] CO2 Design user interfaces using views, layouts, and menus [Apply] CO3 Implement navigation using intents and fragments effectively [Apply] CO4 Develop applications using Android core components efficiently [Apply] CO5 Create notifications and manage data using Shared Preferences [Apply] CO6 Implement data persistence using SQLite, Room, and Firebase [Apply]		
Course Content:			
Module 1	Introduction and Architecture of Android		4 Sessions
Topics:			

Android: History and features, Architecture, Development Tools, Android Debug Bridge (ADB), and Life cycle.		
Module 2	User Interfaces, Intent and Fragments	4 Sessions
Topics: Views, Layout, Menu, Intent and Fragments.		
Module 3	Components of Android	4 Sessions
Topics: Activities, Services, Broadcast receivers, Content providers, User Navigation		
Module 4	Notifications and Data Persistence	3 Sessions
Topics: Notification, Shared Preferences, SQLite database, Android Room with a View, Firebase		
List of Experiments		60 Sessions

1. Design an app to read user inputs using EditText and display arithmetic results using Toast.
2. Create an app to calculate age using DatePicker for DOB selection.
3. Design an app to input personal information using AutoCompleteTextView for place selection.
4. Create an app to select elective course using Spinner and display ID & course using Toast.
5. Design a restaurant menu app to calculate total order amount.
6. Develop an app using Intent to check voting eligibility and display result in second activity.
7. Demonstrate fragments with color buttons to change background color in another fragment.
8. Create an app to input vitals (temperature, BP) and notify if abnormal.
9. Create a movie ticket booking app using SharedPreferences to store and retrieve username.
10. Create a student database app using SQLite with insert, update, delete, view and fee concession logic.
11. Create an app that plays background music automatically.
12. Create an app with fade-in animation using XML.
13. Demonstrate sending SMS and Email.
14. Create an app for file transfer using WiFi.
15. Create a “Where am I” app using GPS to display last known location.

Text Books

T1 Dawn Griffiths, David Griffiths, “Head First Android Develoment”, O’Reilly Media, 3rd edition, Nov 2021

T2 Pradeep kothari “Android Application Development - Black Book”, dreamtechpress

Reference Books

R1 Bill Phillips, Chris Stewart, and Kristin Marsicano (Author) “Android Programming” 3rd edition, 2017

R2 The Big Nerd Ranch Guide, Big Nerd Ranch LLC, 5. The Big Nerd Ranch Guide, by” Erik Hellman, “Android Programming – Pushing the Limits”, 1st Edition, Wiley India Pvt Ltd, 2014.

E-Resources

1. https://developers.google.com/certification/associate-android-developer/study-guide/android-core
2. NPTEL course : https://onlinecourses.swayam2.ac.in/nou21_ge41/preview
3. https://www.coursera.org/specializations/android-app-development
4. https://www

CSA2521 Database System Administration Lab

Course Code: CSA2521	**Course Name:** Database System Administration Lab **Type of Course:** SEC	L- T-P- C	0-0-4-2
Version No.	1		
Course pre-requisites	CSA2503		
Anti-requisites	NIL		

Course Description	This lab-oriented course provides hands-on experience in the core functions of a Database Administrator (DBA). Students will gain practical skills in installing and configuring database systems, managing users and roles, implementing data security, performing backup and recovery, tuning system performance, and automating routine tasks. The course emphasizes real-world administrative scenarios to prepare students for roles in database management and enterprise system maintenance. By the end of the course, students will be able to manage a fully functioning database environment with a focus on security, efficiency, and reliability.
Course Objective	The objective of the course is to familiarize the learners with the concepts of Database Administrator Lab and attain Employability Skills through Experiential Learning techniques.
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Describe database installation, user management, and security concepts [Understand] CO2 Apply database configuration for tablespaces, roles, and privileges [Apply] CO3 Apply backup, recovery, and performance tuning strategies [Apply] CO4 Implement automation of database maintenance using schedulers and scripts [Apply] CO5 Demonstrate provisioning and management of cloud databases using AWS RDS [Apply] CO6 Demonstrate configuration and security of databases on Microsoft Azure SQL [Apply]

List of Experiments	60 Sessions

1. Experiment 1: Install and configure MySQL/PostgreSQL/Oracle Database
2. Experiment 2: Create a new database and manage tablespaces (MySQL/PostgreSQL)
3. Experiment 3: Create and manage database users and roles
4. Experiment 4: Implement user privileges and access control (GRANT, REVOKE)
5. Experiment 5: Perform basic security hardening of a DBMS
6. Experiment 6: Implement database authentication mechanisms (password, SSL)
7. Experiment 7: Setup and configure database auditing and logging
8. Experiment 8: Manage database backups using mysqldump/pg_dump and Oracle RMAN
9. Experiment 9: Restore a database from backup and perform crash recovery
10. Experiment 10: Create and configure database replication (Master-Slave for MySQL/PostgreSQL)
11. Experiment 11: Perform full, incremental, and differential backups
12. Experiment 12: Set up and configure automated backup schedules using cron jobs (Linux)
13. Experiment 13: Monitor database health using performance views and logs
14. Experiment 14: Optimize slow queries using EXPLAIN PLAN and indexing strategies
15. Experiment 15: Analyze and tune system performance based on query execution plans
16. Experiment 16: Set up automated database maintenance tasks (index rebuilding, backups)
17. Experiment 17: Use Linux tools like iostat, vmstat, and top to monitor system resources
18. Experiment 18: Setup and configure a basic MySQL/PostgreSQL database cluster (if applicable)
19. Experiment 19: Implement database partitioning for performance optimization
20. Experiment 20: Perform database scaling on cloud platforms (AWS RDS / Azure SQL) and monitor performance

Text Books

T1 Harrington, J. L. (2022). Database design: A practical approach to relational database design (5th ed.). Morgan Kaufmann.

T2 Thomas, R. (2021). SQL and relational theory: How to write accurate SQL code (2nd ed.). O'Reilly Media.

Reference Books

R1 A. Silberschatz, H. F. Korth, and S. Sudarshan, Database System Concepts, 6th ed. New York, NY, USA: McGraw-Hill, 2011.

R2 R. Elmasri and S. B. Navathe, Fundamentals of Database Systems, 7th ed. Boston, MA, USA: Pearson, 2016.

E-Resources

- MySQL Documentation:

https://dev.mysql.com/doc/
- PostgreSQL Documentation: https://www.postgresql.org/docs/
- Oracle Database Documentation: https://docs.oracle.com/en/database/
- Microsoft SQL Server Documentation: https://docs.microsoft.com/en-us/sql

CSA7002 Mini Project

Course Code: CSA7002	Course Name: Mini Project Type of Course: NTCC	L-T-P-C	-	-	-	3
Version No.	1					
Course Description	The Mini Project course is designed to provide students with practical exposure to the application of concepts learned in their program of study. Students will identify a problem, analyze requirements, design and develop a suitable solution, and demonstrate the working prototype or system. The course encourages innovation, creativity, teamwork, problem-solving, project planning, and technical documentation skills.					
Course Objective	To provide students with an opportunity to apply theoretical knowledge and technical skills to solve real-world problems through project-based learning.					
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1: Identify and analyze a real-world problem and formulate project objectives and requirements. CO2: Design and develop a functional solution using appropriate tools, technologies, and methodologies. CO3: Apply technical knowledge, project management principles, and teamwork skills throughout the project lifecycle. CO4: Evaluate, test, and validate the developed solution based on predefined performance criteria. CO5: Prepare professional project documentation and effectively present the project outcomes.					

Mini Project Schedule

1. Title confirmation with the Project Supervisors
2. Project Titles confirmation/Submission of Abstracts.
3. I - Review
4. Problem Statement and Module Design
5. II - Review
6. Application Development
7. III - Review
8. Complete Implementation Results/ Demonstrations
9. Project Documentation Submission
10. Final Documentation submission/ Review the Status of Research Paper
11. Final Review
12. Results and Project Document/Presentation

Rubrics:

1. Project Scope, Planning And Task Definition
2. Literature Review And Problem identification

3. Preliminary Design Selection 4. Detailed System Design/Technical Details 5. End Term Viva 6. Project Report 7. Certification (Optional)

CSA7300 Project

Course Code: CSA7300	Course Name: Project Type of Course: NTCC	L-T-P-C	-	-	-	8
Version No.	1					
Course Description	The BCA Final Year Project is a capstone course designed to integrate knowledge and skills acquired throughout the BCA program. Students will work individually or in teams to develop a real-world software application, research-based project, or innovative solution using emerging technologies. The project encourages problem-solving, technical proficiency, and professional documentation, preparing students for careers in IT and software development.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Summer Internship and attain Employability Skills through Experiential Learning techniques.					
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1: Examine real-world issues and formulate appropriate software problem definitions [Analyze] CO2: Construct and implement effective software solutions using suitable methodologies [Create] CO3: Develop software systems utilizing relevant tools and technologies [Apply] CO4: Prepare and communicate project reports and technical results clearly [Apply] CO5: Assess project performance and maintain established quality standards [Evaluate] CO6: Exhibit teamwork, professional ethics, and project coordination abilities [Evaluate]					

Rubrics: Project Schedule

1. Title confirmation with the Project Supervisors
2. Project Titles confirmation/Submission of Abstracts.
3. I - Review
4. Problem Statement and Module Design
5. II - Review
6. Application Development
7. III - Review
8. Complete Implementation Results/ Demonstrations
9. Project Documentation Submission
10. Final Documentation submission/ Review the Status of Research Paper
11. Final Review
12. Results and Project Document/Presentation

Rubrics:

1. Project Scope, Planning And Task Definition
2. Literature Review And Problem identification
3. Preliminary Design Selection
4. Detailed System Design/Technical Details

5. End Term Viva 6. Project Report 7. *Supervisor 8. Publication/Certification

Core Courses

MAT1201 Applied Mathematics

Course Code: MAT1201	**Course Name:** Applied Mathematics **Type of Course:** Core Course	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	The course explores the study of mathematical structures that are fundamentally discrete, focusing on concepts like Logic, Set theory, Matrices, Determinants and Differential calculus with applications primarily in computer science fields like algorithms, software development, and cryptography; it covers topics such as basic logic gates, laws of Set theory, eigenvalue and eigenvectors, continuity of functions, Boolean algebra, and simplification of Boolean expressions, providing a foundation for analyzing discrete problems and structures within computer applications.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Applied Mathematics and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain set theory concepts, operations, laws, and their applications in computer science. [Understand] CO2 Explain logical reasoning and Boolean algebra concepts for problem solving and circuit design. [Understand] CO3 Apply matrix operations and determinants to solve systems of linear equations. [Apply] CO4 Apply eigenvalues, eigenvectors, and matrix methods to problems in computer science applications. [Apply] CO5 Apply differential calculus concepts to analyze functions and optimization problems. [Apply] CO6 Analyze mathematical models using sets, logic, matrices, and calculus. [Analyze]		
Course Content:			
Module 1	Set Theory		9 Sessions
Topics: Introduction to Sets, Types of Sets (Finite, Infinite, Empty, Singleton, etc.), Operations on Sets (Union, Intersection, Difference, Complement), Venn Diagrams, Laws of Set Theory (De Morgan's Laws, Distributive Laws, etc.), Applications of Sets in Computer Science			
Module 2	Logic and Boolean Algebra		9 Sessions
Topics: Basic Logic Gates (AND, OR, NOT, NAND, NOR, XOR), Truth Tables, Boolean Algebra, and Simplification of Boolean Expressions, Applications in Computer Science (Circuit Design, etc.).			
Module 3	Matrices and Determinants		11 Sessions
Topics: Introduction to Matrices, Types of Matrices (Square, Diagonal, Identity, Symmetric, Skew-Symmetric, etc.), Matrix Operations (Addition, Subtraction, Multiplication, Transpose), Determinants and their Properties, Inverse of a Matrix.			

System of Linear Equations: Solution using Matrices (Cramer's Rule, Gaussian Elimination, Gauss Jordan), Echelon form and Normal form, Characteristic Equation, Eigen Value and Eigen Vectors and Problems Applications of Matrices in Computer Science (Graphics, Cryptography, etc.).		
Module 4	Differential Calculus	16 Sessions
Topics: Concept of Limits, Standard Limits, Continuity of Functions, Types of Discontinuities, Applications in Computer Science (Algorithm Analysis, etc.), Derivatives of Standard Functions (Polynomial, Exponential, Logarithmic, Trigonometric), Maxima & Minima, Partial derivatives, total derivatives.		
Text Books **T1** Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw-Hill, 8th Edition, 2019. **T2** B. S. Grewal, Higher Engineering Mathematics by, 44th Edition, Khanna Publishers, 2017.		
Reference Books **R1** Arthur Gill, "Applied Algebra for Computer Science", Prentice Hall. **R2** K.D. Joshi, "Discrete Mathematics", Wiley Eastern Ltd.		
E-Resources https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html		

MAT1202 Statistical Methods and Techniques

Course Code: MAT1202	**Course Name:** Statistical Methods and Techniques **Type of Course:** Core Course	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	The course introduces the concepts of probability theory and statistical analysis, covering how to collect, organize, interpret, and draw inferences from data using mathematical models to understand randomness and uncertainty, with applications across various fields like science, engineering, economics, and social sciences.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Statistical Methods and Techniques and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain fundamental statistical concepts, data types, data collection, and descriptive measures. [Understand] CO2 Explain probability concepts, random variables, and common probability distributions. [Understand] CO3 Apply probability rules and distributions to solve numerical and real-world problems. [Apply] CO4 Use correlation and regression techniques to analyze relationships between variables. [Analyze] CO5 Apply sampling methods and sampling distributions to draw inferences from data. [Analyze] CO6 Analyze statistical data and models to support decision-making in computing applications. [Analyze]		
Course Content:			
Module 1	Introduction to Statistics		11 Sessions

Topics:
Definition and Scope of Statistics, Types of Data - Qualitative and Quantitative, Data Collection Methods, Presentation of Data - Tabular and Graphical Methods, Measures of Central Tendency -Mean, Median, Mode, Quartiles, Decile, and Percentile, Measures of Dispersion - Range, Quartile Deviation, Variance, Standard Deviation, Covariance.

Module 2	Probability, Random Variables, and Probability Distributions	11 Sessions

Topics:
Basic Concepts of Probability, Sample Space and Events, Types of Probability (Classical, Empirical, Subjective), Rules of Probability - Addition Rule, Multiplication Rule, Conditional Probability, Bayes' Theorem, Independence of Events. Definition of Random Variables (Discrete and Continuous), Probability Mass Function (PMF) and Probability Density Function (PDF), Cumulative Distribution Function (CDF), Expectation and Variance of a Random Variable, Common Probability Distributions: Discrete Probability Distributions: Binomial, Poisson, Continuous Probability Distributions: Normal, Exponential.

Module 3	Correlation and Regression	11 Sessions

Topics:
Scatter Diagrams, Karl Pearson's Coefficient of Correlation, Spearman's Rank Correlation, Simple Linear Regression, Least Squares Method, Applications in Data Analysis.

Module 4	Sampling and Sampling Distributions	12 Sessions

Topics:
Population vs Sample, Sampling Methods - Random, Stratified, Systematic, Cluster, Sampling Distribution of Mean and Proportion, Central Limit Theorem, Applications in Computer Science - Data Sampling, Algorithm Analysis.

Text Books

T1 Ronald .E. Walpole, Raymond. H. Myers, Sharon. L Myers, and Keying E. Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Delhi-9th edition, 2012.

T2 B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.

Reference Books

R1 Miller and Freund, Probability and Statistics for Engineers, Pearson Education Ltd.

R2 Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition. Douglas C. Montgomery & George Runger, Applied Statistics and Probability for Engineers, , Wiley Publications

E-Resources

1. https://nptel.ac.in/courses/109104124
2. https://nptel.ac.in/courses/111106051
3. https://nptel.ac.in/courses/111102137

CSA1200 Digital Computer Fundamentals

Course Code: CSA1200	**Course Name:** Digital Computer Fundamentals **Type of Course:** Core Course	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	The purpose of this course is to enable the students to appreciate the fundamentals of digital logic circuits and Boolean algebra focusing on both combinational and sequential logic circuits. This course is analytical in nature and needs a fundamental knowledge on logical computation with Boolean Algebra. The focus of the course will be to discuss the minimization techniques for making canonical and low-cost digital circuit implementations.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital Computer Fundamentals and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Apply minimization techniques to simplify Boolean expressions [Apply] CO2 Demonstrate the Combinational circuits for a given logic. [Understand] CO3 Illustrate the Sequential logic circuits. [Understand] CO4 Implement various combinational logic circuits using gates. [Apply] CO5 Apply FSM models to design sequential logic circuits. [Apply] CO6 Analyze digital circuits and simulation results to evaluate performance [Analyze]		
Course Content:			
Module 1	Boolean function simplification		15 Sessions
Topics: Review of Number systems and logic gates, Number base conversions, Overview of Boolean functions and simplifications, two, three, four variable K-Maps- Don't care conditions- Both SOP and POS- Universal Gates (NAND & NOR) Implementations.			
Module 2	Combinational Logic circuits		15 Sessions
Topics: Introduction to Combinational circuits, Analysis, Design procedure, Binary Adder and Subtractor, Magnitude comparator, Parity generator and checker, Multiplexers-Demultiplexers, Decoders, Encoders and Priority Encoders.			
Module 3	Sequential and Programmable logic circuits		15 Sessions
Topics: Introduction to sequential circuits, Storage elements: latches and flip flops, Characteristic tables and equations, excitation table, Analysis of clocked sequential circuits, Mealy & Moore Models of finite state machines - Registers & Counters.			

Text Books

T1 Thomas L. Flyod, "Digital Fundamentals", Eleventh Edition, Pearson Education.ISBN-10: 132737965. (2014) eBook-[PDF] DIGITAL LOGIC DESIGN FOURTH EDITION FLOYD | abri.engenderhealth.org.

Reference Books

R1 Mano, M. Morris and Ciletti Michael D., "Digital Design", 5th Edition, Pearson Education.

R2 Jain, R. P., "Modern Digital Electronics", 4th Edition, McGraw Hill Education (India).

E-Resources

1. https://www.researchgate.net/publication/339975715_Study_and_Evaluation_of_Digital_Circuit_Design_Using_Evolutionary_Algorithm
2. https://ieeexplore.ieee.org/document/5723860

CSA1201 Computer Organization

Course Code: CSA1201	**Course Name:** Computer Organization **Type of Course:** Core Course	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	CSA1200		
Anti-requisites	NIL		
Course Description	Computer Organization is an introductory course that focuses on the fundamental principles and concepts behind the design and implementation of modern computer systems. The course explores the structure and functionality of computers at the hardware level, providing students with a solid foundation in understanding how computers work.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Computer Organization and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain basic structure and operations of a computer. [Understand] CO2 Categorize the arithmetic and logic unit. [Understand] CO3 Illustrate the basics of pipelined execution. [Apply] CO4 Outline parallelism and multi-core processors. [Apply] CO5 Analyse processor performance, parallelism, and power trade-offs. [Apply] CO6 Evaluate memory hierarchy and I/O organization efficiency. [Analyze]		
Course Content:			
Module 1	Computer Organization & Instructions		12 Sessions
Topics: Basics of a computer system: Evolution, Ideas, Technology, Performance, Power wall, Uniprocessors to Multiprocessors. Addressing and addressing modes. Instructions: Operations and Operands, Representing instructions, Logical operations, control operations.			
Module 2	Arithmetic operations		10 Sessions
Topics: Fixed point Addition, Subtraction, Multiplication and Division. Floating Point arithmetic, High performance arithmetic, Subword parallelism			
Module 3	Processor		12 Sessions
Topics: Introduction, Logic Design Conventions, Building a Datapath — A Simple Implementation scheme — An Overview of Pipelining — Pipelined Datapath and Control. Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions.			
Module 4	Memory And I/O Organization		11 Sessions
Topics: Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, Serial Bus Architectures, Mass storage, Input and Output Devices.			

Text Books

T1 Carl Hamacher, ZvonkoVranesic and SafwatZaky, “Computer Organization”, Fifth Edition, Tata McGraw Hill, 2021

T2 Godse, A. P., &Godse, D. A. (2021). Computer Organization and Architecture. Technical Publications.

Reference Books
R1 David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Elsevier, 2019. **R2** William Stallings, "Computer Organization and Architecture – Designing for Performance", Sixth Edition, Pearson Education, 2003.
E-Resources 1. https://www.tutorialspoint.com/computer_logical_organization/index.htm 2. https://www.coursera.org/learn/introduction-to-computer-organization

CSA1202 Software Engineering

Course Code: CSA1202	**Course Name:** Software Engineering **Type of Course:** Core Course	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course aims to equip students with a comprehensive understanding of the software development process and software project management principles. It covers key aspects such as software process models, requirement engineering, system analysis, design, implementation, and testing. Additionally, students will explore project evaluation, planning, effort estimation, and risk management, essential for effective software project execution. Through this course, students will gain the skills necessary to develop reliable software systems while managing project constraints effectively.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Software Engineering and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain software engineering principles and process models. [Understand] CO2 Describe requirements engineering and design concepts. [Understand] CO3 Develop SRS, UML diagrams, and architectural designs. [Apply] CO4 Apply testing techniques and SQA practices. [Apply] CO5 Analyze project plans, risks, and estimation models. [Apply] CO6 Analyze software processes using quality and maturity metrics. [Analyze]		
Course Content:			
Module 1	Introduction to Software Engineering & Process Models		11 Sessions
Topics: Software and Software Engineering: Nature of Software, Software Engineering Practice, Software Myths, SDLC and Software Processes: Generic Model, Prescriptive Process Model, Unified Process Model, Agile Development: Extreme Programming, SCRUM			
Module 2	Software Requirements and Design		10 Sessions
Topics: Requirements Engineering: Eliciting requirements, Functional and non- Functional requirements, SRS, Requirements modeling : Developing Use Cases, Developing Activity diagram and Swimlane diagram, Design: Design concepts, Architectural design, Component based design, User interface design			
Module 3	Software Testing And Quality Assurance		11 Sessions
Topics:			

Introduction to Software Testing: verification and validation, Test Strategies for conventional Software, Validation Testing, Whitebox Testing: Basis path testing, Blackbox Testing. Software Quality Assurance: Elements of software quality assurance, SQA Tasks, Goals and Metrics, Software configuration management: SCM process.

Module 4	Software Project Management	13 Sessions

Topics:

Project Management Concepts, Project Planning, Overview of metrics, Estimation for Software projects, Project Scheduling, Risk Management, Maintenance and Reengineering, Software Process Improvement (SPI): CMM Levels.

Text Books

T1 Roger S. Pressman, "Software Engineering: A Practitioner's Approach", Seventh Edition, McGraw Hill International edition, 2009.

T2 BobHughes,MikeCotterell,RajibMall,"Software ProjectManagement",VIEdition,McGraw-Hill, 2018

Reference Books

R1 Ian Sommerville, "Software Engineering, Ninth Edition", Pearson Education, 2008.

R2 RajibMall,"FundamentalsofSoftwareEngineering",VIEdition,PHIlearningprivatelimited,2014.

E-Resources

1.https://www.studocu.com/row/document/lead-city-university/software-engineering/software-engineering-lecture-note/10888094

2.https://www.youtube.com/watch?v=WxkP5KR_Emk

3.https://www.youtube.com/watch?v=OVZYOItkUUs

4.https://nptel.ac.in/courses/

CSA2500 Data Structures

Course Code: CSA2500	**Course Name:** Data Structures **Type of Course:** Core Course	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	CSA1500		
Anti-requisites	NIL		
Course Description	This course introduces the fundamental concepts of data structures and to emphasize the importance of choosing an appropriate data structure and technique for program development. This course has theory and lab component which emphasizes on understanding the implementation and applications of data structures using Java programming language. With a good knowledge in the fundamental concepts of data structures and practical experience in implementing them, the student can be an effective designer, developer for new software applications.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Structures and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain the concepts and operations of linear data structures. [Understand] CO2 Describe the structure and applications of singly and circular linked lists. [Understand] CO3 Illustrate the basic concepts of trees and graphs along with their representations and traversals. [Understand] CO4 Interpret the working of basic searching and sorting algorithms. [Understand] CO5 Apply searching and sorting algorithms to efficiently retrieve and arrange data elements. [Understand] CO6 Analyze algorithms to evaluate time and space complexity in best, average, and worst cases. [Analyze]		
Course Content:			
Module 1	Introduction to Data Structure and Linear Data Structure – Stacks and Queues		11 Sessions
Topics: Introduction – Introduction to Data Structures, Types and concept of Arrays. Stack - Concepts and representation, Stack operations, stack implementation using array and Applications of Stack. Queues - Representation of queue, Queue Operations, Queue implementation using array, Types of Queue and Applications of Queue.			
Module 2	Linear Data Structure- Linked List		11 Sessions
Topics: Linked List - Singly Linked List, Operation on linear list using singly linked storage structures, Circular List, Applications of Linked list. Recursion - Recursive Definition and Processes, Programming examples.			
Module 3	Non-linear Data Structures - Trees and Graph		11 Sessions
Topics: Trees - Introduction to Trees, Binary tree: Terminology and Properties, Use of Doubly Linked List, Binary tree traversals: Pre-Order traversal, In-Order traversal, Post-Order traversal. Graph - Basic Concept of Graph Theory and its Properties, Representation of Graphs.			
Module 4	Searching & Sorting Performance Analysis		12 Sessions
Topics: Sorting & Searching - Sequential and Binary Search, Sorting – Selection and Insertion sort. Performance Analysis - Time and space analysis of algorithms – Average, best- and worst-case analysis.			
Text Books **T1** NarasimhaKarumanchi: "Data Structures and Algorithms Made Easy in Java", 5th Edition, CareerMonk Publications, 2017 **T2** Data Structures Using C by Ashok N. Kamthane (Pearson India, May 2024)			

Reference Books

R1 Mark Allen Weiss: "Data Structures and Algorithm Analysis in Java", 4th Edition, Pearson Educational Limited, 2014.

R2 Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser: "Data Structures and Algorithms in Java", 6th Edition, John Wiley & Sons, Inc., ISBN: 978-1-118-77133-4, 2014

E-Resources

1. https://nptel.ac.in/courses/106106130
2. https://www.geeksforgeeks.org/c/learn-dsa-in-c/
3. https://www.tutorialspoint.com/dsa_using_c/index.htm

CSA2501 Data Structures Lab

Course Code: CSA2501	**Course Name:** Data Structures Lab **Type of Course:** Core Course	L- T-P- C	0-0-2-1
Version No.	1		
Course pre-requisites	CSA1501		
Anti-requisites	NIL		
Course Description	This laboratory course provides hands-on experience in implementing fundamental data structures using a high-level programming language such as C. Students will design, implement, and test linear and non-linear data structures including arrays, stacks, queues, linked lists, trees, and graphs. Through guided lab activities, students will develop problem-solving skills by applying appropriate data structures to real-world scenarios and perform operations such as traversal, insertion, deletion, searching, and sorting. The course emphasizes code efficiency, memory management, and algorithmic thinking for structured software development.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Structures Lab and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Apply linear and non-linear data structures to solve computational problems. [Apply] CO2 Apply recursion algorithms to implement efficient problem-solving techniques in C. [Apply] CO3 Implement stack, queue, and linked list operations. [Apply] CO4 Apply recursion, tree traversals, and basic searching/sorting. [Apply] CO5 Compare searching and sorting techniques. [Apply] CO6 Analyze time and space complexity of algorithms. [Analyze]		
List of Experiments			30 Sessions

1. Write a C program to implement array operations (insertion, deletion, traversal).
2. Write a C program to implement stack operations using arrays.
3. Write a C program to evaluate postfix expressions using stack.
4. Write a C program to check balanced parentheses using stack.
5. Write a C program to implement queue operations using arrays.
6. Write a C program to implement circular queue.
7. Write a C program to implement singly linked list (insertion and deletion).
8. Write a C program to implement circular linked list.
9. Write a C program to implement doubly linked list.
10. Write a C program to perform recursion (factorial, Fibonacci).
11. Write a C program for binary tree creation and traversal (inorder, preorder, postorder).
12. Write a C program to represent graphs using adjacency matrix.
13. Write a C program to implement linear search and binary search.
14. Write a C program to implement sorting algorithms (selection sort, insertion sort).
15. Write a C program to analyze time complexity of searching and sorting algorithms.

Text Books

T1 NarasimhaKarumanchi: "Data Structures and Algorithms Made Easy in Java", 5th Edition, CareerMonk Publications, 2017

T2 Data Structures Using C by Ashok N. Kamthane (Pearson India, May 2024)

Reference Books

R1 Mark Allen Weiss: "Data Structures and Algorithm Analysis in Java", 4th Edition, Pearson Educational Limited, 2014.

R2 Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser: "Data Structures and Algorithms in Java", 6th Edition, John Wiley & Sons, Inc., ISBN: 978-1-118-77133-4, 2014

E-Resources

1.	https://nptel.ac.in/courses/106106130
2.	https://www.geeksforgeeks.org/c/learn-dsa-in-c/
3.	https://www.tutorialspoint.com/dsa_using_c/index.htm

CSA2502 Computer Networks

Course Code: CSA2502	**Course Name:** Computer Networks **Type of Course:** Core Course	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	CSA1200		
Anti-requisites	NIL		
Course Description	This course gives a thorough introduction to all the layers of computer network following the top down approach. Application, Transport, Network, and Data link layer protocols are taught with analysis wherever applicable. All-important concepts required to take up advanced courses and to face placement tests by an undergraduate student will be covered in this course. This course can be followed up with an advanced computer networks by the student to get a complete understanding of this domain		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Computer Networks and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain the fundamentals of computer networks. [Understand] CO2 Apply network-layer principles to configure IP addressing schemes [Apply] CO3 Apply data link layer concepts for error detection and correction techniques. [Apply] CO4 Analyze firewalls and intrusion detection systems. [Analyze] CO5 Analyze congestion control and VLAN performance. [Analyze] CO6 Evaluate wireless technologies and network security mechanisms. [Analyze]		
Course Content:			
Module 1	Overview, Application, and Transport Layer		12 Sessions
Topics: Introduction: Computer Networks, Topologies, OSI Reference Model, Functions of Each Layer, TCP/IP model. Principles of Network Applications, The Web and HTTP, DNS—The Internet's Directory Service, Socket Programming: Creating Network Applications Introduction and Transport-Layer Services, Connectionless Transport: UDP, Principles of Reliable Data Transfer, Connection-Oriented Transport: TCP, Principles of Congestion Control, TCP Congestion Control.			
Module 2	Network Layer		13 Sessions
Topics: Overview of Network Layer, Forwarding and Routing, The Data and Control Planes The Internet Protocol (IP): IPv4 Addressing, IPv4 Datagram Format, Network Address Translation (NAT), IPv6 Introduction Routing Algorithms: The Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm, OSPF Routing, Introduction to BGP. ICMP: The Internet Control Message Protocol			
Module 3	Data Link Layer		10 Sessions
Topics: Introduction to the Link Layer, The Services Provided by the Link Layer, Error-Detection and Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC), MAC Sub Layer, Frame Format, Frame Types; Switched Local Area Networks, Link-Layer Addressing and ARP, Virtual Local Area Networks (VLANs)			

Module 4	Wireless and Security in Computer Networks	10 Sessions
Topics: Introduction, Wireless Links and Network Characteristics, Wi-Fi: 802.11 Wireless LANs, Cellular Networks: 4G and 5G. Operational Security: Firewalls and Intrusion Detection Systems.		
Text Books **T1** James F. Kurose, Keith W. Ross, "Computer Networking A Top-down Approach", 8th Edition, Pearson, 2023 **T2** Computer Networks, Tanenbaum, 5th Edition, Pearson Education Media, 2023		
Reference Books **R1** CompTIA Network+ Certification All in one Exam Guide, Mike Meyers, 7th Edition, McGraw Hill, 2023 **R2** Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007.		
E-Resources 1. Computer Networks:https://gaia.cs.umass.edu/kurose_ross/index.php 2. https://www.coursera.org/learn/computer-networking		

CSA2503 Relational Database Management Systems

Course Code: CSA2503	**Course Name:** Relational Database Management Systems **Type of Course:** Core Course	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	CSA1201		
Anti-requisites	NIL		
Course Description	This course introduces the core principles and techniques required in the design and implementation of database systems. It covers concepts of relational database systems (RDBMS). More emphasis is set on how to design, develop, organize, maintain and retrieve the information efficiently. It helps the students to learn and practice data modeling and database designs.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Relational Database Management Systems and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain database architecture, ER modeling, and relational algebra concepts [Understand] CO2 Describe SQL fundamentals and query optimization techniques. [Understand] CO3 Apply query optimization techniques to evaluate and improve the performance of database queries. [Apply] CO4 Apply schema design principles to remove redundancy and anomalies in relational databases. [Apply] CO5 Analyze functional dependencies and normalization techniques to refine relational database schemas. [Analyze] CO6 Analyze transaction properties and query execution strategies. [Analyze]		
Course Content:			
Module 1	Introduction to Database Modelling and Relational Algebra		15 Sessions
Topics:			

Introduction to Database: Schema, Instance, 3-shema architecture, physical and logical data independence, Data isolation problem in traditional file system, advantages of database over traditional file systems. Entity Relationship (ER) Model, ER Model to Relational Model, Examples on ER model.
Relational Algebra with selection, projection, rename, set operations, Cartesian product, joins (inner and outer joins), and division operator. Examples on Relational Algebra Operations.

Module 2	Fundamentals of SQL and Query Optimization	15 Sessions

Topics:
Database Querying: DDL, DML, Constraints, Operators- BETWEEN, IN, LIKE, where clause, order by command, Set Operators, Aggregate Functions, having, group by clauses, Views, Procedures, Cursors and Triggers.
Query Optimization: Purpose, transformation of relational expressions, estimating cost and statistics of expression, choosing evaluation plans, linear and bushy plans, dynamic programming algorithms.

Module 3	Designing and Refining Database Schema	08 Sessions

Topics:
Schema Design: Problems in schema design, redundancy and anomalies. Schema refinement: Functional Dependencies, Normalization and forms - First, Second, Third, Dependency Preservation – Boyce/Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

Module 4	Transaction Processing	07 Sessions

Topics:
Fundamentals of Transaction: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties (ACID) of Transactions.

Text Books

T1 Elmasri R and Navathe S B, "Fundamentals of Database System", Pearson Publication, 7th Edition, 2018.
T2 RamaKrishna & Gehrke, "Database Management Systems" 3rd Edition, 2018, McGraw-Hill Education.

Reference Books

R1 W. Lemahieu, S. vanden Broucke and B. Baesens, "Principles of Database Management: Practical Guide to Storing, Managing and Analyzing Big and Small Data", Cambridge University Press, 2018.
R2 Avi Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill ,7th Edition, 2019.

E-Resources
1. https://nptel.ac.in/courses/106/105/106105175/?utm
2. https://data-psl.github.io/lectures2020/slides/09_database.pdf?utm
3. https://annamalaiuniversity.ac.in/studport/download/sci/cis/resources/MCA01-%20RDBMS%20-%2019MCAC203.pdf?utm

CSA2504 Relational Database Management Systems Lab

Course Code: CSA2504	**Course Name:** Relational Database Management Systems Lab **Type of Course:** Core Course	L- T-P- C	0-0-2-1
Version No.	1		
Course pre-requisites	CSA2103		
Anti-requisites	NIL		

Course Description	This course is designed to implement various databases using MySQL DATABASE in information technology applications. All the exercises will focus on the fundamentals for creating, populating, sophisticated, interactive way of querying, and simultaneous execution of the transactions of database.
Course Objective	The objective of the course is to familiarize the learners with the concepts of Relational Database Management Systems Lab and attain Skill Development through Problem Solving Methodologies.
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Implement DDL & DML operations on databases. [Understanc CO2 Demonstrate data retrieval using SELECT queries [Understanc CO3 Apply SQL operators for conditional querying [Apply] CO4 Analyze data using aggregate & grouping functions [Analyze] CO5 Apply database constraints in table design. [Analyze] CO6 Analyze complex SQL queries with subqueries & CASE [Analyze]

List of Experiments	30 Sessions

1. Write SQL queries to create database schema using DDL commands.
2. Write SQL queries to perform basic DML operations (INSERT, UPDATE, DELETE).
3. Write SQL queries using constraints (PRIMARY KEY, FOREIGN KEY, UNIQUE, NOT NULL).
4. Write SQL queries using operators (BETWEEN, IN, LIKE, ORDER BY).
5. Write SQL queries using aggregate functions (COUNT, SUM, AVG, MAX, MIN).
6. Write SQL queries using GROUP BY and HAVING clauses.
7. Write SQL queries to perform set operations (UNION, INTERSECT, EXCEPT).
8. Write SQL queries to implement joins (INNER JOIN, LEFT JOIN, RIGHT JOIN).
9. Write SQL queries to create and use views.
10. Write SQL queries to implement stored procedures.
11. Write SQL queries to implement cursors.
12. Write SQL queries to create and use triggers.
13. Design an ER model and convert it into a relational schema.
14. Perform normalization (1NF, 2NF, 3NF, BCNF) on a given dataset.
15. Demonstrate transaction processing and ACID properties using SQL commands.

Text Books

T1 Elmasri R and Navathe S B, “Fundamentals of Database System”, Pearson Publication, 7th Edition, 2018.

T2 RamaKrishna & Gehrke, “Database Management Systems” 3rd Edition, 2018, McGraw-Hill Education.

Reference Books

R1 W. Lemahieu, S. vanden Broucke and B. Baesens, “Principles of Database Management: Practical Guide to Storing, Managing and Analyzing Big and Small Data”, Cambridge University Press, 2018.

R2 Avi Silberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, McGraw-Hill ,7th Edition, 2019

E-Resources

1. https://nptel.ac.in/courses/106/105/106105175/?utm

CSA2505 Analysis of Algorithms

Course Code: CSA2505	**Course Name:** Analysis of Algorithms **Type of Course:** Core Course	L- T-P- C	2-1-0-3
Version No.	1		
Course pre-requisites	CSA2500		
Anti-requisites	NIL		
Course Description	This Course introduces techniques for the design and analysis of efficient algorithms and methods of applications. Deals with analyzing time and space complexity of algorithms, and to evaluate trade-offs between different algorithms.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Analysis of Algorithms and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain problem types, asymptotic notations, and algorithm analysis. [Understand] CO2 Describe brute force, divide-and-conquer, greedy, and dynamic programming techniques. [Understand] CO3 Apply brute force methods to solve sorting and search problems. [Apply] CO4 Implement divide-and-conquer and dynamic programming algorithms. [Apply] CO5 Analyze time complexity using Master Theorem and asymptotic methods. [Apply] CO6 Compare greedy and dynamic programming approaches for optimization problems. [Analyze]		
Course Content:			
Module 1	Introduction		10 Sessions
Topics: Important Problem types, Asymptotic Notations and its properties, Mathematical analysis for Recursive and Non-recursive algorithms.			
Module 2	Algorithm design techniques-Brute force		10 Sessions
Topics: Selection Sort, sequential search, Uniqueness of Array, Exhaustive search Travelling Salesman, Knapsack Problem.			
Module 3	Divide-and-Conquer		10 Sessions
Topics: Master Theorem, Merge sort, Quick sort, Binary search.			
Module 4	Dynamic programming and greedy technique		15 Sessions
Topics: Introduction, Coin changing problem, Multi stage graph – Optimal Binary Search Trees, warshall's, floyds,0/1 Knapsack, Prim's, Kruskal's. Hamiltonian Path Problem, M Coloring Problem. Backtracking, - Backtracking – n-Queens problem.			
Text Books **T1** Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI Learning Private Limited(2021) **T2** Levitin, A. (2011). Introduction to the design and analysis of algorithms (3rd ed.). Pearson			

Reference Books	
R1	AnanyLevitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education.
R2	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson.

E-Resources

1. https://onlinecourses.nptel.ac.in/noc19_cs47/preview
2. https://www.geeksforgeeks.org/analysis-of-algorithms-set-1-asymptotic-analysis/
3. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm

CSA2506 Operating Systems and Unix Programming

Course Code: CSA2506	**Course Name:** Operating Systems and Unix Programming **Type of Course:** Core Course	L- T-P- C	2-0-0-2
Version No.	1		
Course pre-requisites	CSA2500 and CSA1201		
Anti-requisites	NIL		
Course Description	The main objective of this course is to cover basic concepts of operating systems. Operating Systems functions, Basic Concepts, Notion of a process, Concurrent processes, Problem of mutual exclusion, Deadlock, Process Scheduling, Memory management, Multiprogramming, File systems; time sharing systems and their design consideration. This course will prepare students to develop software in and for Linux/UNIX environments. Also this course helps the students in UNIX operating system and their effective use for problem solving.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Operating Systems and Unix Programming and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain OS architecture, services, and process management concepts. [Understand] CO2 Describe IPC mechanisms, threads, and deadlock handling techniques. [Understand] CO3 Apply scheduling and synchronization algorithms to process scenarios. [Apply] CO4 Implement memory allocation and virtual memory management techniques. [Apply] CO5 Analyze deadlock situations using Banker's and detection algorithms. [Analyze] CO6 Analyze page replacement and file system strategies for performance. [Analyze]		
Course Content:			
Module 1	Introduction to OS and System Structure		8 Sessions
Topics: Introduction: Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS. Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. Process Scheduling: Scheduling algorithms:, Multiprocessor scheduling: Real Time scheduling.			
Module 2	IPC and Deadlocks		7 Sessions
Topics: Inter-process Communication: Concurrent processes, precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Deadlocks - prevention, avoidance, detection and recovery. Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads. Banker's algorithm, Deadlock detection and Recovery.			
Module 3	Memory Management		8 Sessions

Topics:

Memory Management: Logical and Physical address maps, Memory allocation:

Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction

Module 4	Virtual Memory and File Management	7 Sessions

Topics:

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page allocation, Partitioning, Paging, Page fault, Working Set, Segmentation, Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU) File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods , Free-space management , directory implementation , efficiency and performance.

Text Books

T1 Abraham Silberschatz, Peter B. Galvin, Greg Gagne-Operating System Concepts, Wiley, 10th Edition, 2019.

T2 Tanenbaum, Andrew S., and Albert S. Woodhull. Operating systems: design and implementation. Vol. 68. Englewood Cliffs: Prentice Hall, 1997

Reference Books

R1 The Unix programming Environment by Brain W. Kernighan & Rob Pike, Pearson.

R2 Introduction to Unix Shell Programming by M.G.Venkateshmurthy, Pearson

E-Resources

1. https://nptel.ac.in/courses/106108101
2. https://nptel.ac.in/courses/106106144

CSA2507 Operating Systems and Unix Programming Lab

Course Code: CSA2507	**Course Name:** Operating Systems and Unix Programming Lab **Type of Course:** Core Course	L- T-P- C	0-0-2-1
Version No.	1		
Course pre-requisites	CSA1201 and CSA2500		
Anti-requisites	NIL		
Course Description	The main objective of this course is to cover basic concepts of operating systems. Operating Systems functions, Basic Concepts, Notion of a process, Concurrent processes, Problem of mutual exclusion, Deadlock, Process Scheduling, Memory management, Multiprogramming, File systems; time sharing systems and their design consideration. This course will prepare students to develop software in and for Linux/UNIX environments. Also this course helps the students in UNIX operating system and their effective use for problem solving.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Operating Systems and Unix Programming Lab and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain basic UNIX concepts, commands, and vi editor [Understand] CO2 Define file commands and UNIX system calls. [Understand] CO3 Evaluate system calls for process and file operations [Apply] CO4 Implement shell scripting for problem solving [Apply] CO5 Analyze and simulate UNIX commands (ls, grep). [Apply] CO6 Analyze priority scheduling and compute performance metrics [Analyze]		

List of Experiments — 30 Sessions

1. To study of Basic UNIX Commands and various UNIX editors such as vi
2. To study the File manipulation Commands
3. Programs using the following system calls of UNIX operating system fork, exec, getpid, exit,wait
4. Programs using the following system calls of UNIX operating system close, stat, opendir, readdir
5. Program for simulation of ls unix commands
6. Program for simulation of grep unix commands
7. Write a Shell program to check the given number is even or odd
8. Write a Shell program to check the given year is leap year or not
9. Write a Shell program to find the factorial of a number
10. Write a Shell program to swap the two integers
11. Implementation of Priority scheduling algorithms. With total and average waiting time
12. Implementation of Priority scheduling algorithms. With total and average turnaround time
13. Write a Shell program to display a given Message
14. Write a Shell Program to find the roots of the quadratic equation.
15. Write a shell program to find the smallest digit of a value
16. Write a shell script to perform integer arithmetic operations
17. Write a shell program to reverse a number.
18. Write a shell program to find the sum of even and odd numbers in an array
19. Write a Simple Shell script to print the sum of n natural numbers
20. Write a shell program to count the number of digits of a value.

Text Books

T1 Abraham Silberschatz, Peter B. Galvin, Greg Gagne-Operating System Concepts, Wiley, 10th Edition, 2019.

T2 Tanenbaum, Andrew S., and Albert S. Woodhull. Operating systems: design and implementation. Vol. 68. Englewood Cliffs: Prentice Hall, 1997

Reference Books

R1 The Unix programming Environment by Brain W. Kernighan & Rob Pike, Pearson.
R2 Introduction to Unix Shell Programming by M.G.Venkateshmurthy, Pearson

E-Resources

1. https://nptel.ac.in/courses/106108101
2. https://www.udemy.com/course/unix-getting-started/
3. https://www.coursera.org/learn/unix

CSA2520 Virtualization and Cloud Infrastructure

Course Code: CSA2520	**Course Name:** Virtualization and Cloud Infrastructure **Type of Course:** Core Course	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	CSA2520		
Anti-requisites	NIL		
Course Description	This course introduces the core principles of virtualization and cloud computing, covering key concepts such as hypervisors, virtual machines, containers, and virtual networks. It explores cloud architectures, service models (IaaS, PaaS, SaaS), and deployment models including public, private, and hybrid clouds. Students gain hands-on experience with tools like VMware, VirtualBox, and KVM, and learn to deploy applications on platforms such as AWS, Microsoft Azure, and Google Cloud, while addressing topics like scalability, resource management, security, cloud storage, and container orchestration using Docker and Kubernetes.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Virtualization and Cloud Infrastructure and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain virtualization concepts, types, and hypervisors. [Understand] CO2 Describe cloud architectures and service models. [Understand] CO3 Configure virtualization platforms and container tools. [Apply] CO4 Implement cloud networking and storage solutions. [Apply] CO5 Analyze multi-cloud and microservices architectures. [Apply] CO6 Analyze performance, scalability, and security in virtual/cloud systems. [Analyze]		
Course Content:			
Module 1	Introduction to Virtualization		4 Sessions
Topics: Concepts and benefits of virtualization, Types of virtualization: hardware, software, network, storage, Hypervisors: Type 1 vs Type 2, Virtual Machines and their architecture.			
Module 2	Virtualization Tools and Technologies		3 Sessions
Topics: Installation and configuration of virtualization platforms (e.g., VMware, VirtualBox, KVM), Containerization concepts and tools (Docker basics), Managing virtual networks and storage in virtual environments			
Module 3	Advanced Cloud Computing Architectures and Services		4 Sessions
Topics: Serverless computing and Function as a Service (FaaS), Multi-cloud and hybrid cloud architectures- Virtual networking in the cloud (VPCs, subnets, gateways, load balancers) - Cloud storage options (object, block, file storage) and data			

lifecycle management - Introduction to microservices and container orchestration (Kubernetes architecture and components)		
Module 4	Performance, Security, and Best Practices	4 Sessions
Topics: Performance metrics and monitoring in virtual/cloud environments - Security challenges and solutions in virtualization and cloud - Scalability and resource management - Best practices for deployment and management of virtualized/cloud infrastructure		
List of Experiments		60 Sessions

1. Install and configure VirtualBox/VMware Workstation and create virtual machines with different operating systems.
2. Install and compare Type 1 and Type 2 hypervisors based on performance.
3. Create, manage, and restore virtual machine snapshots.
4. Configure networking in virtual machines using NAT, Bridged, and Host-only modes.
5. Install Docker and execute basic container operations.
6. Create custom Docker images using Dockerfile.
7. Deploy multi-container applications using Docker Compose.
8. Configure container networking and persistent storage using volumes.
9. Launch and manage virtual machines using AWS EC2 and connect via SSH.
10. Create and manage cloud storage using AWS S3.
11. Deploy applications using PaaS platforms such as Heroku or Google App Engine.
12. Design and configure Virtual Private Cloud (VPC) with subnets and security groups.
13. Implement Infrastructure as Code using Terraform scripts.
14. Set up Kubernetes cluster using Minikube and deploy applications.
15. Monitor cloud resources and perform security auditing using cloud monitoring tools.

Text Books

T1 D. C. Marinescu, Cloud Computing: Theory and Practice, 3rd ed., Amsterdam, Netherlands: Elsevier, 2022.

T2 T. Erl, R. Puttini, and Z. Mahmood, Cloud Computing: Concepts, Technology & Architecture, 2nd ed., Upper Saddle River, NJ, USA: Prentice Hall, 2013.

Reference Books

R1 C. Marinescu, Cloud Computing: Theory and Practice, 2nd ed. Burlington, MA, USA: Morgan Kaufmann, 2017.

R2 B. Sosinsky, Cloud Computing Bible, 1st ed. Hoboken, NJ, USA: Wiley, 2011.

E-Resources

1.https://www.redhat.com/en/topics/cloud-computing/cloud-vs-virtualization
2.https://aws.amazon.com/what-is/virtualization/

CSA1203 Essentials of Data Science

Course Code: CSA1203	**Course Name:** Essentials of Data Science **Type of Course:** Core Courses	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	The purpose of this course is to enable the students to learn the Fundamentals of Data Science-Data Analysis for effective data driven decisions and to develop the abilities of analyzing the Data. Data science is the science of analyzing raw data using statistics and machine learning techniques with the purpose of drawing conclusions about that information.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Essentials of Data Science and attain Skill Development through Problem Solving Methodologies.		

Course Outcomes	**On successful completion of the course the students shall be able to:**	
	CO1 Explain data science process	[Understand]
	CO2 Describe types of data description for data science process	[Understand]
	CO3 Illustrate relationships between data.	[Apply]
	CO4 Identify the role of ML and Domain Expertise in Data Science	[Apply]
	CO5 Analyze least squares regression line	[Apply]
	CO6 Evaluate KNN Algorithm with help of an example	[Analyze]

Course Content:

Module 1	Introduction to Data Science	10 Sessions

Topics:
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – cleaning, integrating, and transforming data -Data preparation - Exploratory Data analysis – build the model– presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data

Module 2	Describing Data	10 Sessions

Topics:
Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores

Module 3	Describing Relationships	10 Sessions

Topics:
Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean

Module 4	Introduction to Machine Learning and Domain Expertise.	15 Sessions

Topics:
Defining Machine Learning and its processes, Learning Styles Learning with supervised algorithms, Learning with unsupervised algorithms, Learning with reinforcement algorithms. KNN Algorithm and K-Means. Data Engineering, Map reduce, Word Frequency Problem,, Map Reduce Solution, Other Examples of Map Reduce, Pregel.

Text Books

T1 David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016

T2 Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.

Reference Books

R1 Lillian Pierson, "Data Science for Dummies", 2nd ed, John Wiley & Sons, Inc., 2017.

R2 John D. Kelleher and Brendan Tierney, Data science, The MIT Press Essential knowledge series, 2018.

E-Resources

1. https://nptel.ac.in/courses/106/106/106106179/?utm
2. https://www.ibm.com/training/data-science?utm
3. https://www.edx.org/learn/data-science/harvard-university-data-science-r-basics?utm

CSA1708 Data Mining

Course Code: CSA1708	**Course Name:** Data Mining **Type of Course:** Core Course	L- T-P- C	2-1-0-3
Version No.	1		
Course pre-requisites	CSA2503		
Anti-requisites	NIL		
Course Description	The purpose of this Course is to introduce the students to issues in data mining, data pre-processing techniques, data mining tasks, association rules, advanced association rules, classification, and different approaches for classification, clustering, and outlier detection. Topics include: Association rule mining, classification, clustering and outlier detection.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Mining and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain the basic concepts and issues involved in Data Mining. [Understand] CO2 Discuss different preprocessing techniques on Data Analysis. [Understand] CO3 Discover frequent item sets by using Association rule algorithms. [Apply] CO4 Apply different Classification and Clustering techniques used in data mining. [Apply] CO5 Analyze classification by Back Propagation. [Apply] CO6 Illustrate anomaly detection preliminaries. [Analyze]		
Course Content:			
Module 1	Introduction to Data mining		11 Sessions
Topics: Introduction to Data mining – Data Mining Goals– Stages of the Data Mining Process–Data Mining Techniques– Applications.			
Module 2	Types of data		10 Sessions
Topics: Types of data – Data Quality – Data Preprocessing Techniques – Similarity and Dissimilarity measures.			
Module 3	Motivation and terminology		12 Sessions
Topics: Motivation and terminology – Basic idea: item sets – Generating frequent item sets and rules efficiently – Apriori Algorithm– FP Growth.			
Module 4	Decision tree Induction		12 Sessions
Topics: Decision tree Induction – Bayesian classification – Rule based classification – Classification by Back Propagation - Lazy learners – Modern evaluation and selection techniques to improve classification accuracy. Clustering Analysis – portioning method – Hierarchical methods –Basics of Density based method – Grid based methods. Anomaly detection preliminaries - Different Outlier detection techniques-Web mining- Text mining- Data mining software Application.			

Text Books

T1 Tan P. N., Steinbach M & Kumar V. "Introduction to Data Mining", Pearson Education, 2016.

T2 Han J & Kamber M, "Data Mining: Concepts and Techniques", Elsevier, Second Edition, 2006

Reference Books

R1 G K Gupta, "Introduction to Data Mining with Case Studies", PHI, Third Edition, 2014

R2 Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", Tata McGraw – Hill.

E-Resources

1. https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2233842&site=ehost-

live 2. https://nptel.ac.in/courses/105106053

CSA2515 Data Modelling and Visualization

Course Code: CSA2515	**Course Name:** Data Modelling and Visualization **Type of Course:** Core Courses	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	CSA1203		
Anti-requisites	NIL		
Course Description	The purpose of the course is to install a strong foundation of scientific process orientation that is the cornerstone of effective data handling, and creative design thinking appended with strong programming skills to create meaningful visualizations of data. The student should have prior knowledge of python programming and basic knowledge of data concepts. The associated laboratory provides an opportunity to strengthen student's skillset in the arena of Data Preprocessing and Visualization. With a good knowledge in the fundamental concepts of the various libraries for handling and visualizing data the student can gain a stronghold in Data Science enabling the student to be an effective analyst for prospective employers.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Modelling and Visualization and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Understand the various types of data, apply and evaluate the principles of data visualization. [Apply] CO2 Acquire skills to apply visualization techniques to a problem and its associated dataset. [Apply] CO3 Create interactive visualization for better insight using various visualization tools [Apply] CO4 Implement the visualization concepts practically using Python [Apply] CO5 Apply the time series visualization with the help of an example. [Apply]		
Course Content:			
Module 1	Introduction to Data Modelling (Python Basics & EDA)		4 Sessions
Topics: Introduction to Data Science & Python, Overview of Data Modeling & Statistical Analysis, Python Libraries: NumPy, Pandas, Matplotlib, Seaborn, Data Importing & Preprocessing, Handling Missing Values & Outliers, Feature Engineering & Feature Selection,Exploratory Data Analysis (EDA)			
Module 2	Statistical Data Modelling & Machine Learning		4 Sessions
Topics: Probability Distributions: Normal, Binomial, Poisson, Hypothesis Testing (t-test, ANOVA, Chi-Square), Correlation and Regression Analysis (Linear, Multiple, Polynomial), Principal Component Analysis (PCA) & Linear Discriminant Analysis (LDA), Time Series Analysis & Forecasting, Market Basket Analysis (Association Rule Mining).			
Module 3	Data Visualization Techniques		4 Sessions
Topics: Introduction to Data Visualization, Visualization Libraries in Python (Matplotlib, Seaborn, Plotly), Basic Plots (Bar, Line, Scatter, Histogram, Pie), Advanced Plots (Heatmaps, Boxplots, Violin Plots), Time Series Visualization, Geographic & Financial Data Visualization, Dashboard Development with Plotly Dash.			
Module 4	Big Data Handling in Python		3 Sessions
Topics:			

Big Data Handling in Python (Dask, Spark), Clustering Techniques (K-Means, Hierarchical Clustering), Deep Learning for Data Analysis (Introduction to TensorFlow/PyTorch), Streaming Data Visualization (Real-time data analysis), Financial Data Analysis & Visualization, Final Project: End-to-End Data Science Pipeline.

List of Experiments	60 Sessions

1. Working with NumPy Functions
2. Pandas Functions
3. Acquiring and Plotting Data
4. Practicals Based on Data Cleaning and Preparation
5. Practicals Based on Data Wrangling
6. Statistical Analysis – Multivariate Analysis, PCA, LDA, Correlation, Regression, and ANOVA
7. Practicals Based on Data Visualization Using Matplotlib
8. Visualization of Massive Datasets – Finance
9. Visualization of Massive Datasets – Healthcare and Census
10. Practical Based on Time Series Data Analysis (Stock Market)
11. Market Basket Data Analysis and Visualization
12. Text Visualization Using Web Analytics
13. Financial Analysis Using Clustering and Histogram
14. Financial Analysis Using Heatmap
15. Visualization on Streaming Datasets (Stock Market Dataset, Weather Forecasting)

Text Books

T1 Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.

T2 McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media. W.(2017)

Reference Books

R1 Dr.Chun-hauh Chen, W.K.Hardle, A.Unwin, Handbook of Data Visualization, Springer publication, 2016.

R2 Christian Toninski, Heidrun Schumann, Interactive Visual Data Analysis, CRC press publication,2020 3. Alexandru C. Telea, Data Visualization: Principles and Practice, AK Peters, 2014.

E-Resources

1. https://pythonprogramming.net/live-graphs-data-visualization-application-dash-python-tutorial/
2. Google Data Analytics Professional Certificate | Coursera
3. Learning Python for Data Analysis and Visualization Ver 1 | Udemy

CSA2509 Data Management using Cloud

Course Code: CSA2509	**Course Name:** Data Management using Cloud **Type of Course:** Core Courses	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	CSA2503		
Anti-requisites	NIL		
Course Description	This Course is designed to introduce the concepts of Cloud Computing as a new computing paradigm. Cloud Computing has emerged in recent years as a new paradigm for hosting and delivering services over the Internet. The students can explore various Cloud Computing terminology, principles and applications. Understanding different views of the Cloud Computing such as theoretical, technical and commercial aspects.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Management using Cloud and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Describe fundamentals of cloud computing, virtualization and cloud computing services. [Understand] CO2 Discuss high-throughput and data-intensive computing [Understand] CO3 Illustrate security and standards in cloud computing [Apply] CO4 Demonstrate the installation and configuration of virtual machine [Apply] CO5 Analyze the windows azure platform appliance [Apply] CO6 LED lighting in digital image correlation [Analyze]		
Course Content:			
Module 1	Introduction to Cloud and Virtualization		12 Sessions
Topics: Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Computing Platforms and Technologies, Virtualization, Characteristics of Virtualized Environments Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Technology Examples, Cloud Computing Architecture, IaaS, PaaS, SaaS, Types of Clouds, Economics of Cloud			
Module 2	High Throughput and Data Intensive Computing		12 Sessions
Topics: Task computing, MPI applications, Task based programming, Introduction to DIC, Technologies for DIC, Aneka Map Reduce Programming.			
Module 3	Cloud Security and Standards		12 Sessions
Topics: Cloud Security Challenges, Software-as-a-Service Security, Application standards, Client standards, Infrastructure and Service standards.			
Module 4	Cloud Platforms: Amazon Web Services		09 Sessions
Topics: Communication Services, Additional Services, Google App Engine: Architecture and Core Concepts, Application Life-Cycle, Cost Model, Observations, Microsoft Azure: Core Concepts, SQL Azure, Windows Azure Platform Appliance, Observations. Demonstration of VM setup and configuration			
Text Books **T1** John Rittinghouse and James Ransome, "Cloud Computing, Implementation, Management and Security", CRC Press **T2** Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education.			

Reference Books
R1 David E.Y. Sarna, "Implementing and Developing Cloud Applications", CRC Press. **R2** Anthony T Velte, Toby J Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", Tata McGraw-Hill.
E-Resources 1. https://nptel.ac.in/courses/106105167?utm 2. https://cloud.google.com/training/data-engineering?utm 3. https://aws.amazon.com/training/learn-about/data-analytics/?utm

CSA2516 Data Analysis using R Programming

Course Code: CSA2516	**Course Name:** Data Analysis using R Programming **Type of Course:** Core Courses	L- T-P- C	0-0-4-2
Version No.	1		
Course pre-requisites	CSA1203		
Anti-requisites	NIL		
Course Description	This course introduces fundamental and advanced statistical techniques using R Programming for data analysis. Students will learn data manipulation, visualization, hypothesis testing, regression analysis, and machine learning techniques in R. The course covers both descriptive and inferential statistics, enabling students to interpret real-world datasets effectively. Hands-on sessions with R packages like ggplot2, dplyr, and caret will enhance analytical skills. By the end of the course, students will be able to apply statistical methods to solve complex data-driven problems.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Data Analysis using R Programming and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain R fundamentals, data handling, and visualization concepts. [Understand] CO2 Summarize principles of exploratory data analysis and regression assumptions [Understand] CO3 Perform data preprocessing, transformation, and visualization using R tools [Apply] CO4 Implement regression and classification models on real-world datasets. [Apply] CO5 Analyze the model performance using appropriate statistical metrics and validation techniques. [Apply] CO6 Analyse the regression and classification techniques to determine the best-fit model for a given dataset. [Analyze]		

List of Experiments	**60 Sessions**
1. Using with and without R objects on console 2. Using mathematical functions on console 3. Write an R script, to create R objects for calculator 4. Write an R script to find basic descriptive statistics using summary, str, quartile function on mtcars& cars datasets. 5. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location. b. Reading Excel data sheet in R 6.Find the data distributions using box and scatter plot. 7. Find the outliers using plot. 8. Plot the histogram, bar chart and pie chart on sample data 9.Find the correlation matrix. 10. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data 11.Create a regression model for a given dataset 12.Install relevant package for classification. 13. Choose classifier for classification problem. 14.Installing relevant package for classification.	

15. Evaluate the performance of classifier.
Text Books **T1** Hadley Wickham and Garrett Grolemund, "R for Data Science", O'reilly, 2017. **T2** Tilman M. Davies, "The Book of R: A First Course in Programming and Statistics", No Starch Press, 2016.
Reference Books **R1** Dr.BharatiMotwani, "Data Analytics using R", Wiley, 2019. **R2** Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley, 2017
E-Resources 1. https://www.coursera.org/learn/r-programming?utm 2. https://www.skills.google/paths/2267/course_templates/1226?utm 3. https://pll.harvard.edu/course/data-science-r-basics?utm

CSA2517 Machine Learning Algorithms

Course Code: CSA2517	**Course Name:** Machine Learning Algorithms **Type of Course:** Core Courses	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	CSA2505		
Anti-requisites	NIL		
Course Description	This course provides an introduction to the fundamental concepts and techniques of Machine Learning. It covers the basic machine learning workflow, data preprocessing methods, optimization techniques, and model evaluation metrics. The course introduces supervised learning algorithms such as regression and classification methods, as well as unsupervised learning techniques including clustering and dimensionality reduction. Students will also gain practical exposure to implementing machine learning models using Python libraries such as Scikit-Learn and explore real-world datasets through case studies while understanding ethical considerations in machine learning.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Machine Learning Algorithms and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Understand the basic concepts, types, workflow, and applications of machine learning. [Understand] CO2 Apply data preprocessing techniques to prepare datasets for machine learning models. [Apply] CO3 Analyze and evaluate supervised learning models using performance metrics. [Analyze] CO4 Implement and compare optimization and ensemble algorithms for classification and regression. [Apply] CO5 Understand and evaluate unsupervised learning techniques and consider ethical aspects in ML. [Apply]		
Course Content:			
Module 1	Introduction to Machine Learning Algorithms		15 Sessions
Topics: Introduction to Machine Learning - Types of Machine Learning: Supervised, Unsupervised, Semi Supervised, Reinforcement – Basic ML workflow - Key Concepts: Features, Labels, Training and Testing- Applications and Real-world Use Cases.			

Module 2	Data Preprocessing and Supervised Learning Techniques	10 Sessions

Topics:

Data Cleaning - Normalization - Encoding - Train-Test Split - Overfitting and Underfitting concepts- Cross-Validation Techniques - Classification and Regression, Linear Regression- single Linear and multiple Linear Regression- Logistic Regression: Binary Classification and Multi-variate Classification - Model Evaluation metrics: Confusion Matrix, Accuracy, Precision, Recall and F1-Score

Module 3	Supervised Learning and Optimization Algorithms	10 Sessions

Topics:

KNN-Decision Tree- ID3, CART- Naïve Bayes Classifier, Types of Naïve Bayes- Gradient Descent Optimization Algorithm- Stochastic Gradient Descent (SGD) - Support Vector Machine - Ensemble Techniques: Bagging, Random Forest, Boosting -AdaBoost, Gradient Boosting

Module 4	Unsupervised Learning Techniques	10 Sessions

Topics:

Clustering Techniques: Introduction to Clustering: Types of Clustering, K-Means, Hierarchical Clustering, Model Evaluation of Clustering– Dimensionality Reduction: PCA, LDA - Association Rule Mining and, Collaborative Filtering Techniques - Ethical Considerations

Text Books

T1 A. Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd ed., Sebastopol, CA, USA: O'Reilly Media, 2019. [Note: The 3rd edition was released in 2022.]

T2 S. Raschka and V. Mirjalili, Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2, 3rd ed., Birmingham, U.K.: Packt Publishing, 2020.

Reference Books

R1 Raul Garreta, Guillermo Moncecchi, Learning scikit-learn: Machine Learning in Python, Packt Publishing Limited, 2013

R2 K. P. Murphy, Probabilistic Machine Learning: An Introduction, Cambridge, MA, USA: MIT Press, 2022.

E-Resources

1.https://developers.google.com/machine-learning/crash-course

2.https://www.coursera.org/learn/machine-learning

CSA2518 Machine Learning Algorithms Lab

Course Code: CSA2518	**Course Name:** Machine Learning Algorithms Lab **Type of Course:** Core Courses	L- T-P- C	0-0-2-1
Version No.	1		
Course pre-requisites	CSA1503		
Anti-requisites	NIL		
Course Description	A machine learning algorithm is a mathematical or computational procedure that is designed to learn patterns and relationships from data, and use that knowledge to make predictions, classifications, or decisions. These algorithms form the core building blocks of machine learning systems and enable computers to automatically learn from and analyze large amounts of data. The development and implementation of machine learning algorithms require careful consideration of factors such as data quality, feature engineering, model selection, hyperparameter tuning, and evaluation techniques to ensure reliable and accurate results.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Machine Learning Algorithms Lab and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain the process of training and testing datasets in the context of machine learning techniques. [Understand] CO2 Apply optimization and parameter tuning techniques for machine Learning algorithms [Apply] CO3 Apply a machine learning model to solve various problems using machine learning algorithms [Apply] CO4 Design a model through machine learning algorithm [Analyze] CO5 Develop Basic ML Workflow Implementation in python. [Analyze]		

List of Experiments	**60 Sessions**
1. Basic Python Programming Refresher – Variables, data types, loops, conditionals, functions. 2. Exploring Datasets – Load and explore datasets using pandas and matplotlib (Iris, Titanic datasets). 3. Types of Machine Learning – Classify tasks into supervised, unsupervised, and reinforcement learning using real-world examples. 4. Data Cleaning and Preprocessing – Handle missing data, remove duplicates, normalize and encode categorical data. 5. Train-Test Split and Cross Validation – Split datasets and perform k-fold cross-validation using scikit-learn. 6. Linear Regression – Predict house prices using LinearRegression() on Boston Housing dataset. 7. Logistic Regression & KNN – Implement logistic regression on Iris dataset and build KNN classifier for digit recognition. 8. K-Means Clustering – Cluster customer data (Mall Customer Segmentation dataset). 9. Hierarchical Clustering – Apply and visualize dendrograms using scipy.cluster.hierarchy. 10. PCA for Dimensionality Reduction – Reduce features of Iris dataset and visualize 2D scatter plot. 11. Model Evaluation Metrics – Compare Accuracy, Precision, Recall, F1-score using confusion matrix. 12. Basic ML Workflow with Scikit-learn – Complete pipeline: load, preprocess, train, test, evaluate. 13. Case Study: Heart Disease Prediction – Build and evaluate model using UCI dataset. 14. Case Study: Diabetes Detection – Train and evaluate model on PIMA Indian Diabetes dataset. 15. Ethical Considerations in ML – Analyze bias in datasets/models with examples.	

Text Books

T1 Manaranjan Pradhan, U Dinesh Kumar, "Machine Learning Using Python" Wiley, First Edition 2019.

T2 Pattern Recognition and Machine Learning" by Christopher Bishop: This book provides a comprehensive introduction to machine learning, covering both classical and modern techniques. It covers topics such as Bayesian methods, support vector machines, neural networks, and deep learning

Reference Books
R1 Stuart J. Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach," Pearson, Fourth Edition 2020 **R2** Ethem Alpaydin, "Machine Learning: The New AI," MIT Press, First Edition 2016.
E-Resources 1.https://nptel.ac.in/courses/ 2.https://www.udemy.com/course/ 3.https://www.coursera.org/learn/

Discipline Specific Electives

Track 1: Artificial Intelligence and Machine Learning

CSA3501 Natural Language Processing

Course Code: CSA3501	**Course Name: Natural Language Processing**	L-T-P-C	3-0-0-3
Version No.	1		
Course pre-requisites	Programming in Python, Data Structures, Fundamentals of Machine Learning		
Anti-requisites	NIL		
Course Description	This course introduces the fundamental concepts, techniques, and applications of Natural Language Processing (NLP). It enables computers to process, understand, and generate human language. The course covers text preprocessing, linguistic analysis, machine learning techniques for NLP, deep learning architectures, and transformer-based models. On successful completion of this course, students will be able to develop intelligent language-processing applications such as sentiment analysis systems, chatbots, machine translation systems, and text summarization tools.		
Course Objective	The objective of this course is to familiarize learners with the concepts, techniques, and tools of Natural Language Processing and develop skills for analyzing, processing, and generating human language using machine learning and deep learning approaches.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1: Explain the fundamentals, linguistic concepts, and applications of Natural Language Processing. [Understand] CO2: Apply text preprocessing and feature extraction techniques for NLP tasks. [Apply] CO3: Develop machine learning models for text classification and sentiment analysis. [Apply] CO4: Implement advanced NLP applications using deep learning and transformer-based architectures. [Apply] CO5: Examine the performance of NLP models using appropriate evaluation techniques. [Analyze] CO6: Evaluate NLP solutions for real-world language processing applications. [Analyze]		
Course Content:			
Module 1	Fundamentals of Natural Language Processing		11 Sessions
Topics: Introduction to Natural Language Processing, Applications of NLP, Challenges in NLP, NLP Pipeline, Corpus and Linguistic Resources, Lexical Analysis, Morphological Analysis, Syntax Analysis, Semantic Analysis, Pragmatics, Introduction to NLP Libraries (NLTK and spaCy).			
Module 2	Text Preprocessing and Feature Engineering		11 Sessions
Topics: Text Cleaning and Normalization, Tokenization, Stop-word Removal, Stemming, Lemmatization, Part-of-Speech Tagging, Named Entity Recognition (NER), Bag of Words (BoW), TF-IDF Representation, Word Embeddings (Word2Vec and GloVe), Feature Extraction Techniques			

Module 3	Machine Learning for NLP	12 Sessions
Topics: Text Classification, Sentiment Analysis, Naïve Bayes Classifier, Logistic Regression, Support Vector Machines (SVM), N-gram Language Models, Topic Modeling, Information Retrieval Concepts, Model Evaluation Metrics: Accuracy, Precision, Recall, F1-Score, Confusion Matrix.		
Module 4	Deep Learning and Transformer-Based NLP	11 Sessions
Topics: Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), Sequence-to-Sequence Models, Attention Mechanism, Transformer Architecture, BERT, GPT Models, Machine Translation, Question Answering Systems, Chatbots and Conversational AI, Generative AI Applications in NLP.		
Text Books **T1** Speech and Language Processing. **T2** Natural Language Processing with Python		
Reference Books **R1** Practical Natural Language Processing **R2** Deep Learning for Natural Language Processing		
E-Resources • NLTK Documentation • spaCy Documentation • Hugging Face Transformers Documentation • Stanford NLP Resources • Google NLP Guide		

CSA3502 Big Data Analytics

Course Code: CSA3502	**Course Title:** Big Data Analytics **Type of Course: Elective_4**	L-T-P-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSA1503					
Anti-requisites	NIL					
Course Description	This course introduces the concepts and applications of Big Data Analytics with emphasis on large-scale data processing, analytics, and practical implementation using modern frameworks. The course covers Big Data architecture, distributed storage, data processing models, Hadoop ecosystem, analytics techniques, and visualization approaches. Students will gain hands-on experience using data analytics tools and frameworks to process and analyze structured and unstructured data for real-world decision making.					
Course Objective	To enable learners to understand Big Data concepts and apply analytical techniques using modern tools and frameworks for solving data-driven problems.					
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain Big Data concepts, architecture and distributed processing techniques. [Understand] CO2 Apply Big Data storage and processing techniques using suitable frameworks. [Apply] CO3 Analyze structured and unstructured data using analytical approaches. [Apply] CO4 Develop data-driven solutions and visualizations for real-world applications. [Apply]					

	CO5	Evaluate Big Data analytical outcomes and communicate insights using appropriate visualization and reporting techniques.	[Apply]

Course Content:

Module 1	Fundamentals of Big Data	8 Sessions

Topics:
Introduction to Big Data, Evolution of Data Management, Characteristics of Big Data (Volume, Velocity, Variety, Veracity, Value), Types of Data, Structured Data, Semi-Structured Data, Unstructured Data, Big Data Architecture, Distributed Computing Concepts, Big Data Challenges, Big Data Applications, Introduction to Hadoop Ecosystem.

Module 2	Big Data Storage and Processing	7 Sessions

Topics:
Introduction to Hadoop, Hadoop Architecture, Hadoop Distributed File System (HDFS), HDFS Components, Data Storage Concepts, Data Blocks and Replication, Introduction to MapReduce, Map Operations, Reduce Operations, Data Processing Workflow, Introduction to YARN, Hadoop Ecosystem Components.

Module 3	Big Data Analytics and Frameworks	8 Sessions

Topics:
Introduction to Data Analytics, Data Collection and Preprocessing, Data Cleaning Techniques, Data Analysis Concepts, Introduction to Apache Spark, Spark Architecture, Resilient Distributed Datasets (RDD), DataFrames, Spark SQL, Data Transformation Techniques, Data Aggregation, Introduction to Data Visualization.

Module 4	Big Data Applications	7 Sessions

Topics:
Descriptive Analytics, Predictive Analytics, Business Intelligence Concepts, Recommendation Systems, Real-Time Analytics, Data Visualization Dashboards, Data Privacy and Ethics, Data Governance Concepts, Emerging Trends in Big Data Analytics.

List of Experiments	30 Sessions

1. Install and configure Python, Jupyter Notebook/Google Colab, and required libraries for Big Data Analytics.
2. Load, inspect, and preprocess structured and unstructured data using Python libraries.
3. Perform data cleaning operations including handling missing values, duplicate records, and data transformation.
4. Implement data manipulation techniques such as filtering, sorting, grouping, and aggregation using DataFrames.
5. Perform Exploratory Data Analysis (EDA) and generate descriptive statistics for data interpretation.
6. Design and visualize analytical reports using line charts, bar charts, scatter plots, and histograms.
7. Demonstrate Hadoop Distributed File System (HDFS) operations for data storage and retrieval.
8. Implement MapReduce concepts for processing large datasets.
9. Develop programs using Apache Spark to perform distributed data processing.
10. Perform data transformation and aggregation operations using Spark DataFrames.
11. Implement descriptive and predictive analytics techniques for data analysis.
12. Design interactive dashboards and visualize analytical outcomes using appropriate visualization tools.
13. Compare different analytical approaches and evaluate performance using suitable metrics.
14. Develop and present a mini project for solving a real-world problem using Big Data Analytics.

Targeted Application & Tools Used
Python, Google Colab / Jupyter Notebook, Hadoop, Apache Spark, Pandas, NumPy, Matplotlib.

Textbooks

T1: Triguero, Isaac, Salvador García, and Francisco Herrera. Large-Scale Data Analytics with Python and Spark. Cambridge University Press, 2023.
T2: Kulkarni, Parag, Sara Joshi, and David Brown. *Big Data Analytics*. PHI Learning, 2024.

References Books

R1 Karau, Holden, Andy Konwinski, Patrick Wendell, and Matei Zaharia. *Learning Spark: Lightning-Fast Data Analytics*. 2nd ed., O'Reilly Media, 2020.

R2: White, Tom. *Hadoop: The Definitive Guide*. 4th ed., O'Reilly Media, 2015. R3: Kleppmann, Martin. *Designing Data-Intensive Applications*. O'Reilly Media, 2017.
E-Resources 1. https://hadoop.apache.org/ 2. https://spark.apache.org/ 3. https://nptel.ac.in/courses/106104189

CSA3504 Intelligent Application Development

Course Code: CSA3504	**Course Name:** Intelligent Application Development **Type of Course:** Integrated / SEC	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	CSA1500 – Problem Solving using C		
Anti-requisites	NIL		
Course Description	This course provides the opportunity for students to develop intelligent applications using modern programming frameworks, machine learning concepts, APIs, and data-driven technologies. Students will learn application development techniques integrated with artificial intelligence, automation, and intelligent decision-making systems. Topics include: Introduction to intelligent systems, application development fundamentals, APIs and web services, data preprocessing, machine learning basics, chatbot development, intelligent recommendation systems, cloud-based intelligent applications, and deployment techniques.		
Course Objective	The objective of the course is to familiarize learners with the concepts of Intelligent Application Development and enable skill development through experiential learning techniques involving AI-enabled applications and modern software tools.		
Course Outcomes	**On successful completion of the course the students shall be able to:**		
	CO1	Explain the fundamentals of intelligent systems and application development	[Understand]
	CO2	Develop applications using APIs and intelligent automation techniques	[Apply]
	CO3	Implement data preprocessing and machine learning basics in applications	[Apply]
	CO4	Design intelligent applications such as chatbots and recommendation systems	[Apply]
	CO5	Utilize cloud platforms and deployment tools for intelligent applications	[Apply]
	CO6	Build end-to-end intelligent applications integrating AI technologies	[Apply]
Course Content:			
Module 1	Fundamentals of Intelligent Systems and Application Development		5 Sessions
Topics: Introduction to intelligent systems, basics of application development, intelligent automation concepts, software development tools, APIs and web services.			
Module 2	Data Processing and Machine Learning Basics		3 Sessions
Topics: Data collection, preprocessing techniques, supervised and unsupervised learning basics, model training and evaluation.			
Module 3	Intelligent Applications and AI Integration		3 Sessions

Topics: Chatbot development, recommendation systems, natural language processing basics, AI integration using APIs.		
Module 4	Cloud Deployment and Intelligent Solutions	4 Sessions
Topics: Cloud-based intelligent applications, deployment techniques, testing and maintenance of intelligent systems, ethical considerations in AI applications.		
List of Experiments		60 Sessions

Experiment – 1:Develop a menu-driven application for student record management using functions.
Experiment – 2:Implement a banking system to perform deposit, withdrawal, and balance enquiry operations.
Experiment – 3:Write a program to encrypt and decrypt text using simple cipher techniques.
Experiment – 4:Develop a password validation system using regular expressions.
Experiment – 5:Implement searching and sorting algorithms and compare their performance.
Experiment – 6:Create a program to perform matrix operations using NumPy.
Experiment – 7:Develop a mini attendance management system using file handling.
Experiment – 8:Write a program to analyze text data and display word frequency statistics.
Experiment – 9:Create a contact management application using dictionaries and file handling.
Experiment – 10:Develop a chatbot application using conditional statements and functions.
Experiment – 11:Implement a simple recommendation system based on user preferences.
Experiment – 12:Create a graphical user interface (GUI) application using Tkinter.
Experiment – 13:Develop an image processing application using OpenCV basics.
Experiment – 14:Implement a machine learning model for prediction using Scikit-learn.
Experiment – 15:Design and deploy a mini intelligent application integrating GUI, database, and AI features.

Text Books

T1 Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 4th Edition, 2021.

T2 David Flanagan, "JavaScript: The Definitive Guide", O'Reilly Media, 2020..

Reference Books

R1 Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", MIT Press, 2016.

R2 Al Sweigart, "Automate the Boring Stuff with Python", No Starch Press, 2019.

R3 Tom Mitchell, "Machine Learning", McGraw-Hill Education, 2017.

E-Resources

1. TensorFlow Documentation
2. Scikit-learn Documentation
3. OpenAI Platform Documentation
4. Coursera AI Courses
5. W3Schools Python Tutorial

CSA3505 Generative AI Applications

Course Code: CSA3505	**Course Name:** Generative AI Applications **Type of Course:** Integrated / SEC	L- T- P- C	1-0-4-3
Version No.	1		
Course pre-requisites	Basics of Programming and Artificial Intelligence		
Anti-requisites	NIL		
Course Description	This course provides the opportunity for students to explore and develop applications using Generative Artificial Intelligence technologies. Students will learn the fundamentals of generative AI models, prompt engineering, text and image generation, chatbot development, AI-assisted content creation, and deployment of AI applications. Topics include: Introduction to Generative AI, large language models, prompt engineering, generative text and image applications, AI-powered chatbots, ethical AI practices, APIs for AI integration, and deployment of generative AI applications.		
Course Objective	The objective of the course is to familiarize learners with the concepts of Generative AI Applications and enable skill development through experiential learning techniques using modern AI tools and platforms.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain the fundamentals of Generative AI and large language models [Understand] CO2 Apply prompt engineering techniques for AI content generation [Apply] CO3 Develop AI-powered text and image generation applications [Apply] CO4 Design chatbot and virtual assistant applications using Generative AI [Apply] CO5 Utilize APIs and cloud platforms for integrating AI services [Apply] CO6 Build and deploy Generative AI applications with ethical considerations [Apply]		
Course Content:			
Module 1	Fundamentals of Generative AI		5 Sessions
Topics: Introduction to Generative AI, AI applications, large language models, basics of neural networks, generative AI tools and platforms.			
Module 2	Prompt Engineering and AI Content Generation		3 Sessions
Topics: Prompt engineering techniques, text generation, AI-assisted content creation, image generation basics.			
Module 3	Chatbots and AI Application Development		3 Sessions
Topics: Chatbot development, virtual assistants, AI APIs, integration of generative AI into applications.			
Module 4	Deployment and Ethical AI Practices		4 Sessions
Topics: Cloud deployment of AI applications, testing and maintenance, AI ethics, responsible AI usage and security considerations.			
List of Experiments			60 Sessions
Experiment – 1:Write a program to generate text using a Generative AI tool. Experiment – 2:Create a simple AI chatbot for greeting users. Experiment – 3:Develop an application to generate stories using prompts. Experiment – 4:Implement prompt engineering techniques for better AI responses. Experiment – 5:Create an AI-based email drafting application. Experiment – 6: Develop a text summarization application using AI APIs. Experiment – 7:Build an AI-powered question answering system. Experiment – 8:Implement language translation using Generative AI tools. Experiment – 9:Create an AI image generation application. Experiment – 10: Develop a voice-to-text conversion application using AI APIs. Experiment – 11:Build a recommendation system using Generative AI concepts.			

Experiment – 12:Implement sentiment analysis on customer reviews. Experiment – 13:Create a resume or content generator using AI. Experiment – 14:Deploy a Generative AI application on a cloud platform. Experiment – 15:Design and develop an end-to-end Generative AI application integrating chatbot, text generation, and image generation features.
Text Books **T1** Tom Taulli, "Generative AI: How ChatGPT and Other AI Tools Will Revolutionize Business", Apress, 2023. **T2** Bernard Marr, "Generative AI in Practice", Wiley Publications, 2024.
Reference Books **R1** Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", MIT Press, 2016.. **R2** Ashish Vaswani et al., "Attention Is All You Need", Neural Information Processing Systems, 2017. **R3** David Foster, "Generative Deep Learning", O'Reilly Media, 2022..
E-Resources 1. OpenAI Documentation 2. Hugging Face Documentation 3. TensorFlow Tutorials 4. Coursera Generative AI Courses 5. Google AI Resources

CSA3506 Computer Vision Applications

Course Code: CSA3506	**Course Name:** Computer Vision Applications **Type of Course:** Integrated/ SEC	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This subject emphasis on fundamentals of Image processing and Computer vision. Students will gain the knowledge of Image Formation, Image Enhancement and Segmentation. Students will also learn various feature extraction techniques. This subject has more emphasis on core vision tasks through Motion estimation and Object as well as pattern recognition. Students shall explore the areas where automation can be possible through Image processing and Computer Vision.		
Course Objective	Course Objectives • To introduce students to the fundamentals of digital image processing and computer vision concepts. • To enable students to understand image enhancement, segmentation, and feature extraction techniques for visual data analysis. • To develop the ability to implement object recognition and motion estimation techniques using modern computer vision algorithms. • To explore real-world applications of computer vision in areas such as face recognition, OCR, surveillance, and automation systems.		

Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Explain the fundamentals of digital image processing, image formation, and computer vision systems. **[Understand]** **CO2:** Utilize image enhancement and segmentation techniques for digital image analysis. **[Apply]** **CO3:** Implement feature extraction and object recognition techniques. **[Apply]** **CO4:** Examine computer vision applications in real-world domains. **[Analyze]** **CO5:** Employ machine learning and deep learning techniques for image analysis. **[Apply]** **CO6:** Evaluate the performance and challenges of computer vision systems. **[Analyze]**

Course Content:

Module 1	**Introduction**	4 Sessions

Introduction: Digital Image fundamentals, Image Sensing and acquisition, Sampling and Quantization, Image formation models, Overview of Computer Vision, Applications of Image processing and Computer Vision

Module 2	**Image Enhancement and Segmentation**	4 Sessions

Image Enhancement: Image enhancement in spatial domain, Basic grey level Transformations, Histogram Processing Techniques, Spatial Filtering, Image smoothing and Image Sharpening, Image enhancement process in frequency domain, Low pass filtering, High pass filtering

Image Segmentation: point, line and edge detection, Thresholding, Regions Based segmentation, Edge linking and boundary detection

Module 3	**Feature Extraction and Object Recognition**	4 Sessions

Feature Extraction: Importance of Features, Feature extraction techniques, Histogram of Oriented Gradient (HOG), Scale Invariant Feature Transform (SIFT), Background subtraction techniques, Image Matching, Principal Component Analysis (PCA)

Object Recognition and Motion Estimation: Object Recognition techniques: Viola-Jones, Yolo, Deep learning algorithms for Object Recognition. Optical Flow, Gaussian Mixture Model (GMM), Structure of Motion, Motion Estimation.

Module 4	**Applications of Image Processing and Computer vision**	3 Sessions

Applications of Image Processing and Computer vision: Face Recognition, Facial Expression Recognition, Optical Character Recognition, Automated Video Surveillance

List of Experiments	60 Sessions

1. Implement various grey level transformations for Image Enhancement.
2. Implement Histogram Equalization technique.
3. Write a Program to apply convolution processes on an input image for image smoothing.
4. Implement Histogram of Oriented Gradient (HOG) for Feature extraction.
5. Write a Program to apply Scale Invariant Feature Transform on input image.
6. Implement frame differencing technique for background subtraction from video.
7. Implement Principal Component Analysis for the computation of Eigenvector to reduce the dimensionality.
8. Implement object detection algorithm YOLO.
9. Implement R-CNN algorithms for object detection.
10. Implement Optical Character Recognition using Tesseract/OpenCV
11. Implement motion estimation using optical flow technique.
12. Implement Object recognition.
13. Implement Facial Expression Recognition.

Text Books

T1 Digital Image Processing- Refael C. Gonzalez and Richard E. Woods, Wesley

T2 Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.

Reference Books

R1 Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.

R2 Computer Vision, D. H. Ballard, C. M. Brown, Prentice-Hall, Englewood Cliffs, 1982.

E-Resources

NPTEL Courses:

1. https://onlinecourses.nptel.ac.in/noc19_cs58/preview
2. https://onlinecourses.nptel.ac.in/noc19_ee55/preview

CSA3507 Applied AI and Automation for Business Solutions

Course Code: CSA3507	**Course Name:** Applied AI and Automation for Business Solutions **Type of Course:** Open Elective	L- T-P- C	2-0-2-3
Version No.	1		
Course pre-requisites	NA		
Anti-requisites	NIL		
Course Description	This course introduces the fundamental concepts, types, and applications of Artificial Intelligence in business and management. It explains the evolution, features, and goals of AI along with its implementation in enterprise environments. The course covers AI applications across various sectors such as healthcare, finance, retail, education, and supply chain management. It also discusses AI agents, robotics, and the relationship between AI, machine learning, and data science. Emphasis is given to ethical issues, governance, data privacy, and regulatory frameworks in AI. The course enables students to understand and apply AI concepts for informed managerial decision making.		
Course Objective	➢ To introduce students to the basic concepts, goals, and features of Artificial Intelligence (AI) in business. ➢ To help students understand different types of AI and how AI is implemented in enterprises. ➢ To explore how AI is used across various business functions like marketing, HR, finance, and supply chain. ➢ To explain the role of AI agents, robots, and how AI connects with machine learning and data science. ➢ To discuss the ethical, legal, and regulatory challenges of using AI in business.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Explain virtualization concepts, architecture, and benefits. **[Understand]** **CO2:** Differentiate various hypervisor types and virtualization models. **[Analyze]** **CO3:** Create and manage virtual machines using virtualization platforms. **[Apply]** **CO4:** Implement storage and network virtualization solutions. **[Apply]** **CO5:** Deploy and manage containerized applications in virtualized environments. **[Apply]** **CO6:** Analyze security, performance, and management issues in virtualization environments. **[Analyze]**		
Course Content:			
Module 1	**Introduction to Artificial Intelligence**		10 Sessions
Introduction to Artificial Intelligence: Definition and scope, Evolution of AI in Business, Importance and applications of AI, Foundations of AI, Features of AI, Goals of AI, Managerial view of AI, AI subfields, issues and challenges in AI.			
Module 2	**AI Types and Implementation**		10 Sessions
AI Types and Implementation: AI types – Based on capabilities: Narrow AI, General AI, Super AI, Based on functionalities: Reactive Machines, Limit memory -generative AI, virtual assistant and chat bots, responsible AI, Self-aware AI, Generative AI. Role of Data in enterprise AI, a blueprint for enterprise, AI implementation.			
Module 3	**AI Application in Business**		10 Sessions

AI Application in Business: AI Product Development Lifecycle, Product market Fit, Stages of the AI lifecycle, AI in Customer relationship management, healthcare, Finance, Retail, Agriculture, Education, Supply chain, Sales forecasting, HR Analytics.		
Module 4	**AI Agents & Robots and Regulatory Aspects in AI**	15 Sessions
AI Agents & Robots: Autonomous agents, Agentic AI, Robots in used today, Human machine collaboration, Managing automation with robots. AI & ML – overlaps among AI, ML and Data science. **Ethical and Regulatory aspects in AI:** Ethical considerations in AI, AI risk and governance, managing AI security concerns, bias and fairness in AI systems. AI regulatory frameworks, Data privacy and security, liability and accountability, Intellectual Property in AI.		
Text Books: **T1:** Sathish S. Nadig, Principles of Artificial Intelligence, Himalaya Publishing House. **T2:** Anannya Shaha, Shilu Varghese, Artificial Intelligence in Business, Himalaya Publishing House, 1e, 2021. **T3:** Kaushiki Sanyal, Rajesh Chakrabarti, Artificial Intelligence and India, Oxford University Press, 2020. **T4:** P. Vishvapathi, Abdul Khadeer, Khaja Mahabubullah, Artificial Intelligence, Quill Tech Publications, 1e, 2026. **T5:** G. Ashok Kumar, K. C. Sreedhar et al., Artificial Intelligence: Foundations, Frontiers and Futures, Quill Tech Publications, 1e, 2025.		
Reference Books: **R1:** Alexis Leon, Artificial Intelligence, Vikas Publishing House, New Delhi. **R2:** S. Rajasekaran, G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications, PHI Learning. **R3:** E. Balagurusamy, Artificial Intelligence, McGraw-Hill Education (India). **R4:** P. K. Sinha, Priti Sinha, Artificial Intelligence, BPB Publications, New Delhi. **R5:** M. A. Jayaram, Artificial Intelligence and Machine Learning, McGraw-Hill Education.		
E-Resources 1. https://nptel.ac.in/courses/106105077 — NPTEL: Artificial Intelligence (IIT Kharagpur) 2. https://nptel.ac.in/courses/106106139 — NPTEL: Introduction to Artificial Intelligence (IIT Madras) 3. https://www.ai.gov.in/ — Government of India AI Portal (India AI) 4. https://www.mygov.in/campaigns/indiaai/ — India AI Initiative – Digital India 5. https://www.ibm.com/topics/artificial-intelligence — IBM AI Learning Resources		

Track 2: AI and Data Science

CSA3509 Natural Language Processing

Course Code: CSA3509	**Course Name: Natural Language Processing**	L-T-P-C	3-0-0-3
Version No.	1		
Course pre-requisites	Programming in Python, Data Structures, Fundamentals of Machine Learning		
Anti-requisites	NIL		
Course Description	This course introduces the fundamental concepts, techniques, and applications of Natural Language Processing (NLP). It enables computers to process, understand, and generate human language. The course covers text preprocessing, linguistic analysis, machine learning techniques for NLP, deep learning architectures, and transformer-based models. On successful completion of this course, students will be able to develop intelligent language-processing applications such as sentiment analysis systems, chatbots, machine translation systems, and text summarization tools.		

Course Objective	The objective of this course is to familiarize learners with the concepts, techniques, and tools of Natural Language Processing and develop skills for analyzing, processing, and generating human language using machine learning and deep learning approaches.	
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1: Explain the fundamentals, linguistic concepts, and applications of Natural Language Processing. [Understand] CO2: Apply text preprocessing and feature extraction techniques for NLP tasks. [Apply] CO3: Develop machine learning models for text classification and sentiment analysis. [Apply] CO4: Implement advanced NLP applications using deep learning and transformer-based architectures. [Apply] CO5: Examine the performance of NLP models using appropriate evaluation techniques. [Analyze] CO6: Evaluate NLP solutions for real-world language processing applications. [Analyze]	
Course Content:		
Module 1	Fundamentals of Natural Language Processing	11 Sessions
Topics: Introduction to Natural Language Processing, Applications of NLP, Challenges in NLP, NLP Pipeline, Corpus and Linguistic Resources, Lexical Analysis, Morphological Analysis, Syntax Analysis, Semantic Analysis, Pragmatics, Introduction to NLP Libraries (NLTK and spaCy).		
Module 2	Text Preprocessing and Feature Engineering	11 Sessions
Topics: Text Cleaning and Normalization, Tokenization, Stop-word Removal, Stemming, Lemmatization, Part-of-Speech Tagging, Named Entity Recognition (NER), Bag of Words (BoW), TF-IDF Representation, Word Embeddings (Word2Vec and GloVe), Feature Extraction Techniques		
Module 3	Machine Learning for NLP	12 Sessions
Topics: Text Classification, Sentiment Analysis, Naïve Bayes Classifier, Logistic Regression, Support Vector Machines (SVM), N-gram Language Models, Topic Modeling, Information Retrieval Concepts, Model Evaluation Metrics: Accuracy, Precision, Recall, F1-Score, Confusion Matrix.		
Module 4	Deep Learning and Transformer-Based NLP	11 Sessions
Topics: Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), Sequence-to-Sequence Models, Attention Mechanism, Transformer Architecture, BERT, GPT Models, Machine Translation, Question Answering Systems, Chatbots and Conversational AI, Generative AI Applications in NLP.		
Text Books **T1** Speech and Language Processing. **T2** Natural Language Processing with Python		
Reference Books **R1** Practical Natural Language Processing **R2** Deep Learning for Natural Language Processing		
E-Resources • NLTK Documentation • spaCy Documentation • Hugging Face Transformers Documentation • Stanford NLP Resources • Google NLP Guide		

CSA3510 Big Data Analytics

Course Code: CSA3510	**Course Title:** Big Data Analytics **Type of Course: Elective_4**	L-T-P-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSA1503					
Anti-requisites	NIL					
Course Description	This course introduces the concepts and applications of Big Data Analytics with emphasis on large-scale data processing, analytics, and practical implementation using modern frameworks. The course covers Big Data architecture, distributed storage, data processing models, Hadoop ecosystem, analytics techniques, and visualization approaches. Students will gain hands-on experience using data analytics tools and frameworks to process and analyze structured and unstructured data for real-world decision making.					
Course Objective	To enable learners to understand Big Data concepts and apply analytical techniques using modern tools and frameworks for solving data-driven problems.					
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain Big Data concepts, architecture and distributed processing techniques. [Understand] CO2 Apply Big Data storage and processing techniques using suitable frameworks. [Apply] CO3 Analyze structured and unstructured data using analytical approaches. [Apply] CO4 Develop data-driven solutions and visualizations for real-world applications. [Apply] CO5 Evaluate Big Data analytical outcomes and communicate insights using appropriate visualization and reporting techniques. [Apply]					
Course Content:						
Module 1	Fundamentals of Big Data	8 Sessions				
Topics: Introduction to Big Data, Evolution of Data Management, Characteristics of Big Data (Volume, Velocity, Variety, Veracity, Value), Types of Data, Structured Data, Semi-Structured Data, Unstructured Data, Big Data Architecture, Distributed Computing Concepts, Big Data Challenges, Big Data Applications, Introduction to Hadoop Ecosystem.						
Module 2	Big Data Storage and Processing	7 Sessions				
Topics: Introduction to Hadoop, Hadoop Architecture, Hadoop Distributed File System (HDFS), HDFS Components, Data Storage Concepts, Data Blocks and Replication, Introduction to MapReduce, Map Operations, Reduce Operations, Data Processing Workflow, Introduction to YARN, Hadoop Ecosystem Components.						
Module 3	Big Data Analytics and Frameworks	8 Sessions				
Topics: Introduction to Data Analytics, Data Collection and Preprocessing, Data Cleaning Techniques, Data Analysis Concepts, Introduction to Apache Spark, Spark Architecture, Resilient Distributed Datasets (RDD), DataFrames, Spark SQL, Data Transformation Techniques, Data Aggregation, Introduction to Data Visualization.						
Module 4	Big Data Applications	7 Sessions				
Topics: Descriptive Analytics, Predictive Analytics, Business Intelligence Concepts, Recommendation Systems, Real-Time Analytics, Data Visualization Dashboards, Data Privacy and Ethics, Data Governance Concepts, Emerging Trends in Big Data Analytics.						
List of Experiments		30 Sessions				

15. Install and configure Python, Jupyter Notebook/Google Colab, and required libraries for Big Data Analytics.
16. Load, inspect, and preprocess structured and unstructured data using Python libraries.
17. Perform data cleaning operations including handling missing values, duplicate records, and data transformation.
18. Implement data manipulation techniques such as filtering, sorting, grouping, and aggregation using DataFrames.
19. Perform Exploratory Data Analysis (EDA) and generate descriptive statistics for data interpretation.
20. Design and visualize analytical reports using line charts, bar charts, scatter plots, and histograms.
21. Demonstrate Hadoop Distributed File System (HDFS) operations for data storage and retrieval.
22. Implement MapReduce concepts for processing large datasets.
23. Develop programs using Apache Spark to perform distributed data processing.
24. Perform data transformation and aggregation operations using Spark DataFrames.
25. Implement descriptive and predictive analytics techniques for data analysis.
26. Design interactive dashboards and visualize analytical outcomes using appropriate visualization tools.
27. Compare different analytical approaches and evaluate performance using suitable metrics.
28. Develop and present a mini project for solving a real-world problem using Big Data Analytics.

Targeted Application & Tools Used

Python, Google Colab / Jupyter Notebook, Hadoop, Apache Spark, Pandas, NumPy, Matplotlib.

Textbooks

T1: Triguero, Isaac, Salvador García, and Francisco Herrera. Large-Scale Data Analytics with Python and Spark. Cambridge University Press, 2023.
T2: Kulkarni, Parag, Sara Joshi, and David Brown. *Big Data Analytics*. PHI Learning, 2024.

References Books

R1 Karau, Holden, Andy Konwinski, Patrick Wendell, and Matei Zaharia. *Learning Spark: Lightning-Fast Data Analytics*. 2nd ed., O'Reilly Media, 2020.
R2: White, Tom. *Hadoop: The Definitive Guide*. 4th ed., O'Reilly Media, 2015.
R3: Kleppmann, Martin. *Designing Data-Intensive Applications*. O'Reilly Media, 2017.

E-Resources

4. https://hadoop.apache.org/
5. https://spark.apache.org/
6. https://nptel.ac.in/courses/106104189

CSA3511 Data Analytics Using Python

Course Code: CSA3511	**Course Title: Data Analytics Using Python** **Type of Course: Elective_4**	L-T-P-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course is designed to provide students with fundamental knowledge and practical skills in analysing and interpreting data using Python programming. The course introduces concepts of data analytics, Python programming fundamentals, data preprocessing, data manipulation using libraries such as NumPy and Pandas, and data visualization using Matplotlib and Seaborn. Through hands-on laboratory exercises and real-world datasets, the course enables students to develop analytical thinking and problem-solving skills for data-driven decision-making across various application domains.					

Course Objective	To enable students to apply Python-based tools and techniques for data analysis, visualization, and extracting meaningful insights from datasets.	
Course Outcomes	**On successful completion of the course the students shall be able to:**	
	CO1 Understand the fundamental concepts of data analytics, Python programming, and their applications in data-driven problem solving.	[Understand]
	CO2 Apply Python programming constructs and data structures for solving analytical problems.	[Apply]
	CO3 Apply NumPy and Pandas libraries for data processing, manipulation, and data management tasks.	[Apply]
	CO4 Apply visualization and exploratory data analysis techniques to represent and interpret datasets effectively	[Apply]
	CO5 Apply statistical methods and analytical techniques to solve real-world data analysis problems and generate meaningful insights.	[Apply]

Course Content:

Module 1	Introduction to Data Analytics and Python Programming	8 Sessions

Topics:
Introduction to data analytics, Types of analytics-Descriptive, Diagnostic, Predictive, Prescriptive, Applications of data analytics, Introduction to Python, Variables and data types, Operators and expressions, Conditional statements, Looping statements, Functions and modules, Lists, Tuples, Dictionaries, Sets

Module 2	Data Processing and Manipulation using Python Libraries	7 Sessions

Topics:
Introduction to NumPy, Array creation and operations, Array indexing and slicing, Mathematical and statistical functions, Introduction to Pandas, Series and DataFrame, Importing datasets from CSV and Excel files, Data selection and filtering, Handling missing values, Data cleaning and transformation, Sorting and grouping data

Module 3	Data Visualization and Exploratory Data Analysis	8 Sessions

Topics:
Introduction to data visualization, Visualization concepts and importance, Matplotlib fundamentals, Seaborn basics, Line charts, Bar charts, Pie charts, Histograms, Scatter plots, Box plots, Heat maps, Introduction to Exploratory Data Analysis (EDA), Identifying trends and patterns in datasets.

Module 4	Statistical Analysis and Real-World Data Analytics Applications	7 Sessions

Topics:
Descriptive statistics, Mean, Median, Mode, Variance, Standard deviation, Correlation, Covariance, Outlier detection, Data interpretation techniques, Business analytics applications, Healthcare analytics applications, Education analytics applications, Financial analytics applications, Case studies, Mini project

List of Experiments	30 Sessions

1. Write Python programs using variables, operators, and data types
2. Implement conditional and looping statements in Python
3. Develop programs using functions and modules
4. Perform operations on lists, tuples, dictionaries, and sets
5. Create and manipulate NumPy arrays
6. Perform array indexing, slicing, and mathematical operations using NumPy
7. Create Pandas Series and DataFrames
8. Import datasets from CSV and Excel files using Pandas
9. Perform data selection, filtering, sorting, and grouping operations
10. Handle missing values and perform data cleaning techniques
11. Create line charts and bar charts using Matplotlib
12. Generate pie charts, histograms, and scatter plots
13. Create box plots and heat maps using Seaborn
14. Perform descriptive statistical analysis (Mean, Median, Mode, Variance, Standard Deviation) on datasets
15. Conduct exploratory data analysis on a real-world dataset and prepare a mini project report

Targeted Application & Tools Used Python, Google Colab / Jupyter Notebook, Anaconda, Pandas, NumPy, Matplotlib.
Textbooks T1: W. McKinney, *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter*, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022. T2: J. Grus, *Data Science from Scratch: First Principles with Python*, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2019. T3: L. Igual and S. Seguí, *Introduction to Data Science: A Python Approach to Concepts, Techniques and Applications*. Cham, Switzerland: Springer, 2017.
References Books R1:P. Bruce, A. Bruce, and P. Gedeck, *Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python*, 2nd ed. Sebastopol, CA, USA: O'Reilly Media, 2020. R2: J. VanderPlas, *Python Data Science Handbook: Essential Tools for Working with Data*. Sebastopol, CA, USA: O'Reilly Media, 2016.
E-Resources 7. https://www.coursera.org/specializations/python 8. https://onlinecourses.nptel.ac.in/e-learning 9. https://www.udemy.com/course/python-for-data-science-and-machine-learning-bootcamp

CSA3512 Predictive Analytics

Course Code: **CSA3512**	Course Name: Predictive Analytics Type of Course: Lab / Lab Integrated Course	L- T-P- C	2-0-2-3
Version No.	1		
Course Pre-requisites	Basic Communication General Knowledge about Descriptive Analytics		
Anti-requisites	NIL		
Course Description	This course introduces learners to predictive analytics, data mining, and their applications in business, healthcare, and marketing. It covers data preprocessing, predictive algorithms (regression, decision trees, clustering, classification), time-series forecasting, and basic big-data concepts. The emphasis is on understanding methods, applying them in labs, and interpreting results for managerial decisions.		
Course Objective	The objective of the course is to familiarize learners with the concepts of Predictive Analytics and their applications in real-world decision-making scenarios. It aims to enhance employability skills through experiential learning by engaging students in hands-on data analysis, modeling, and interpretation using industry-relevant tools.		
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1** Understand the basics of analytics and predictive analytics and their use in real-world decision making [Understand] **CO2** Clean and explore data using descriptive statistics and visualizations [Apply] **CO3** Apply regression, decision trees, Naïve Bayes, k-NN, and k-means clustering to solve practical problems [Apply]		

	CO4 Build and evaluate time-series forecasts and use multiple regression for numeric predictions [Analyze] **CO5** Identify ethical issues in data mining and big data and explain results for data-driven decisions [Evaluate]			
Course Content:				
Module 1	Introduction to Predictive Analytics	Assignment	Introduction to Predictive Analytics	8 Sessions
Topics: Analytics- Definition, importance, Analytics in decision making, Applications, Challenges, Experts perception on analytics, Popularity in Analytics, Predictive analytics in business Scenarios- case studies				
Module 2	Predictive Analytics & Data Mining	Assignment	Predictive Analytics & Data Mining	7 Sessions
Topics: Predictive Analytics- Definition, Importance and application; Predictive Analytics – Marketing, Health care & other industries; Skills and roles in Predictive Analytics, Tools & Software, Data Mining – Definition, applications, Types of patterns, Data mining tools & dark side of data mining.				
Module 3	Data, Methods & Algorithms for Predictive Analytics	Assignment	Data, Methods & Algorithms for Predictive Analytics	8 Sessions
Topics: Nature, Pre-processing of data for analytics, Data Mining methods; Prediction, Classification- Decision tress, Cluster analysis, K means clustering, Association, Predictive analytics misconception, Algorithms - Naïve Bays, nearest neighbour, Regression - Simple linear regression (SLR) using OLS method, Multiple linear regression (MLR), Violation of Ordinary least squares (OLS) method - Auto correlation, Heteroscedasticity , multicollinearity				
Module 4	Business Forecasting & Decisions Trees with Big Data in Predictive Analytics	Assignment	Business Forecasting & Decisions Trees with Big Data in Predictive Analytics	7 Sessions
Topics: Business Forecasting, Time Series Data and Time Series Analysis- based Forecasting, Forecasting Accuracy, Auto-regressive and Moving average model, Decision Trees : Introduction to decision trees; Analysis – unstructured data . Fundamental concepts of Big data, Challenges and problems in data analytics stream analytics– A/B Testing Data preparation, cleaning, and exploratory analysis using data visualization and descriptive statistics, Applications of multiple regression for numeric prediction				

List of Laboratory Tasks

1. Predicting buying behavior

Use transaction data to identify buying habits based on previous purchase history and predict likely next purchase patterns for customers.

2. Fraud detection in transactions

Analyze transaction logs to detect unusual behavior and anomalies, sending alerts when the system finds patterns similar to past cyberattacks or fraudulent activities.

3. Healthcare diagnosis support

Use historical patient data (symptoms, tests, outcomes) to predict possible diseases and help doctors reach a more accurate diagnosis of the root cause.

4. Cart abandonment prediction

Predict how likely a customer is to abandon an online shopping cart and provide insights on whether each customer will purchase or leave based on their prior visits and browsing behavior.

5. Content recommendation system

Use viewing or browsing history to predict what users are likely to watch or click next and recommend personalized content in entertainment or e commerce platforms.

6. Predictive equipment maintenance

Monitor sensor data from machinery to predict when maintenance is needed; the system alerts personnel so maintenance can be scheduled before unscheduled breakdowns occur.

7. Customer churn prediction

Analyze customer usage, billing, and interaction data to predict which customers are likely to stop using a service, allowing early retention efforts.

8. Loan default risk prediction

Use credit history, income, and past repayment data to predict the probability that a borrower will default on a loan and support risk based lending decisions.

9. Sales forecasting for retail

Use historical sales data to forecast future demand for products, helping stores manage inventory and plan promotions more effectively.

10. Student performance prediction

Use exam scores, attendance, and assignment data to predict which students are at risk of low performance so instructors can intervene early.

11. Sentiment based product review prediction

Analyze product reviews and ratings to predict whether a new review will be positive or negative and help brands monitor customer sentiment.

12. Traffic flow and congestion prediction

Use historical traffic data from sensors and GPS to predict congestion patterns and suggest optimal routes or timing for travel.

13. Energy consumption forecasting

Use past energy usage data from households or industries to predict future demand and support efficient power grid planning and billing.

14. Email open and click through prediction

Use past email campaign data to predict which customers are likely to open an email or click a link, helping marketers optimize targeting and timing.

15. Patient readmission risk prediction

Use hospital discharge and medical history data to predict which patients are most likely to be readmitted, enabling proactive care planning and follow up.

Text Book

- T1 : Predictive Analytics Delen, D. (2020). Predictive Analytics: Data Mining, Machine Learning and Data Science for Practitioners. Upper Saddle River, NJ, USA: FT Press. (Pearson Publication)

References

- R1 Dinesh Kumar, U. (2021). Business Analytics: The Science of data-Driven Decision Making.
- R2 Business Analytics - Data Analysis & Decision Making", S. Christian Albright and Wayne L. Winston, Cengage Publication, 5th Edition, 2012

E-Resources

W1.https://www.sas.com/en_in/insights/analytics/predictive-analytics.html
W2. https://www.techtarget.com/searchbusinessanalytics/definition/predictive-analytics
W3. https://www.cio.com/article/228901/what-is-predictive-analytics-transforming-data- intofuture-insights.html
W4. https://www.simplilearn.com/what-is-predictive-analytics-article
W5. https://www.northeastern.edu/graduate/blog/predictive-analytics/

CSA3513 R Programming for Data Analysis

Course Code: CSA3513	**Course Name:** R Programming for Data Analysis **Type of Course:**	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces fundamental and advanced statistical techniques using R Programming for data analysis. Students will learn data manipulation, visualization, hypothesis testing, regression analysis, and machine learning techniques in R. The course covers both descriptive and inferential statistics, enabling students to interpret real-world datasets effectively. Hands-on sessions with R packages like ggplot2, dplyr, and caret will enhance analytical skills. By the end of the course, students will be able to apply statistical methods to solve complex data-driven problems.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Statistical Analysis using R Programming attain Employability Skills through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Apply basic R functions pertaining to fundamental data analysis. [Apply] CO2 Interpret data using appropriate statistical methods. [Apply] CO3 Demonstrate the decision trees concept with the given dataset. [Apply] CO4 Demonstrate the Mining concepts for both Data and Text. [Apply] CO5 Analyze the factor Analysis to identify underlying latent variables. [Analyze] CO6 Analyze the classifier performance using standard metrics. [Analyze]		
Course Content:			
Module 1	Introduction		4 Sessions
Topics: Introduction to R, Overview of data analysis, Working with directory in R, Loading and handling data in R, Data Visualization with ggplot2, Data Transformation with dplyr.			
Module 2	Exploratory Data Analysis		4 Sessions
Topics: Exploring a new dataset, Anomalies in numerical data, Visualizing relations between variables, Assumptions of Linear Regression, Validating Linear Assumption, Missing Values, Covariation, Patterns and Models, gglot2 Calls.			
Module 3	Regression Analysis		4 Sessions
Topics: Introduction, Types of Regression Analysis Models, Linear Regression, Simple Linear Regression, Non-Linear Regression, Regression Analysis with Multiple Variables, Cross Validation, Principal Component Analysis, Factor Analysis.			
Module 4	Classification		3 Sessions
Topics: Introduction, Different types of Classification, Logistic Regression, Support Vector Machines, K-Neatest Neighbors, Naïve Bayes Classifier, Decision Tree Classification, Random Forest Classification, Evaluation.			
List of Experiments			60 Sessions
1. Using with and without R objects on console 2. Using mathematical functions on console 3. Write an R script, to create R objects for calculator 4. Write an R script to find basic descriptive statistics using summary, str, quartile function on mtcars& cars datasets. 5. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location. b. Reading Excel data sheet in R 6.Find the data distributions using box and scatter plot. 7. Find the outliers using plot. 8. Plot the histogram, bar chart and pie chart on sample data			

9.Find the correlation matrix. 10. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data 11.Create a regression model for a given dataset 12.Install relevant package for classification. 13. Choose classifier for classification problem. c. Evaluate the performance of classifier. 14.Install relevant package for classification. 15. Choose classifier for classification problem. c. Evaluate the performance of classifier.
Text Books **T1** Hadley Wickham and Garrett Grolemund, "R for Data Science", O'reilly, 2017. **T2** Tilman M. Davies, "The Book of R: A First Course in Programming and Statistics", No Starch Press, 2016.
Reference Books **R1** Dr.BharatiMotwani, "Data Analytics using R", Wiley, 2019. **R2** Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley, 2017.
E-Resources 1. https://r4ds.had.co.nz/?utm_source=chatgpt.com 2. https://nptel.ac.in/courses/106106179?utm_source=chatgpt.com 3. https://www.edx.org/professional-certificate/harvardx-data-analysis-for-life-sciences?utm_source=chatgpt.com

CSA3514 Data Visualization and Business Intelligence

Course Code: CSA3514	**Course Name:** Data Visualization and Business Intelligence **Type of Course:** Integrated/ SEC	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces students to the fundamentals of data visualization and visual analytics using modern Business Intelligence (BI) tools such as Tableau and Microsoft Power BI. The course focuses on transforming raw data into meaningful visual representations for effective analysis and decision-making. This course provides an introduction to the concepts, techniques, and applications of Business Intelligence (BI), Business Analytics, and Data Mining for data-driven decision-making. The course focuses on understanding business intelligence systems, analytical methods, business performance monitoring, and data exploration techniques used in modern organizations.		
Course Objective	The objective of the course is to understand the fundamentals of data visualization and the role of visual analytics in data-driven decision making.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Understand the principles of data visualization and visual analytics for effective presentation of data. [Understand] CO2 Create and customize various charts, graphs, and visual representations for data analysis. [Apply]		

	CO3	Develop advanced visualizations such as histograms, box plots, heat maps, tree maps, and dual-axis charts.	[Apply]
	CO4	Explain various analytical techniques and business analytics methods used for decision-making.	[Apply]
	CO5	Design and build interactive dashboards and stories for business intelligence applications.	[Apply]
	CO6	Analyze business performance and business processes using analytical and monitoring techniques.	[Apply]

Course Content:

Module 1	Fundamentals of Data Visualization and Analytics	4 Sessions

Topics:
Introduction to Visualization, Data Connection, Visual Analytics: Basic Charts, Data Granularity, Groups & Sets, Filters, Calculations, Date Math, Data Aggregations, Custom Aggregations and Ratios ,Organizing Data ,Formatting Data using Labels and Tooltips ,Annotations, Trendlines, Histogram, Single Axis Graphs ,Dual Axis Graph

Module 2	Advanced Visual Analytics and Dashboard Design	4 Sessions

Topics:
Box Plot, Funnel Chart, Tree Map, Heat Map, Market Basket Analysis, Dashboards and their Relevance, Building a Dashboard, Interactive Dashboard, Action-Based Dashboard, Formatting Dashboard ,Legends and Highlights in Dashboards, Publishing Workbook, Story and its Relevance, Create a Story, Adding Story Points, Understanding Story Points, Formatting Story , Visualizations in Story

Module 3	Fundamentals of Business Intelligence and Analytics	4 Sessions

Topics:
Introduction to Business Intelligence, Mobile Business Intelligence, Real-time Business Intelligence, Business Analytics and Software Analytics, Embedded Analytics, Information Systems in BI , Business Activity Monitoring, Types of Analytical Techniques in BI, Business Performance Management, Business Process Discovery, Data Mining – Introduction and Applications, Examples of Data Mining Applications, Problem Explanation and Data Exploration ,Associated Techniques in BI

odule 4	Data Mining Techniques and Analytical Methods	3 Sessions

pics:
EKA Tool – Introduction and Usage, Complexity of Data , Data Transformation , Context Analysis , Anomaly Detectio
sociation Rule Learning, Cluster Analysis, Statistical Classification , Regression Analysis, Automatic Summarization, Da
ning Workflows and Practical Analysis, Analytical Report Generation and Interpretation

List of Experiments	60 Sessions

Experiment – 1: Installation and familiarization with the BI and visualization tool environment.
Experiment – 2: Connecting datasets from Excel, CSV, and database sources..
Experiment – 3: Creating basic visualizations using bar charts, line charts, and pie charts..
Experiment – 4: Performing data sorting, filtering, and grouping operations.
Experiment – 5: Creating calculated fields and applying date functions.
Experiment – 6: Performing data aggregation and custom aggregation analysis.
Experiment – 7: Formatting visualizations using labels, colors, tooltips, and annotations.
Experiment – 8: Creating histogram visualizations for frequency distribution analysis.
Experiment – 9: Creating trend lines and performing trend analysis.

Experiment – 10: Designing single-axis and dual-axis charts for comparative analysis. Experiment – 11: Creating box plots for statistical data analysis.. Experiment – 12: Designing interactive dashboards with filters, highlights, and actions. Experiment – 13: Creating and publishing dashboards, stories, and visualization reports using BI tools. Experiment – 14: Performing data preprocessing and data transformation techniques. Experiment – 15: Implementation of business activity monitoring using dashboards and KPIs. Experiment – 16: Data exploration and visualization using business analytics tools. Experiment – 17: Implementation of association rule learning using Apriori algorithm. Experiment – 18: Performing cluster analysis using K-Means clustering technique. Experiment – 19: Implementation of statistical classification techniques on dataset Experiment – 20: Performing regression analysis for predictive analytics. Experiment – 21: Generating analytical reports and interpreting business insights. Experiment – 21: Generating analytical reports and interpreting business insights Experiment – 21: Mini Project
Text Books **T1** The Big Book of Dashboards, Ryan Sleeper, Packt Publishing, First Edition **T2** Data Mining: Practical Machine Learning Tools and Techniques, Ian H. Witten, Eibe Frank, Mark A. Hall, Christopher J. Pal, Morgan Kaufmann (Elsevier), 4th Edition
Reference Books R1 Information Dashboard Design: Displaying Data for At-a-Glance Monitoring,Stephen Few, Analytics Press, 2nd Edition. R2 Successful Business Intelligence: Unlock the Value of BI and Big Data, Cindi Howson, McGraw-Hill Education, 2nd Edition.
E-Resources 1. https://www.tableau.com/learn/training?utm_source=chatgpt.com 2. https://learn.microsoft.com/en-us/power-bi/?utm_source=chatgpt.com

CSA3515 Generative AI Applications

Course Code: CSA3515	**Course Name:** Generative AI Applications **Type of Course:** Integrated / SEC	L- T- P- C	1-0-4-3
Version No.	1		
Course pre-requisites	Basics of Programming and Artificial Intelligence		
Anti-requisites	NIL		
Course Description	This course provides the opportunity for students to explore and develop applications using Generative Artificial Intelligence technologies. Students will learn the fundamentals of generative AI models, prompt engineering, text and image generation, chatbot development, AI-assisted content creation, and deployment of AI applications. Topics include: Introduction to Generative AI, large language models, prompt engineering, generative text and image applications, AI-powered chatbots, ethical AI practices, APIs for AI integration, and deployment of generative AI applications.		
Course Objective	The objective of the course is to familiarize learners with the concepts of Generative AI Applications and enable skill development through experiential learning techniques using modern AI tools and platforms.		

Course Outcomes	**On successful completion of the course the students shall be able to:**	
	CO1 Explain the fundamentals of Generative AI and large language models	[Understand]
	CO2 Apply prompt engineering techniques for AI content generation	[Apply]
	CO3 Develop AI-powered text and image generation applications	[Apply]
	CO4 Design chatbot and virtual assistant applications using Generative AI	[Apply]
	CO5 Utilize APIs and cloud platforms for integrating AI services	[Apply]
	CO6 Build and deploy Generative AI applications with ethical considerations	[Apply]
Course Content:		
Module 1	Fundamentals of Generative AI	5 Sessions
Topics: Introduction to Generative AI, AI applications, large language models, basics of neural networks, generative AI tools and platforms.		
Module 2	Prompt Engineering and AI Content Generation	3 Sessions
Topics: Prompt engineering techniques, text generation, AI-assisted content creation, image generation basics.		
Module 3	Chatbots and AI Application Development	3 Sessions
Topics: Chatbot development, virtual assistants, AI APIs, integration of generative AI into applications.		
Module 4	Deployment and Ethical AI Practices	4 Sessions
Topics: Cloud deployment of AI applications, testing and maintenance, AI ethics, responsible AI usage and security considerations.		
List of Experiments		60 Sessions
Experiment – 1:Write a program to generate text using a Generative AI tool. Experiment – 2:Create a simple AI chatbot for greeting users. Experiment – 3:Develop an application to generate stories using prompts. Experiment – 4:Implement prompt engineering techniques for better AI responses. Experiment – 5:Create an AI-based email drafting application. Experiment – 6: Develop a text summarization application using AI APIs. Experiment – 7:Build an AI-powered question answering system. Experiment – 8:Implement language translation using Generative AI tools. Experiment – 9:Create an AI image generation application. Experiment – 10: Develop a voice-to-text conversion application using AI APIs. Experiment – 11:Build a recommendation system using Generative AI concepts. Experiment – 12:Implement sentiment analysis on customer reviews. Experiment – 13:Create a resume or content generator using AI. Experiment – 14:Deploy a Generative AI application on a cloud platform. Experiment – 15:Design and develop an end-to-end Generative AI application integrating chatbot, text generation, and image generation features.		
Text Books **T1** Tom Taulli, "Generative AI: How ChatGPT and Other AI Tools Will Revolutionize Business", Apress, 2023. **T2** Bernard Marr, "Generative AI in Practice", Wiley Publications, 2024.		

Reference Books
R1 Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", MIT Press, 2016.. **R2** Ashish Vaswani et al., "Attention Is All You Need", Neural Information Processing Systems, 2017. **R3** David Foster, "Generative Deep Learning", O'Reilly Media, 2022..
E-Resources 6. OpenAI Documentation 7. Hugging Face Documentation 8. TensorFlow Tutorials 9. Coursera Generative AI Courses 10. Google AI Resources

Track 3: Cloud Computing, Big Data & Business Intelligence

CSA3516 Virtualization Technologies

Course Code: CSA3516	**Course Name:** Virtualization Technologies **Type of Course:**		L- T-P- C	1-0-4-3
Version No.	1			
Course pre-requisites	NIL			
Anti-requisites	NIL			
Course Description	This course introduces the concepts, architectures, and implementation techniques of virtualization technologies used in modern computing environments. Students will learn server virtualization, desktop virtualization, storage virtualization, network virtualization, hypervisors, virtual machine management, containerization, and cloud virtualization platforms. Practical sessions using VirtualBox, VMware, Docker, and Kubernetes will provide hands-on experience in creating and managing virtualized infrastructures. By the end of the course, students will be able to deploy, configure, secure, and manage virtualization solutions for enterprise and cloud environments.			
Course Objective	The objective of the course is to familiarize learners with virtualization concepts and modern infrastructure technologies while developing practical skills through experiential learning using industry-standard virtualization tools and platforms.			
Course Outcomes	**On successful completion of the course the students shall be able to:**			
	CO1	Explain the concepts and architecture of virtualization technologies.		[Understand]
	CO2	Configure and manage virtual machines using hypervisors.		[Apply]
	CO3	Implement storage and network virtualization solutions.		[Apply]
	CO4	Deploy and manage containerized applications using Docker.		[Apply]
	CO5	Analyse virtualisation security and performance challenges.		[Analyze]
	CO6	Design and evaluate virtualized cloud infrastructures.		[Analyze]
Course Content:				
Module 1	Introduction to Virtualization			4 Sessions
Topics: Introduction to Virtualization, History and Evolution of Virtualization, Benefits and Challenges, Types of Virtualization, Server Virtualization, Desktop Virtualization, Application Virtualization, Storage Virtualization, Network Virtualization, Virtualization Use Cases.				
Module 2	Hypervisors and Virtual Machines			4 Sessions
Topics:				

Hypervisor Architecture, Type-1 Hypervisors, Type-2 Hypervisors, Full Virtualization, Para-Virtualization, Hardware-Assisted Virtualization, Virtual Machine Lifecycle, Resource Allocation, Virtual Machine Migration, Snapshot Management.

Module 3	Storage and Network Virtualization	4 Sessions

Topics:

Storage Virtualization Concepts, SAN and NAS Technologies, Virtual Storage Pools, Software Defined Storage (SDS), Network Virtualization, VLANs, Virtual Switches, Software Defined Networking (SDN), Network Function Virtualization (NFV), Virtual Network Management.

Module 4	Containerization and Cloud Virtualization	3 Sessions

Topics:

Containers and Virtual Machines, Docker Architecture, Docker Images and Containers, Docker Networking, Docker Volumes, Container Orchestration, Kubernetes Fundamentals, Virtualization in Cloud Computing, IaaS, PaaS, SaaS, Cloud Resource Management.

List of Experiments	60 Sessions

1. Installation and configuration of Oracle VirtualBox.
2. Creation of Virtual Machines using VirtualBox.
3. Installation of Linux operating system on a virtual machine.
4. Installation of Windows operating system on a virtual machine.
5. Configure CPU, Memory, and Storage resources for VMs.
6. Create and restore VM snapshots.
7. Clone and export virtual machines.
8. Configure host-only networking.
9. Configure bridged networking.
10. Configure NAT networking.
11. Install VMware Workstation and create VMs.
12. Virtual disk creation and management.
13. Configure shared folders between host and guest OS.
14. Install Docker on Linux.
15. Create and run Docker containers.
16. Create custom Docker images.
17. Docker volume management.

Text Books

T1 Virtualization Essentials, Wiley Publications, 2012.

T2 Mastering VMware vSphere, Sybex Publications, Latest Edition.

Reference Books

R1: Cloud Computing: Concepts, Technology and Architecture, Pearson Education.

R2: Docker Deep Dive, Independently Published.

R3: Kubernetes Up and Running, O'Reilly Media.

R4: Virtualization: A Manager's Guide, O'Reilly Media.

E-Resources

4. https://techdocs.broadcom.com/?utm_source=chatgpt.com
5. https://docs.docker.com/?utm_source=chatgpt.com
6. https://kubernetes.io/docs/home/?utm_source=chatgpt.com
7. https://www.virtualbox.org/wiki/Documentation?utm_source=chatgpt.com

CSA3517 Devops and Microservices

Course Code: CSA3517	**Course Name:** Devops and Microservices **Type of Course:** Elective Course	L- T-P- C	2-0-2-3
Version No.	1		
Course pre-requisites	CSA1503		
Anti-requisites	NIL		
Course Description	This intermediate course enables students to perform Devopas and microservices development using python, with emphasis on employability skills. The course covers key technologies and architectures that enables the student to design and implement microservices. On successful completion of this course, the student shall be able to pursue a career in front end development. The students shall develop strong problem-solving skills as part of this course.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Agile software development using Java and attain Employability Skills through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain Agile philosophy, manifesto, principles, and frameworks [Understand] CO2 Apply Scrum artifacts, events, and roles in software projects [Apply] CO3 Perform Agile project planning, estimation, and release management [Apply] CO4 Develop software iteratively using Agile engineering practices [Apply] CO5 Use DevOps and CI/CD tools for Agile software delivery [Apply] CO6 Execute Agile team-based projects and evaluate sprint outcomes [Apply]		
Course Content:			
Module 1	Introduction to Agile Software Development		4 Sessions
Topics: Web Limitations of traditional SDLC models, Agile Manifesto and principles,Agile lifecycle,Agile vs Waterfall model,Incremental and iterative development,Agile methodologies ,Scrum			
Module 2	Scrum Framework		4 Sessions
Topics: Scrum values and pillars,Scrum roles:Product Owner,Scrum Master,Development Team,Scrum events:Sprint,Sprint Planning,Daily Scrum,Sprint Review			
Module 3	Agile Requirements and Estimation		4 Sessions
Topics: User stories,Story mapping,Acceptance criteria,INVEST principles,Estimation techniques:Planning Poker, Story Points,Velocity,Release planning			
Module 4	Agile Engineering Practices		3 Sessions
Topics: Extreme Programming (XP),Pair programming,Refactoring,Continuous Integration,Test Driven Development (TDD),Behavior Driven Development (BDD),Agile modeling,Coding standards,Agile testing strategies			
List of Experiments			60 Sessions
1. Installation and configuration of Git and GitHub 2. Creating repositories and performing version control operations 3. Agile team formation and Scrum role assignment 4. Creating Product Backlog using Jira/Trello 5. Writing effective User Stories using INVEST principles 6. Sprint planning and task allocation 7. Conducting Daily Scrum meetings and maintaining sprint logs 8. Story point estimation using Planning Poker 9. Pair programming implementation exercise			

10. Refactoring existing codebase using Agile practices
11. Implementing Test Driven Development (TDD)
12. Unit testing using JUnit/PyTest

Text Books

T1 Orit Hazzan,Yael Dubinsky "Agile software engineering",Springer, 2008

T2 Ken Schwaber, Mike Beedle "Agile Software Development with Scrum",Prentice Hall, 2002

Reference Books

R1 Joachim Rossberg "Agile project mangement with Azure Devops" Apress,2019.

R2 Disha handa, Jarnail singh. "Agile and Beyond Software Development Practices",AKG GlobalPublishing House, 2023

E-Resources

1. Scrum Guide Official Website
2. Agile Alliance
3. Coursera Agile Development and Scrum
4. IIT Kanpur Agile Scrum Course

CSA3518 Data Warehousing

Course Code: CSA3518	**Course Name:** Data Warehousing	L-T-P-C	3-0-0-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces the concepts, architecture, design principles, and implementation techniques of Data Warehousing. Students will learn how data warehouses support decision-making processes through data integration, multidimensional modeling, ETL processes, OLAP operations, and business intelligence applications. The course covers data warehouse architectures, dimensional modeling, data quality, performance optimization, and emerging trends in enterprise data management. By the end of the course, students will be able to design and evaluate data warehouse solutions for organizational decision support systems.		

Course Objective	The objective of the course is to familiarize learners with the concepts of Data Warehousing and Decision Support Systems, enabling them to design, manage, and evaluate enterprise data warehouse solutions for effective business intelligence and analytical processing.	
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1: Explain the concepts, architecture, and applications of Data Warehousing. [Understand] CO2: Design multidimensional data models using star and snowflake schemas. [Apply] CO3: Implement ETL processes for integrating data from heterogeneous sources. [Apply] CO4: Analyze OLAP operations and multidimensional data structures. [Analyze] CO5: Evaluate data warehouse performance, security, and data quality issues. [Analyze] CO6: Assess business intelligence applications and emerging trends in data warehousing. [Analyze]	
Course Content:		
Module 1	Fundamentals of Data Warehousing	12 Sessions
Topics: Introduction to Data Warehousing, Operational Systems vs Data Warehouses, Characteristics of Data Warehouses, Need for Data Warehousing, Decision Support Systems, Data Warehouse Architecture, Components of Data Warehouse, Metadata Management, Data Warehouse Development Lifecycle, Enterprise Data Warehouse, Data Marts, Virtual Warehouses, Applications of Data Warehousing.		
Module 2	Data Modeling and ETL Processes	11 Sessions
Topics: Multidimensional Data Model, Facts and Dimensions, Fact Tables, Dimension Tables, Measures, Hierarchies, Star Schema, Snowflake Schema, Fact Constellation Schema, Data Warehouse Design Methodologies, Data Extraction Techniques, Data Transformation Methods, Data Cleansing, Data Loading Strategies, ETL Architecture, Data Integration, Data Quality Management.		
Module 3	OLAP and Business Intelligence	11 Sessions
Topics: Introduction to OLAP, OLTP vs OLAP, Multidimensional Analysis, OLAP Architecture, MOLAP, ROLAP, HOLAP, OLAP Operations, Roll-up, Drill-down, Slice, Dice, Pivot, Data Cube Technology, Business Intelligence Concepts, Dashboard Systems, Reporting Systems, Analytical Processing, Performance Metrics for BI Systems.		
Module 4	Advanced Data Warehousing and Emerging Trends	11 Sessions
Topics: Data Warehouse Security, Data Governance, Data Privacy and Compliance, Warehouse Performance Optimization, Indexing Techniques, Partitioning Strategies, Query Optimization, Data Warehouse Maintenance, Big Data Warehousing, Cloud Data Warehousing, Real-Time Data Warehousing, Data Lakes, Data Lakehouse Architecture, Artificial Intelligence in Data Warehousing, Future Trends and Challenges.		
Text Books T1: Data Warehousing Fundamentals, Wiley Publications. T2: The Data Warehouse Toolkit, Wiley Publications.		
Reference Books R1: Building the Data Warehouse, Wiley Publications. R2: Mastering Data Warehouse Design, Wiley Publications. R3: Data Warehouse Systems, Springer Publications.		
E-Resources • https://docs.oracle.com/en/database/oracle/oracle-database/?utm_source=chatgpt.com • https://docs.aws.amazon.com/redshift/?utm_source=chatgpt.com		

CSA3519 Predictive Analytics

Course Code: CSA3519	Course Name: Predictive Analytics Type of Course: Lab / Lab Integrated Course	L- T-P- C	2-0-2-3
Version No.	1		
Course Pre-requisites	Basic Communication General Knowledge about Descriptive Analytics		
Anti-requisites	NIL		
Course Description	This course introduces learners to predictive analytics, data mining, and their applications in business, healthcare, and marketing. It covers data preprocessing, predictive algorithms (regression, decision trees, clustering, classification), time-series forecasting, and basic big-data concepts. The emphasis is on understanding methods, applying them in labs, and interpreting results for managerial decisions.		
Course Objective	The objective of the course is to familiarize learners with the concepts of Predictive Analytics and their applications in real-world decision-making scenarios. It aims to enhance employability skills through experiential learning by engaging students in hands-on data analysis, modeling, and interpretation using industry-relevant tools.		
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1** Understand the basics of analytics and predictive analytics and their use in real-world decision making [Understand] **CO2** Clean and explore data using descriptive statistics and visualizations [Apply] **CO3** Apply regression, decision trees, Naïve Bayes, k-NN, and k-means clustering to solve practical problems [Apply] **CO4** Build and evaluate time-series forecasts and use multiple regression for numeric predictions [Analyze] **CO5** Identify ethical issues in data mining and big data and explain results for data-driven decisions [Evaluate]		

Course Content:

Module 1	Introduction to Predictive Analytics	Assignment	Introduction to Predictive Analytics	8 Sessions
Topics: Analytics- Definition, importance, Analytics in decision making, Applications, Challenges, Experts perception on analytics, Popularity in Analytics, Predictive analytics in business Scenarios- case studies				
Module 2	Predictive Analytics & Data Mining	Assignment	Predictive Analytics & Data Mining	7 Sessions
Topics: Predictive Analytics- Definition, Importance and application; Predictive Analytics – Marketing, Health care & other industries; Skills and roles in Predictive Analytics, Tools & Software, Data Mining – Definition, applications, Types of patterns, Data mining tools & dark side of data mining.				
Module 3	Data, Methods & Algorithms for Predictive Analytics	Assignment	Data, Methods & Algorithms for Predictive Analytics	8 Sessions
Topics: Nature, Pre-processing of data for analytics, Data Mining methods; Prediction, Classification- Decision tress, Cluster analysis, K means clustering, Association, Predictive analytics misconception, Algorithms - Naïve Bays, nearest neighbour, Regression - Simple linear regression (SLR) using OLS method, Multiple linear regression (MLR), Violation of Ordinary least squares (OLS) method - Auto correlation, Heteroscedasticity , multicollinearity				
Module 4	Business Forecasting & Decisions Trees with Big Data in Predictive Analytics	Assignment	Business Forecasting & Decisions Trees with Big Data in Predictive Analytics	7 Sessions
Topics:				

Business Forecasting, Time Series Data and Time Series Analysis- based Forecasting, Forecasting Accuracy, Auto-regressive and Moving average model, Decision Trees : Introduction to decision trees; Analysis – unstructured data . Fundamental concepts of Big data, Challenges and problems in data analytics stream analytics– A/B Testing Data preparation, cleaning, and exploratory analysis using data visualization and descriptive statistics, Applications of multiple regression for numeric prediction

List of Laboratory Tasks

1. Predicting buying behavior

Use transaction data to identify buying habits based on previous purchase history and predict likely next purchase patterns for customers.

2. Fraud detection in transactions

Analyze transaction logs to detect unusual behavior and anomalies, sending alerts when the system finds patterns similar to past cyberattacks or fraudulent activities.

3. Healthcare diagnosis support

Use historical patient data (symptoms, tests, outcomes) to predict possible diseases and help doctors reach a more accurate diagnosis of the root cause.

4. Cart abandonment prediction

Predict how likely a customer is to abandon an online shopping cart and provide insights on whether each customer will purchase or leave based on their prior visits and browsing behavior.

5. Content recommendation system

Use viewing or browsing history to predict what users are likely to watch or click next and recommend personalized content in entertainment or e commerce platforms.

6. Predictive equipment maintenance

Monitor sensor data from machinery to predict when maintenance is needed; the system alerts personnel so maintenance can be scheduled before unscheduled breakdowns occur.

7. Customer churn prediction

Analyze customer usage, billing, and interaction data to predict which customers are likely to stop using a service, allowing early retention efforts.

8. Loan default risk prediction

Use credit history, income, and past repayment data to predict the probability that a borrower will default on a loan and support risk based lending decisions.

9. Sales forecasting for retail

Use historical sales data to forecast future demand for products, helping stores manage inventory and plan promotions more effectively.

10. Student performance prediction

Use exam scores, attendance, and assignment data to predict which students are at risk of low performance so instructors can intervene early.

11. Sentiment based product review prediction

Analyze product reviews and ratings to predict whether a new review will be positive or negative and help brands monitor customer sentiment.

12. Traffic flow and congestion prediction

Use historical traffic data from sensors and GPS to predict congestion patterns and suggest optimal routes or timing for travel.

13. Energy consumption forecasting

Use past energy usage data from households or industries to predict future demand and support efficient power grid planning and billing.

14. Email open and click through prediction

Use past email campaign data to predict which customers are likely to open an email or click a link, helping marketers optimize targeting and timing.

15. Patient readmission risk prediction

Use hospital discharge and medical history data to predict which patients are most likely to be readmitted, enabling proactive care planning and follow up.

Text Book

• T1 : Predictive Analytics Delen, D. (2020). Predictive Analytics: Data Mining, Machine Learning and Data Science for Practitioners. Upper Saddle River, NJ, USA: FT Press. (Pearson Publication)
References • R1 Dinesh Kumar, U. (2021). Business Analytics: The Science of data-Driven Decision Making. • R2 Business Analytics - Data Analysis & Decision Making", S. Christian Albright and Wayne L. Winston, Cengage Publication, 5th Edition, 2012
E-Resources W1.https://www.sas.com/en_in/insights/analytics/predictive-analytics.html W2. https://www.techtarget.com/searchbusinessanalytics/definition/predictive-analytics W3. https://www.cio.com/article/228901/what-is-predictive-analytics-transforming-data- intofuture-insights.html W4. https://www.simplilearn.com/what-is-predictive-analytics-article W5. https://www.northeastern.edu/graduate/blog/predictive-analytics/

CSA3520 Data Visualization

Course Code: CSA3520	**Course Name:** Data Visualization **Type of Course:** Theory Integrated Lab Course	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	Python Programming		
Anti-requisites	NIL		
Course Description	To introduce students to the foundational principles, design methodologies, and practical tools required to transform complex datasets into impactful visual representations that drive data-informed decision-making.		
Course Objective	Teach the core principles of human visual perception, cognitive load, and design ethics required to build accurate, non-misleading visual encodings. Train students to programmatically clean, restructure, and map diverse datasets (temporal, geospatial, and hierarchical) for optimal visualization. Provide rigorous, hands-on mastery of industry-standard visualization libraries (such as Python's Plotly/Seaborn) and business intelligence tools. Enable students to design, develop, and deploy user-centric interactive dashboards and cohesive data stories that effectively drive data-driven decision-making.		
Course Outcomes	**On successful completion of the course the students shall be able to:**		
	CO1	Explain fundamental concepts and cognitive design principles of data visualization.	Understand
	CO2	Prepare and clean raw datasets for effective visualization pipelines.	Apply
	CO3	Select appropriate chart types based on data attributes and analytical goals.	Analyze
	CO4	Design interactive dashboards and visual stories using modern visualization tools.	Analyze
	CO5	Compare histogram and Junk charts	Analyze
Course Content:			
Module 1	Foundations of Visualization		3 Sessions
Topics:			

Introduction to data visualization and its importance. The visualization pipeline: Data collection to perception. Human visual perception, pre-attentive attributes, and Gestalt principles. Data types (quantitative, categorical, ordinal) and visual encoding.		
Module 2	Core Chart Types and Design Principles	3 Sessions
Topics: Comparison and distribution charts: Bar charts, histograms, box plots. Trend and relationship charts: Line graphs, scatter plots, bubble charts. Common visualization pitfalls, junk charts, and the data-ink ratio. Color theory, palettes, and accessibility (color blindness considerations).		
Module 3	Visualizing Complex Data Structures	3 Sessions
Topics: Time-series data: Geospatial tracking, seasonal decompositions. Geospatial visualization: Choropleth maps, dot density maps, map projections. Hierarchical and network data: Tree maps, sunburst charts, node-link diagrams. High-dimensional data visualization techniques.		
Module 4	Interaction and Dashboard Design	3 Sessions
Topics: Permissions and Device Features, API Integration and Networking, Firebase Basics, Testing and Debugging, App Security Best Practices, APK Generation and Application Deployment to Play Store.		
Module 5	Ethics and Advanced Trends	3 Sessions
Topics: Ethics in data visualization: Avoiding distortion, bias, and misleading scales. Overview of the visualization ecosystem (Tableau, Power BI, D3.js, Python ecosystems). Big data visualization challenges and down sampling techniques. Future trends: Immersive analytics (AR/VR) and automated insights.		
List of Experiments		60 Sessions

Phase 1: Tool Foundations & Data Prep (12 Hours)

- **Lab 1-2 (4 Hrs):** Environment setup. Basic data cleaning, parsing, and data type formatting using Python (Pandas) or Tableau Prep.
- **Lab 3-4 (4 Hrs):** Implementing basic chart types (Bar, Line, Pie) in Python (Matplotlib/Seaborn) and Tableau.
- **Lab 5-6 (4 Hrs):** Customizing visual encodings: Applying colour palettes, adjusting fonts, and modifying axis scales to maximize the data-ink ratio.

Phase 2: Advanced Charting & Multi-Dimensional Data (16 Hours)

- **Lab 7-8 (4 Hrs):** Creating advanced statistical plots: Box plots, violin plots, and scatter plot matrices to identify outliers.
- **Lab 9-10 (4 Hrs):** Building time-series visualizations: Dual-axis charts, area charts, and heatmaps to reveal temporal trends.
- **Lab 11-12 (4 Hrs):** Developing geospatial visualizations: Generating choropleth and symbol maps using shapefiles and coordinates.
- **Lab 13-14 (4 Hrs):** Visualizing networks and hierarchies: Constructing tree maps, sunbursts, and interactive network graphs.

Phase 3: Interactivity & Dashboard Development (16 Hours)

- **Lab 15-16 (4 Hrs):** Implementing basic interactivity: Creating dynamic filters, parameters, and tooltips in Tableau or Power BI.
- **Lab 17-18 (4 Hrs):** Advanced interactions: Developing cross-filtering, brushing, and drill-down functionalities.
- **Lab 19-20 (4 Hrs):** Creating web-based interactive visualizations using Python libraries like Plotly and Dash.
- **Lab 21-22 (4 Hrs):** Designing a multi-view operational dashboard applying visual hierarchy and grid layouts.

Phase 4: Capstone Project & Visual Storytelling (16 Hours)

- **Lab 23-24 (4 Hrs):** Project ideation, dataset selection, data cleaning, and wireframe designing.
- **Lab 25-26 (4 Hrs):** Developing a comprehensive, interactive dashboard using an exploratory dataset.
- **Lab 27-28 (4 Hrs):** Building a data narrative story-board to guide a user through key analytical insights.
- **Lab 29-30 (4 Hrs):** Peer evaluation, accessibility testing, dashboard optimization, and final project presentations.

Text Books	
T1	Claus O. Wilke, *Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures, O'Reilly Media*
T2	Kieran Healy, *Data Visualization: A Practical Introduction*, Princeton University Press
Reference Books	
R1	Cole Nussbaumer Knaflic. *Storytelling with Data: A Data Visualization Guide for Business Professionals, Wiley*
E-Resources	• https://github.com/clauswilke/dataviz • https://libraryskills.io/resource/data-visualization-a-practical-introduction/

CSA3521 HADOOP FRAMEWORK

Course Code: CSA3521	**Course Name: HADOOP FRAMEWORK** **Type of Course:** Theory Integrated Lab Course	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	Linux Operating System & Shell Scripting		
Anti-requisites	NIL		
Course Description	To provide students with a solid foundation in big data architecture, enabling them to configure distributed storage, write parallel processing applications, manage data warehouses, and orchestrate large-scale automated data pipelines.		
Course Objective	Teach the core principles of human visual perception, cognitive load, and design ethics required to build accurate, non-misleading visual encodings. Train students to programmatically clean, restructure, and map diverse datasets (temporal, geospatial, and hierarchical) for optimal visualization. Provide rigorous, hands-on mastery of industry-standard visualization libraries (such as Python's Plotly/Seaborn) and business intelligence tools. Enable students to design, develop, and deploy user-centric interactive dashboards and cohesive data stories that effectively drive data-driven decision-making.		
Course Outcomes	**On successful completion of the course the students shall be able to:**		

CO1	Explain the architecture, master-slave topologies, and processing paradigms of the Apache Hadoop framework.	Understand
CO2	Configure a multi-node cluster and execute automated data ingestion from external databases.	Apply
CO3	Optimize parallel data workloads and write complex analytical schemas over distributed data warehouses.	Analyze
CO4	Design, schedule, and deploy end-to-end, fault-tolerant big data processing workflows.	Analyze
CO5	Comparison between MapReduce and Yarn	Analyze

Course Content:		
Module 1	Core Big Data Infrastructure & HDFS	4 Sessions

Topics:

Big Data introduction: The 5 Vs, data growth limits, and distributed systems evolution. Hadoop Ecosystem: Core components overview and master-slave architecture layout. Hadoop Distributed File System (HDFS): NameNode, Data

Node, Secondary NameNode duties. HDFS Operations: Block sizing, replication mechanics, rack awareness, and read/write pipelines.

Module 2	Distributed Processing with MapReduce & YARN	4 Sessions

Topics:

MapReduce paradigm: Mapper, Shuffling, Sorting, Combiner, Partitioner, and Reducer stages. Data formats: Input splits, record readers, key-value serialization, and standard file formats. Yet Another Resource Negotiator (YARN): Resource Manager, Node Manager, and Application Master. YARN cluster resource scheduling, container allocation, and job execution lifecycle

Module 3	Distributed Data Warehousing with Apache Hive	4 Sessions

Topics:

Apache Hive overview: Architecture, compilation engine, Metastore variants, and HiveQL vs. SQL. Schema management: Internal (Managed) vs. External tables, structural formats (ORC, Parquet). Optimization techniques: Static and Dynamic Partitioning, Bucketing strategies, and execution plans. Advanced query mechanics: Windowing analytical operations, built-ins, and User Defined Functions (UDFs)

Module 4	Ingestion, Orchestration & Workflow Automation	3 Sessions

Topics:

Data Ingestion layers: Structured vs. unstructured data ingestion challenges. Apache Sqoop: Operational mechanics, parallel RDBMS import/export tasks, and incremental loads. Apache Oozie: Distributed workflow management, Control nodes, Action nodes, and execution DAGs. Cluster Coordination: Overview of Apache ZooKeeper for consensus and high-availability configuration.

List of Experiments	60 Sessions

Module 1 Labs: Cluster Setup & Storage (Weeks 1 - 4)

- **Week 1 (4 Hrs): Environment Provisioning**
  Setting up Linux environments, installing Java JDK, configuring SSH keys, and deploying Hadoop in Single-Node Pseudo-Distributed mode.
- **Week 2 (4 Hrs): Multi-Node Cluster Configuration**
  Editing site configuration files (core-site.xml, hdfs-site.xml, yarn-site.xml), formatting master NameNodes, and launching the distributed cluster services.
- **Week 3 (4 Hrs): HDFS Operations & CLI Command Mastery**
  Using HDFS shell instructions for folder creation, file permissions, data movement, storage profiling, and testing real-time NameNode safe mode behaviors.
- **Week 4 (4 Hrs): Ingestion from Relational Databases**
  Installing MySQL, populating enterprise schemas, and executing Apache Sqoop ingestion parameters to migrate relational tables directly into target HDFS blocks.

Module 2 Labs: Parallel Execution Engine (Weeks 5 - 8)

- **Week 5 (4 Hrs): Fundamental MapReduce Design**
  Developing and executing a foundational Word Count program to manipulate text assets using Driver, Mapper, and Reducer code pipelines.
- **Week 6 (4 Hrs): Custom Optimization in MapReduce**
  Extending the MapReduce processing structure by designing custom Combiners and Partitioners to filter and group log data streams.
- **Week 7 (4 Hrs): Advanced Analytical Processing**
  Developing a MapReduce script to parse web server log structures, clean corrupt lines, map client IPs, and aggregate traffic burst frequencies.
- **Week 8 (4 Hrs): YARN Profile Monitoring**
  Tracking live MapReduce application performance via the YARN Web UI, auditing active resource allocation, killing dangling jobs, and parsing tracking logs.

Module 3 Labs: Data Warehousing (Weeks 9 - 11)

- **Week 9 (4 Hrs): Hive Storage & Schema Construction**
  Setting up Hive, establishing the relational Metastore connection, and constructing Managed vs. External tables mapped onto pre-existing HDFS data dumps.
- **Week 10 (4 Hrs): Hive Partitioning & Optimization**
  Implementing Static and Dynamic Partitioning structures over extensive transaction logs to minimize analytical storage footprint and accelerate query runtimes.

- **Week 11 (4 Hrs): Advanced Querying & Performance Auditing**
  Executing Bucketing strategies on wide tables, running multi-table relational joins, applying windowing formulas, and diagnosing query bottlenecks using the EXPLAIN clause.

Module 4 Labs: Automation & Pipeline Architecture (Weeks 12 - 15)

- **Week 12 (4 Hrs): Sqoop Incremental Pipelines**
  Configuring Apache Sqoop scripts to perform append-only and last-modified incremental updates to safely synchronize transactional RDBMS updates with HDFS directories.
- **Week 13 (4 Hrs): Workflow Orchestration with Oozie**
  Building an Apache Oozie workflow deployment XML template to sequence an active Sqoop data extraction followed by a dependent Hive script evaluation.
- **Week 14 (4 Hrs): Capstone Project Deployment: Architecture & Setup**
  Designing a scalable big data pipeline template using public unstructured datasets, defining data ingestion schemas, and wiring the structural analytical flows.
- **Week 15 (4 Hrs): Capstone Execution, Verification & Presentation**
  Deploying the complete pipeline loop via Oozie, auditing master-slave node loads, logging errors, verifying target table output persistence, and demonstrating data validity.

Text Books

T1 *Tom White, Hadoop: The Definitive Guide (4th Edition), O'Reilly Media*

T2 *Dayong Du , Apache Hive Essentials (2nd Edition), Packt Publishing*

Reference Books

R1 *Mark Grover, Ted Malaska, Jonathan Seidman, & Gwen Shapira. Expert Hadoop Administration: Managing, Tuning, and Securing Spark and Hadoop Clusters, O'Reilly Media*

R2 *Sam R. Alapati , Expert Hadoop Administration: Managing, Tuning, and Securing Spark and Hadoop Clusters, Addison-Wesley Professional*

E-Resources

- https://hadoop.apache.org/docs/r1.2.1/hdfs_design.pdf
- https://homepages.cwi.nl/~boncz/lsde/papers/hdfs_design.pdf
- https://web.cs.dal.ca/~allen/HadoopDefinitiveGuide.pdf

CSA3522 Social Media Analytics

Course Code: CSA3522	**Course Name:** Social Media Analytics **Type of Course:** Theory Integrated Lab Course	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	Data Structures, Python Programming		
Anti-requisites	NIL		
Course Description	To equip students with the knowledge and practical skills to collect, process, analyze, and interpret data from social media platforms, enabling data-driven insights into user behavior, content performance, sentiment, and emerging trends for business and research applications.		
Course Objective	Introduce students to key social media platforms, APIs, and data collection methodologies. Train students to apply natural language processing (NLP) techniques for sentiment analysis and opinion mining. Enable students to measure audience engagement metrics, reach, and virality using statistical and analytical tools. Equip students to design and deploy social media monitoring dashboards and automated reporting pipelines for real-world campaigns.		

Course Outcomes	**On successful completion of the course the students shall be able to:**		
	CO1	Describe the landscape of social media platforms, data types, and key analytics metrics.	Understand
	CO2	Collect and preprocess social media data using APIs and scraping tools for analytics pipelines.	Apply
	CO3	Apply NLP techniques including sentiment analysis, topic modeling, and named entity recognition on social media data.	Analyze
	CO4	Design and develop interactive social media dashboards and automated reporting systems for campaign monitoring.	Analyze
	CO5	Evaluate influencer reach, network propagation, and content virality using graph analytics.	Analyze

Course Content:

Module 1	Introduction to Social Media Analytics	7 Sessions

Topics:

Overview of social media platforms (Twitter/X, Instagram, YouTube, LinkedIn, Reddit). Types of social media data: structured, unstructured, and semi-structured. Key analytics metrics: engagement rate, reach, impressions, CTR, and share of voice. Analytics pipeline: data collection, preprocessing, analysis, and reporting.

Module 2	Data Collection and Preprocessing	8 Sessions

Topics:

Social media APIs: Twitter API v2, Instagram Graph API, YouTube Data API. Web scraping fundamentals using BeautifulSoup and Selenium. Data cleaning: handling missing values, noise removal, deduplication, and normalization. Text preprocessing: tokenization, stop-word removal, stemming, and lemmatization.

Module 3	Sentiment Analysis and NLP for Social Media	8 Sessions

Topics:

Lexicon-based and machine-learning approaches to sentiment classification. Topic modeling: LDA and BERTopic for trend identification. Named entity recognition (NER) for brand and influencer mentions. Emotion detection and opinion mining using pre-trained transformer models.

Module 4	Engagement Metrics and Network Analysis	7 Sessions

Topics:

Engagement measurement: likes, comments, shares, retweets, and saves. Virality models: cascade analysis and information diffusion. Social network analysis (SNA): centrality measures, clustering, and community detection using NetworkX. Influencer identification: follower analysis, engagement ratios, and authority scores.

List of Experiments	30 Sessions

Phase 1: Data Collection & Preprocessing (6 Hours)

- **Experiment 1 (2 Hrs):** Setting up Python environment and collecting data from Twitter/X API v2 using Tweepy; filter tweets by hashtag, keyword, and date range.
- **Experiment 2 (2 Hrs):** Web scraping public social media data from Reddit using PRAW and Instagram using Instaloader; store collected data in structured JSON and CSV formats.
- **Experiment 3 (2 Hrs):** Text preprocessing pipeline: implementing tokenization, stop-word removal, stemming (PorterStemmer), and lemmatization (spaCy) on a collected tweet dataset using NLTK.

Phase 2: Sentiment Analysis & NLP (8 Hours)

- **Experiment 4 (2 Hrs):** Lexicon-based sentiment analysis using VADER and TextBlob on a product-review tweet dataset; compute positive, negative, and neutral scores and visualize distribution using Matplotlib.
- **Experiment 5 (2 Hrs):** Machine learning-based sentiment classification using Scikit-learn (Logistic Regression, Naive Bayes) on a labelled Twitter dataset; evaluate model performance using accuracy, precision, recall, and F1-score.
- **Experiment 6 (2 Hrs):** Fine-tuning a pre-trained BERT model (HuggingFace Transformers) for sentiment analysis on a social media corpus; compare results with VADER and Scikit-learn classifiers.
- **Experiment 7 (2 Hrs):** Topic modeling on Reddit posts using LDA (Gensim); extract top topics, generate coherence scores, and visualize topic clusters using pyLDAvis.

Phase 3: Engagement Metrics & Network Analysis (8 Hours)

- **Experiment 8 (2 Hrs):** Computing engagement metrics (likes, retweets, replies, engagement rate) for a sample brand campaign dataset; identify top-performing posts using Pandas and rank them with visualizations in Seaborn.

- **Experiment 9 (2 Hrs):** Constructing a retweet network graph using NetworkX; compute degree centrality, betweenness centrality, and PageRank to identify key influencer nodes.
- **Experiment 10 (2 Hrs):** Community detection in a social network using Louvain algorithm; visualize detected communities using Gephi-exported data and colour-coded network graphs in Python.
- **Experiment 11 (2 Hrs):** Trend detection and virality analysis: tracking hashtag frequency over time using time-series plots and computing cascade depth and breadth for viral tweets.

Phase 4: Dashboards & Capstone (8 Hours)

- **Experiment 12 (2 Hrs):** Building an interactive social media analytics dashboard using Plotly Dash; display KPI cards, sentiment trends, and word clouds from a live Twitter stream.
- **Experiment 13 (2 Hrs):** Designing a brand monitoring report in Power BI: connecting to a social media data source, creating slicers for platform and date filters, and building a multi-page reporting template.
- **Experiment 14 (2 Hrs):** Crisis analytics lab: simulate a negative brand sentiment event, detect sentiment spike using automated alerting logic in Python, and generate a crisis response summary report.
- **Experiment 15 (2 Hrs):** Capstone project: end-to-end social media analytics pipeline — collect data from a chosen platform, preprocess, perform sentiment and network analysis, and present findings in a fully deployed Dash dashboard with narrative insights.

Text Books

T1	Lada A. Adamic & Bernardo A. Huberman. *Social Media Mining: An Introduction, Cambridge University Press*
T2	Matthew A. Russell & Mikhail Klassen. *Mining the Social Web, O'Reilly Media*

Reference Books

R1	Gary King, Jennifer Pan & Margaret Roberts. *Computational Social Science: Discovery and Prediction, Cambridge University Press*

Reference Books

E-Resources

- https://developer.twitter.com/en/docs
- https://huggingface.co/docs/transformers

CSA3523 Generative AI and Prompt Engineering

Course Code: CSA3523	**Course Name:** Generative AI and Prompt Engineering **Type of Course:** Theory Integrated Lab Course	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	Python Programming, Introduction to Machine Learning		
Anti-requisites	NIL		
Course Description	To provide students with a comprehensive understanding of generative AI architectures, large language models, and the systematic design of effective prompts, enabling them to build, evaluate, and deploy AI-powered applications across diverse real-world domains.		
Course Objective	Introduce students to the foundations of generative AI including transformer architectures, diffusion models, and large language models (LLMs). Equip students with structured prompt engineering techniques such as zero-shot, few-shot, chain-of-thought, and retrieval-augmented generation (RAG). Enable students to evaluate, fine-tune, and align LLMs using RLHF and parameter-efficient methods. Train students to build and deploy AI-powered applications using OpenAI, HuggingFace, and LangChain frameworks responsibly.		

Course Outcomes	**On successful completion of the course the students shall be able to:**		
	CO1	Explain the architecture and working principles of transformer-based generative AI models and diffusion models.	Understand
	CO2	Apply structured prompt engineering strategies (zero-shot, few-shot, chain-of-thought, RAG) to solve domain-specific tasks.	Apply
	CO3	Analyze and evaluate LLM outputs using standard benchmarks and compare fine-tuning strategies including LoRA and PEFT.	Analyze
	CO4	Design and develop AI-powered applications using LangChain, vector databases, and multimodal generative models.	Analyze
	CO5	Evaluate ethical considerations, safety alignment techniques, and responsible deployment of generative AI systems.	Analyze

Course Content:

Module 1	Introduction to Generative AI and Prompt Engineering	3 Sessions

Topics:

History and evolution of generative AI: from GANs to diffusion models and LLMs. Transformer architecture: self-attention, multi-head attention, positional encoding. Overview of foundation models: GPT series, BERT, T5, LLaMA, and Stable Diffusion. Generative AI taxonomy: text, image, audio, video, and code generation.

Module 2	Prompt Engineering Techniques	3 Sessions

Topics:

Zero-shot, one-shot, and few-shot prompting: design principles and use cases. Chain-of-thought (CoT) prompting and self-consistency decoding strategies. Persona, role, and instruction-based prompting for task specialization. Prompt chaining, prompt templates, and systematic prompt debugging techniques.

Module 3	Retrieval-Augmented Generation and LLM Evaluation	3 Sessions

Topics:

RAG pipeline: document loading, chunking, embedding, vector stores (FAISS, ChromaDB), and retrieval. LLM evaluation metrics: BLEU, ROUGE, BERTScore, perplexity, and human evaluation frameworks. Benchmarking LLMs: MMLU, HellaSwag, TruthfulQA, and HumanEval. Hallucination detection, factual grounding, and output calibration strategies.

Module 4	Fine-Tuning, App Development and Ethics	3 Sessions

Topics:

Parameter-efficient fine-tuning: LoRA, QLoRA, and prefix-tuning with HuggingFace PEFT. RLHF and Direct Preference Optimization (DPO) for alignment. LangChain framework: chains, agents, memory, and multi-step reasoning pipelines. Multimodal models: CLIP, GPT-4V, DALL-E 3 for text-to-image and visual Q&A tasks. AI safety: bias, toxicity, jailbreaking, prompt injection, and responsible deployment.

List of Experiments	30 Sessions

Phase 1: LLM Exploration & Prompt Design (6 Hours)

- **Experiment 1 (2 Hrs):** Exploring OpenAI API (GPT-4o) and HuggingFace Inference API: configure API keys, send structured requests, adjust temperature, top-p, and max-tokens parameters, and compare outputs across models.
- **Experiment 2 (2 Hrs):** Designing and comparing zero-shot, one-shot, and few-shot prompts for classification, summarization, and translation tasks; evaluate output quality and document prompt pattern observations.
- **Experiment 3 (2 Hrs):** Implementing chain-of-thought (CoT) prompting and self-consistency decoding for multi-step arithmetic and logical reasoning problems; compare CoT vs. standard prompts on a benchmark dataset.

Phase 2: RAG, Evaluation & Fine-Tuning (8 Hours)

- **Experiment 4 (2 Hrs):** Building a RAG pipeline using LangChain and FAISS: load a PDF corpus, generate embeddings with sentence-transformers, store in a vector database, and retrieve context-aware answers using GPT-4o.
- **Experiment 5 (2 Hrs):** Evaluating LLM outputs using BLEU, ROUGE-L, and BERTScore on a text summarization task; detect hallucinations by cross-referencing outputs against source documents and compute faithfulness scores.
- **Experiment 6 (2 Hrs):** Parameter-efficient fine-tuning using LoRA (HuggingFace PEFT) on a small LLM (e.g., LLaMA-3-8B) for a domain-specific classification task; compare base model vs. LoRA-adapted model accuracy and inference latency.
- **Experiment 7 (2 Hrs):** Benchmarking two open-source LLMs (e.g., Mistral-7B vs. LLaMA-3-8B) on a custom Q&A dataset using MMLU-style prompts; record accuracy, latency, and cost metrics in a comparative report.

Phase 3: Application Development & Multimodal AI (8 Hours)

- **Experiment 8 (2 Hrs):** Building a multi-turn conversational chatbot using LangChain ConversationChain with memory (ConversationBufferMemory); deploy with a Gradio interface and test context retention across 10 turns.
- **Experiment 9 (2 Hrs):** Developing an LLM-powered autonomous agent using LangChain Agents with tool use (web search, Python REPL, calculator); design a multi-step task and observe agent reasoning traces.
- **Experiment 10 (2 Hrs):** Multimodal prompting with GPT-4V and CLIP: provide image + text prompts for visual question answering, image captioning, and object reasoning; compare responses with text-only prompts.
- **Experiment 11 (2 Hrs):** Text-to-image generation using Stable Diffusion (diffusers library): craft positive and negative prompts, adjust CFG scale and inference steps, and evaluate image quality using FID and CLIP-score metrics.

Phase 4: Ethics, Safety & Capstone (8 Hours)

- **Experiment 12 (2 Hrs):** AI safety and red-teaming: test a deployed LLM chatbot for prompt injection, jailbreaking attempts, and toxic output generation; document vulnerabilities and implement system prompt guardrails to mitigate risks.
- **Experiment 13 (2 Hrs):** Bias detection and mitigation in LLM outputs: evaluate an LLM on gender, ethnicity, and occupational bias using WinoBias and StereoSet benchmarks; apply debiasing prompt strategies and measure improvement.
- **Experiment 14 (2 Hrs):** Designing a production-ready prompt library: create a versioned collection of reusable, tested prompt templates for summarization, classification, code generation, and Q&A; document performance metrics and failure modes for each template.
- **Experiment 15 (2 Hrs):** Capstone project: design, build, and deploy an end-to-end generative AI application (e.g., an intelligent study assistant with RAG, multimodal input, and guardrails) using LangChain and Streamlit; present with evaluation report, model card, and responsible use documentation.

Text Books

T1	Chip Huyen. *AI Engineering: Building Applications with Foundation Models, O'Reilly Media*
T2	Ben Auffarth. *Mining the Social Web, O'Reilly Media*

Reference Books

R1	Ashish Vaswani et al. *Attention Is All You Need, NeurIPS 2017 (Seminal Research Paper)*

Reference Books

E-Resources

- https://platform.openai.com/docs
- https://python.langchain.com/docs

Track 4: Cyber Security & Ethical Hacking

CSA3524 Fundamentals of Cyber Security

Course Code: CSA3524	Course Title: Fundamentals of Cyber Security Type of Course: Program Core –Theory	L-T-P-C	3	0	0	3
Version No.	1.0					

Course Pre-requisites	CSA2502-Computer Networks			
Anti-requisites	NIL			
Course Description	This course introduces the fundamental concepts of cybersecurity, cyber threats, and security mechanisms used to protect digital information and computing systems. Students will learn about network security, cryptography, cyber laws, ethical hacking, and best practices for securing information systems. The course emphasizes awareness of modern cyber threats and the implementation of preventive and defensive security measures in real-world environments.			
Course Objective	The objective of the course is to provide an understanding of the fundamental concepts and importance of cybersecurity in protecting digital systems and information. It also introduces cyber laws, ethical practices, and security policies required for responsible and secure use of technology.			
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Explain the fundamentals of cybersecurity, cyber threats, and security principles. [Understand] CO2: Describe common cyber attacks, vulnerabilities, and security risks in digital systems. [Understand] CO3: Apply basic security mechanisms to protect networks and information systems. [Apply] CO4: Demonstrate the use of cryptographic techniques for securing digital information. [Apply] CO5: Analyze security vulnerabilities and potential threats in networked environments. [Analyze] CO6: Analyze cyber laws, ethical issues, and professional practices in cybersecurity. [Analyze]			
Course Content				
Module 1	Introduction to Cyber Security	Assignment	Problem Solving	12 Sessions
Introduction to Cyber Security, Need and Importance of Cyber Security, Cyber Space and Cyber Threat Landscape , Types of Cyber Attacks: Malware,Virus,Worms,Trojan Horse ,Ransomware , Spyware,.. Phishing, Spoofing, and Social Engineering Attacks , CIA Triad: Confidentiality, Integrity, Availability ,.. Cyber Security Challenges and Emerging Trends, Risk Management and Security Awareness				
Module 2	Network and System Security	Assignment	Problem Solving	12 Sessions
Basics of Network Security, Network Vulnerabilities and Threats, Firewalls and Types of Firewalls,Intrusion Detection System (IDS) and Intrusion Prevention System (IPS),Virtual Private Networks (VPN),Secure Communication Protocols: HTTPS, SSL/TLS, SSH , Wireless Network Security , Wi-Fi Security Standards: WPA, WPA2, WPA3 ,System Security and Endpoint Protection , Antivirus and Anti-malware Tools				
Module 3	Cryptography and Data Security	Assignment	Problem Solving	11 Sessions
Introduction to Cryptography, Plain Text and Cipher Text,Symmetric Key Cryptography, Asymmetric Key Cryptography ,Encryption and Decryption Techniques ,Cryptographic Algorithms: AES, DES, RSA, Hash Functions and Digital Signatures ,Authentication and Authorization, Password Security and Multi-factor Authentication , Public Key Infrastructure (PKI) , Data Backup and Recovery Techniques				
Module 4	Cyber Laws, Ethics, and Security Practices	Assignment	Problem Solving	10 Sessions
Cyber Laws and Cyber Crime, Information Technology Act 2000 (India),Digital Privacy and Data Protection, Ethical Hacking Fundamentals, Penetration Testing Basics ,Cyber Forensics Overview, Incident Response and Disaster Recovery, Security Policies and Standards,Cyber Ethics and Professional Responsibility,Career Opportunities in Cyber Security				
Targeted Application & Tools that can be used: Wireshark, Nmap				

Case Study/Assignment: Assignment proposed for this course in CO1-CO4 1. A company employee receives an email asking for banking credentials with an urgent payment request. As a cybersecurity analyst, identify the type of attack and explain the preventive measures that should be taken. 2. A college computer lab is frequently infected by malware through USB devices. Suggest suitable security mechanisms and policies to prevent such attacks. 3. An organization's website becomes unavailable due to heavy unwanted traffic from multiple systems. Identify the attack and explain how the organization can mitigate it. 4. A user connects to a public Wi-Fi network and later notices unauthorized access to personal accounts. Explain the possible security risks involved and suggest preventive measures.
Problem Solving: Choose and appropriate devices and implement various cyber crime issues
Text Book 1. Cryptography and Network Security, Pearson Education, 6th/7th Edition. 2. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India Publications, 1st Edition. 3. Fundamental of Cyber Security: Principles, Theory and Practices, BPB Publications.
References 1. Network Security Essentials, Pearson Education. 2. Principles of Information Security, Cengage Learning. 3. Cyber Security Essentials, CRC Press. 4. Information Systems Security, Wiley India Publications. Web Based Resources and E-books: NPTEL Courses on Cyber Security – Video lectures and course materials from IITs. SANS Institute Resources – Cybersecurity training materials, white papers, and research resources. IBM Cybersecurity Learning Hub – E-books, tutorials, and cybersecurity concepts.

CSA3525 Data Ethics and Privacy

Course Code: CSA3525	Course Title: Data Ethics and Privacy Type of Course: Program Core –Theory	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSA2502-Computer Networks					
Anti-requisites	NIL					
Course Description	This course introduces the principles of data ethics, privacy, and responsible data management in the digital world. It covers ethical issues related to data collection, storage, sharing, and usage, along with techniques for protecting sensitive information. And enabling students to understand the importance of ethical and secure data handling in modern organizations.					
Course Objective	The objective of the course is to provide an understanding of the fundamental concepts and importance of cybersecurity in protecting digital systems and information and focuses on legal frameworks, regulatory compliance, and emerging challenges related to data ethics and privacy in modern technologies..					
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Explain the fundamental concepts of data ethics and privacy principles. [Understand] CO2: Describe ethical issues and responsible practices in data collection, storage, and usage. [Understand] CO3: Apply data protection techniques and privacy-preserving methods for secure data handling. [Apply]					

	CO4: Implement privacy and security measures to safeguard sensitive information. [Apply] CO5: Interpret legal, ethical, and regulatory frameworks related to data privacy and protection. [Analyze] CO6: Analyze emerging ethical and privacy challenges in modern digital technologies. [Analyze]			
Course Content				
Module 1	Introduction to Data Ethics and Privacy	Assignment	Problem Solving	12 Sessions
Introduction to Data Ethics and Data Privacy, Importance of Ethical Data Practices, Privacy vs Security, Types of Data: Personal, Sensitive, Public, and Confidential Data, Ethical Issues in Data Collection and Usage, Principles of Data Ethics: Fairness, Accountability, Transparency,.. Data Ownership and Consent, Privacy Challenges in the Digital Era				
Module 2	Data Protection and Privacy Techniques	Assignment	Problem Solving	12 Sessions
Fundamentals of Data Protection, Data Classification and Data Handling, Encryption and Decryption Techniques, Authentication and Access Control, Multi-Factor Authentication (MFA), Data Anonymization and Masking, Secure Data Storage and Backup, Privacy-Preserving Technologies				
Module 3	Legal, Regulatory, and Ethical Frameworks	Assignment	Problem Solving	11 Sessions
Cyber Laws and Data Privacy Laws, General Data Protection Regulation (GDPR), Indian IT Act and Personal Data Protection Framework, Intellectual Property Rights and Digital Rights Ethical Issues in Artificial Intelligence and Big Data, Data Breaches and Legal Responsibilities, Professional Ethics in Data Management, Organizational Privacy Policies and Compliance				
Module 4	Emerging Trends and Challenges in Data Ethics and Privacy	Assignment	Problem Solving	10 Sessions
Ethics in Artificial Intelligence and Machine Learning, Social Media Privacy and Digital Footprints, Privacy Risks in Cloud Computing and IoT, Surveillance, Tracking, and Behavioral Analytics, Blockchain and Privacy, Case Studies : on Data Misuse and Privacy Violations, Future Trends in Data Ethics and Privacy				
Targeted Application & Tools that can be used: Wireshark, Nmap				
Case Study/Assignment: Assignment proposed for this course in CO1-CO4 5. A social media company collects user browsing history without clearly informing users. Identify the ethical and privacy issues involved and suggest how transparency can be improved. 6. A hospital stores patient records digitally and experiences unauthorized access to sensitive medical information. Explain the privacy principles violated and recommend suitable protection measures. 7. An employee shares confidential customer information with an external organization without permission. Discuss the ethical concerns and legal consequences of this action. 8. A mobile application asks users for access to contacts, location, camera, and microphone even though these permissions are not required for its functionality. Analyze the privacy risks associated with this practice.				
Problem Solving: Choose and appropriate devices and implement various cyber crime issues				
Text Book 4. "Ethics in Information Technology" George Reynolds,6th Edition,Cengage Learning 5. "Cryptography and Network Security: Principles and Practice", William Stallings,8th Edition Pearson Education				

6. "Cyber Security and Cyber Laws",Nina Godbole, Sunit Belapure,1st Edition ,Wiley India

References

5. Privacy in the Age of Big Data,,Theresa Payton, Theodore Claypoole ,1st Edition,Rowman & Littlefield Publishers
6. The Ethics of Information,Luciano Floridi,1st Edition,Oxford University Press Web Based Resources and E-books:

NPTEL Courses on Cyber Security – Video lectures and course materials from IITs.
SANS Institute Resources – Cybersecurity training materials, white papers, and research resources.
IBM Cybersecurity Learning Hub – E-books, tutorials, and cybersecurity concepts.
European Union Agency for Cybersecurity (ENISA) – Publications and resources on cybersecurity and privacy.

CSA3526 Cloud Security & System Administration

Course Code: CSA3526	**Course Name:** Cloud Security & System Administration **Type of Course:** Elective Course	L- T-P- C	2-0-2-3
Version No.	1		
Course pre-requisites	Basics of Computer Networks, Operating Systems, and Cyber Security		
Anti-requisites	NIL		
Course Description	This course introduces students to the principles and practices of cloud security and system administration. It covers cloud computing fundamentals, virtualization, identity and access management, secure configuration, monitoring, backup and recovery, incident response, and compliance. The laboratory component provides hands-on training in configuring cloud resources, administering systems, applying security controls, and performing troubleshooting in cloud-based environments.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of cloud security and system administration and develop practical skills through experiential learning.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain cloud computing models, service types, and system administration fundamentals. [Understand] CO2 Configure and manage users, permissions, virtual machines, and storage in cloud environments. [Apply] CO3 Apply security controls such as identity management, network security, encryption, and monitoring. [Apply] CO4 Apply backup, recovery, patch management, and incident response techniques in cloud environments.. [Apply] CO5 Evaluate cloud risks, compliance requirements, and secure administration best practices. [Evaluate]		
Course Content:			
Module 1	Introduction to Cloud and System Administration		8 Sessions
Topics: Cloud computing concepts, deployment and service models, system administration roles, shared responsibility model, cloud security basics, virtualization fundamentals.			
Module 2	Cloud Infrastructure and Administration		8 Sessions
Topics: Cloud accounts and projects, virtual machines, storage management, networking basics, security groups, firewalls, identity and access management, user roles, operating system administration in cloud platforms.			
Module 3	Cloud Security Controls		7 Sessions

Topics: Authentication and authorization, multi-factor authentication, encryption at rest and in transit, key management, logging and monitoring, security configuration management, vulnerability management, patching, backup and recovery.		
Module 4	Operations, Compliance and Incident Handling	7 Sessions
Topics: Configuration management, automation basics, auditing, compliance concepts, incident response workflow, service continuity, disaster recovery planning, troubleshooting, and secure administration best practices.		
List of Experiments		30 Sessions

1. Create cloud accounts, resource groups, or projects.
2. Launch and configure virtual machines with access controls.
3. Create and manage storage buckets, disks, and snapshots.
4. Configure users, roles, and permissions using IAM policies.
5. Set up network security rules, firewall rules, and security groups.
6. Enable logging and monitoring for cloud resources.
7. Configure encryption for storage and data transfer.
8. Perform backup and restore operations for virtual machines or data.
9. Apply OS hardening and patch management on cloud VMs.
10. Use command-line or web-based administration tools for system tasks.
11. Analyze security alerts and basic incident indicators.
12. Simulate account compromise and investigate log evidence.
13. Configure multi-factor authentication for administrative access.
14. Prepare a simple disaster recovery plan for a cloud setup.
15. Mini project: secure and administer a small cloud-based environment.

Text Books

T1 Cloud Security and Privacy, Tim Mather, Subra Kumaraswamy, and Shahed Latif.
T2 System Administration and Maintenance, standard Linux/Windows administration references.

Reference Books

R1 NIST cloud computing publications and security guidance.
R2 Cloud provider documentation for IAM, monitoring, networking, and security.
R3 Security best practices and incident response guidance from recognized cybersecurity agencies

E-Resources

1. https://www.cisa.gov/topics/cloud-security?utm_source=chatgpt.com
2. https://www.cisa.gov/topics/cloud-security?utm_source=chatgpt.com
3. https://www.sans.org/cloud-security/?utm_source=chatgpt.com
4. https://www.autopsy.com/support/documentation/?utm_source=chatgpt.com

CSA3527 Digital Forensics

Course Code: CSA3527	**Course Name:** Digital Forensics **Type of Course:** Elective Course	L- T-P- C	2-0-2-3
Version No.	1		
Course pre-requisites	Basics of Computer Networks, Operating Systems, and Cyber Security		
Anti-requisites	NIL		

Course Description	This course introduces students to the principles, tools, and techniques used in digital forensics and cybercrime investigations. The course covers evidence acquisition, file system analysis, network forensics, mobile forensics, malware analysis, and legal aspects of digital evidence handling. Students will gain practical exposure to forensic tools and investigative procedures used in real-world cybercrime investigations. The laboratory component provides hands-on training in collecting, preserving, analyzing, and reporting digital evidence.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital Forensics and attain Employability Skills through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:**		
	CO1	Explain the fundamentals of digital forensics and cybercrime investigation	[Understand]
	CO2	Identify and preserve digital evidence using standard forensic procedures	[Apply]
	CO3	Analyze file systems, logs, and storage devices using forensic tools	[Apply]
	CO4	Analyze network traffic and mobile devices using forensic investigation techniques.	[Apply]
	CO5	Apply forensic techniques for malware and cyber incident analysis	[Apply]
Course Content:			
Module 1	Introduction to Digital Forensics		8 Sessions
Topics: Introduction to digital forensics, Cybercrime investigation process, Types of digital evidence, Forensic investigation methodology, Evidence acquisition and preservation, Chain of custody, Legal and ethical considerations, Digital forensic tools overview.			
Module 2	Disk and File System Forensics		8 Sessions
Topics: Disk structure and partitions, File systems: FAT, NTFS, EXT, Data acquisition techniques, Deleted file recovery, Metadata analysis, Registry analysis, Email and browser forensics, Log analysis.			
Module 3	Network and Web Forensics		7 Sessions
Topics: Introduction to network forensics, Packet capturing and analysis, Network traffic monitoring, Firewall and IDS logs, Web attack investigation, Email tracing, Web server forensics, Cloud forensic concepts.			
Module 4	Mobile and Malware Forensics		7 Sessions
Topics: Mobile device forensics, Android and iOS forensic concepts, SIM and memory analysis, Malware analysis fundamentals, Static and dynamic malware analysis, Incident response procedures, Ransomware investigation basics.			
List of Experiments			30 Sessions
1. Install and configure digital forensic tools such as Autopsy and FTK Imager. 2. Create and analyze forensic images of storage devices using forensic acquisition tools. 3. Recover deleted files and folders from a storage device using forensic software. 4. Examine file metadata, timestamps, and hidden attributes from digital evidence. 5. Analyze Windows registry files and system logs for forensic investigation. 6. Perform browser forensic analysis to identify browsing history, cookies, and downloads. 7.Capture and analyze network packets using Wireshark for suspicious activity detection. 8. Investigate phishing emails by analyzing email headers and attachments. 9. Perform web forensic analysis to identify traces of web attacks and unauthorized access. 10. Conduct basic Android mobile forensic analysis using open-source forensic tools. 11. Perform static malware analysis to identify suspicious executable behavior. 12. Generate and document forensic investigation reports using standard reporting formats. 13.Investigate a simulated cybercrime case involving unauthorized system access. 14. Analyze cloud storage artifacts and recover digital evidence from cloud platforms. 15. Mini Project: Perform end-to-end digital forensic investigation and prepare a case report.			

Text Books
T1 Nelson, Phillips, and Steuart, *Guide to Computer Forensics and Investigations*, Cengage Learning. **T2** Bill Nelson, Amelia Phillips, Christopher Steuart, *Computer Forensics and Cyber Crime Investigation*, Cengage Learning.
Reference Books
R1 Eoghan Casey, *Digital Evidence and Computer Crime*, Academic Press. **R2** Jason Luttgens, Matthew Pepe, and Kevin Mandia, *Incident Response and Computer Forensics*, McGraw-Hill.
E-Resources 1. https://developer.mozilla.org/en-US/ 2. https://www.w3schools.com/ 3. https://www.php.net/manual/en/ 4. https://api.jquery.com/ 5. https://www.wireshark.org/docs/

CSA3528 Cyber Security Tools and Practices

Course Code: CSA3528	**Course Name:** Cyber Security Tools and Practices **Type of Course:** Elective Course	L- T-P- C	2-0-2-3
Version No.	1		
Course pre-requisites	Basics of computer networks, operating systems, and programming fundamentals		
Anti-requisites	NIL		
Course Description	This course introduces the principles, tools, and practices required for securing modern computing environments. Students will learn cyber security fundamentals, network security tools, vulnerability assessment, system hardening, encryption, incident response, and defensive security operations using industry-standard tools such as Kali Linux, Wireshark, Nmap, OpenVAS, Burp Suite, OWASP ZAP, Hydra, and John the Ripper. The laboratory component emphasizes practical security analysis, safe testing, remediation, and reporting skills.		
Course Objective	The objective of the course is to enable learners to: • Understand core cyber security principles, threats, vulnerabilities, and controls. • Use common security tools for monitoring, assessment, and analysis. • Apply secure configuration, encryption, and access-control practices. • Perform controlled vulnerability assessment and defensive security validation. • Prepare security reports and remediation recommendations in a professional format.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain cyber security fundamentals, attack surfaces, and defensive security concepts. [Understand] CO2 Use network security tools for traffic analysis, host discovery, and service identification. [Apply] CO3 Perform vulnerability assessment and basic system hardening in a lab environment. [Apply] CO4 Apply encryption, authentication, and password security practices to protect data. [Apply] CO5 Analyse security incidents and prepare a structured response report. [Analyse] CO6 Create a secure defensive workflow using practical security tools and documented findings [Create]		
Course Content:			

Module 1	Cyber Security Fundamentals and Network Security Tools	8 Sessions
Topics: Introduction to cyber security, CIA triad, threats, vulnerabilities, risk, attack surface, security controls, network basics, Linux security basics, packet structure, traffic analysis, Wireshark installation, capture filters, display filters, Nmap fundamentals, host discovery, port scanning, service identification, safe lab practices.		
Module 2	Vulnerability Assessment and System Security	8 Sessions
Topics: Vulnerability management lifecycle, asset identification, OpenVAS basics, scan configuration, severity interpretation, patching and remediation, user and privilege management, system hardening, firewall concepts, secure service configuration, log analysis, password policies, Hydra for controlled authentication testing, John the Ripper for password auditing, defensive security checks.		
Module 3	Encryption, Web Security, and Defensive Testing	7 Sessions
Topics: Encryption concepts, symmetric and asymmetric cryptography, hashing, certificates, TLS basics, secure file handling, web security basics, Burp Suite basics, OWASP ZAP passive scanning, input validation, session security, secure authentication practices, common web risks, baseline web application assessment.		
Module 4	Incident Response and Case Studies	7 Sessions
Topics: Incident response lifecycle, preparation, detection, containment, eradication, recovery, evidence preservation, alert triage, documentation, reporting, case studies of common attacks, security operations workflow, defensive best practices, mock incident handling, mini project on security posture assessment and response plan.		
List of Experiments		15 Sessions

1. Set up a cybersecurity lab using Kali Linux and verify core security utilities.
2. Capture and analyse network packets using Wireshark to identify protocols and suspicious traffic.
3. Perform host discovery and service enumeration on a lab network using Nmap.
4. Conduct version detection and safe scan-based assessment using Nmap in a controlled environment.
5. Install, configure, and run an OpenVAS scan against a local target machine.
6. Interpret OpenVAS findings and prepare a remediation summary.
7. Analyse system users, groups, permissions, and running services for hardening.
8. Configure firewall rules and verify allowed and blocked traffic.
9. Demonstrate hashing and password policy checks using Linux tools.
10. Use John the Ripper to audit weak password hashes in a lab dataset.
11. Perform a controlled login attack demonstration using Hydra on a local test service.
12. Analyse HTTPS/TLS traffic basics and certificate details using browser and packet traces.
13. Use Burp Suite to intercept and inspect requests from a test web application.
14. Use OWASP ZAP passive scan to identify common web application weaknesses in a lab app.
15. Prepare a security incident report based on a simulated scan, packet trace, and remediation plan.

Text Books

T1 William Stallings and Lawrie Brown, *Computer Security: Principles and Practice*, Pearson, Latest Edition.

T2 Michael T. Goodrich and Roberto Tamassia, *Introduction to Computer Security*, Pearson, Latest Edition.

Reference Books

R1 Neil Daswani, Christoph Kern, Anita Kesavan, *Foundations of Security: What Every Programmer Needs to Know*, Apress.

R2 Kim Traynor, *Practical Linux Security Cookbook*, Packt Publishing, Latest Edition.

R3 David A. Wheeler, *Secure Programming HOWTO* and related security resources.

R4 NIST Special Publications on incident handling and security controls.

E-Resources

1. https://www.kali.org/
2. https://www.wireshark.org/docs/
3. https://nmap.org/book/man.html

4. OpenVAS / Greenbone Documentation
5. OWASP Top 10
6. OWASP ZAP Documentation
7. NIST SP 800-61 Incident Handling Guide
8. Burp Suite Documentation

CSA3529 Ethical Hacking

Course Code: CSA3529	**Course Name:** Ethical Hacking **Type of Course:** Elective Course	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	Basics of computer networks, Linux fundamentals, and introductory		
Anti-requisites	NIL		
Course Description	This course provides a structured introduction to ethical hacking methodology for undergraduate students, covering reconnaissance, footprinting, scanning, enumeration, vulnerability validation, web application security, wireless security, password attacks in controlled environments, penetration testing workflow, post-exploitation concepts at a safe level, and reporting. Students will use widely adopted tools such as Kali Linux, Nmap, Metasploit, Burp Suite, OWASP ZAP, Aircrack-ng, Hydra, and John the Ripper within legally authorized lab setups. The laboratory emphasizes ethical conduct, documentation, and responsible disclosure rather than advanced exploit development.		
Course Objective	The objective of the course is to enable learners to: • Understand ethical hacking concepts, legal boundaries, and rules of engagement. • Perform reconnaissance, scanning, and enumeration using approved tools. • Validate vulnerabilities in web, network, and wireless environments safely. • Use industry-standard tools for controlled penetration testing exercises. • Prepare professional reports with findings, risks, and remediation suggestions.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain ethical hacking stages, legal considerations, and rules of engagement. [Understand] CO2 Perform reconnaissance, footprinting, scanning, and enumeration using approved tools. [Apply] CO3 Use Metasploit, Burp Suite, OWASP ZAP, and Kali Linux tools for controlled testing. [Apply] CO4 Analyse vulnerabilities in web and wireless environments and validate findings safely. [Analyse] CO5 Evaluate post-exploitation information and create a structured penetration test report. [Evaluate] CO6 Design a full lab-based penetration testing workflow and document remediation. [Create]		
Course Content:			
Module 1	Ethical Hacking Foundations and Reconnaissance		4 Sessions

Topics: Ethical hacking concepts, law and authorization, rules of engagement, hacking lifecycle, footprinting, passive reconnaissance, active reconnaissance, OSINT basics, target profiling, DNS and WHOIS lookups, email and metadata reconnaissance, safe lab setup, Kali Linux overview.		
Module 2	Scanning, Enumeration, and Vulnerability Validation	4 Sessions
Topics: Network discovery, port scanning, service detection, OS and version detection, enumeration of SMB, FTP, SSH, and HTTP services, banner grabbing, vulnerability validation workflow, Nmap advanced scanning concepts, safe use of vulnerability scanners, OpenVAS overview, controlled attack surface assessment, reportable findings.		
Module 3	Web, Wireless, and Credential Security Testing	4 Sessions
Topics: Web application security basics, Burp Suite proxy and repeater, OWASP ZAP passive and active assessment in lab, SQL injection concepts, XSS awareness and validation in training applications, session management, authentication weakness testing, wireless security concepts, Aircrack-ng suite, WPA/WPA2 lab assessment, password attacks with Hydra and John the Ripper, safe credential auditing.		
Module 4	Metasploit, Post-Exploitation, and Reporting	3 Sessions
Topics: Metasploit framework basics, auxiliary and exploit module concepts at beginner level, payload awareness, session management, post-exploitation enumeration in controlled labs, evidence collection, impact analysis, remediation guidance, report writing structure, executive summary, technical findings, risk rating, and final presentation.		
List of Experiments		30 Sessions

16. Install and configure Kali Linux for ethical hacking labs.
17. Perform passive reconnaissance using WHOIS, DNS lookups, and metadata collection.
18. Perform active reconnaissance against a lab host and document discovered assets.
19. Scan a target network using Nmap for live hosts and open ports.
20. Perform service and version detection using Nmap and interpret output.
21. Enumerate common services such as SSH, FTP, SMB, and HTTP in a lab environment.
22. Run a safe vulnerability scan using OpenVAS on a local test machine.
23. Correlate scan results with manual verification findings.
24. Capture and inspect HTTP and HTTPS traffic using Burp Suite.
25. Intercept, modify, and forward test requests in Burp Suite Repeater.
26. Use OWASP ZAP to identify common web application weaknesses in a training application.
27. Demonstrate SQL injection concepts safely on a deliberately vulnerable lab app.
28. Demonstrate cross-site scripting concepts safely on a deliberately vulnerable lab app.
29. Analyse authentication and session management weaknesses in a lab web application.
30. Use Metasploit to discover auxiliary information about a target in a controlled lab.
31. Perform a basic auxiliary scan using Metasploit modules.
32. Launch a controlled test against an intentionally vulnerable service in the lab.
33. Analyse the results of a successful test and record affected service details.
34. Enumerate system information from a controlled session after a lab demonstration.
35. Document basic post-exploitation information collection in a safe environment.
36. Perform wireless network discovery using Aircrack-ng tools.
37. Capture wireless packets and identify relevant handshake-related traffic in a lab.
38. Assess wireless security settings and document encryption mode details.
39. Use Hydra to perform a controlled password audit against a local service.
40. Use John the Ripper to test password strength on a provided hash set.
41. Compare dictionary and rule-based password testing approaches in the lab.
42. Create a penetration testing checklist and scope statement for a sample target.
43. Prepare a vulnerability validation sheet based on scan and manual test results.
44. Compile a professional penetration test report with findings and remediation.
45. Present a final ethical hacking case study based on the full lab workflow.

Text Books **T1** Kevin Cardwell, *Ethical Hacking and Penetration Testing Guide*, Jones & Bartlett Learning, Latest Edition. **T2** Rafay Baloch, *Ethical Hacking and Penetration Testing*, CRC Press, Latest Edition.
Reference Books **R1** Georgia Weidman, *Penetration Testing: A Hands-On Introduction to Hacking*, No Starch Press. **R2** Dafydd Stuttard and Marcus Pinto, *The Web Application Hacker's Handbook*, Wiley. **R3** Chris Sanders and Jason Smith, *Practical Packet Analysis*, No Starch Press. **R4** NIST and OWASP resources on reporting, risk, and validation.
E-Resources 1. Kali Linux 2. Nmap Reference Guide 3. Metasploit Documentation 4. Burp Suite Documentation 5. OWASP Top 10 6. OWASP ZAP Documentation 7. Aircrack-ng Documentation 8. John the Ripper 9. Hydra Project 10. CEH Reference Orientation

CSA3530 Penetration Testing & Vulnerability Assessment

Course Code: CSA3530	**Course Name:** Penetration Testing & Vulnerability Assessment **Type of Course:** Theory Integrated Lab Course	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	-		
Anti-requisites	NIL		
Course Description	This course delivers a comprehensive exploration of security assessment methodologies, focusing on the identification, evaluation, and exploitation of system vulnerabilities. Students will examine the complete lifecycle of a penetration test, including target reconnaissance, vulnerability scanning, network and web-based exploitation, and remediation reporting. Through intensive hands-on lab environments, the curriculum bridges theoretical security frameworks with real-world ethical hacking techniques, preparing students to fortify enterprise infrastructure against modern cyber adversaries.		
Course Objective	The objective of this course is to equip students with the technical skills and methodologies required to systematically discover and analyze infrastructure vulnerabilities. Students will master industry-standard penetration testing tools, execute controlled exploitations within simulated environments, and evaluate systemic security weaknesses. Additionally, the course emphasizes translating raw technical findings into actionable defensive remediation plans, ensuring enterprise networks and systems remain resilient against sophisticated digital threats.		

Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Explain fundamental penetration testing methodologies and ethics. **(Understand)** **CO2:** Conduct systematic reconnaissance and target network footprints. **(Apply)** **CO3:** Analyze system vulnerabilities using automated scanning tools. **(Analyze)** **CO4:** Exploit system network and infrastructure configuration flaws. **(Apply)** **CO5:** Validate application security vulnerabilities through exploitation. **(Apply)** **CO6:** Formulate professional technical remediation and risk reports. **(Create)**

Course Content:

Module 1	Reconnaissance & Intelligence Gathering	3 Sessions
Passive and active reconnaissance, OSINT gathering techniques, DNS footprinting, Network scanning parameters, Port identification and banner grabbing, Firewall and IDS evasion principles.		
Module 2	Vulnerability Analysis & Assessment	3 Sessions
System vulnerability scanning mechanics, False positive analysis, Threat classification and severity metrics, Common Vulnerabilities and Exposures (CVE) frameworks, CVSS risk scoring systems, Credentialed vs. non-credentialed auditing.		
Module 3	Exploitation Techniques & Access Acquisition	4 Sessions
Network service exploitation vectors, Metasploit framework operational theory, Client-side attack vectors, Privilege escalation pathways, Post-exploitation methodology, Maintaining persistent access models		
Module 4	Web Application Attacks & Reporting	5 Sessions
OWASP Top 10 injection vulnerabilities, Cross-Site Scripting (XSS) analysis, Authentication bypass mechanisms, Automated application security scanning, Penetration testing reporting structures, Remediation strategy articulation		
List of Experiments		60 Sessions

1. **Experiment 1**: Passive Information Gathering using OSINT tools (Whois, Shodan, and Harvester).
2. **Experiment 2**: Network Footprinting and DNS Enumeration using nslookup, dig, and fierce.
3. **Experiment 3**: Active Network Scanning and Host Discovery using nmap ping sweeps and subnet analysis.
4. **Experiment 4**: Advanced Port Scanning, Service Version Detection, and Operating System Fingerprinting.
5. **Experiment 5**: Automated Infrastructure Vulnerability Assessment using the Nessus or OpenVAS scanning engine.
6. **Experiment 6**: Analyzing Scan Reports to Filter False Positives and Map Vulnerabilities to CVE IDs.
7. **Experiment 7**: Comparative Vulnerability Assessment: Running Credentialed vs. Non-Credentialed Network Audits.
8. **Experiment 8**: Exploiting Unpatched Network Services (e.g., SMB or FTP flaws) using the Metasploit Framework.
9. **Experiment 9**: Executing Linux and Windows Local Privilege Escalation Techniques following Initial Access.
10. **Experiment 10**: Post-Exploitation Tactics: Enumerating Systems, Extracting Hashes, and Mimicking Lateral Movement.
11. **Experiment 11**: Simulating Persistence Mechanisms using Scheduled Tasks, Cron Jobs, and Backdoor Listeners.
12. **Experiment 12**: Detecting and Exploiting SQL Injection (SQLi) Vulnerabilities on Target Web Forms.
13. **Experiment 13**: Identifying and Executing Stored and Reflected Cross-Site Scripting (XSS) Flaws.
14. **Experiment 14**: Exploiting Broken Authentication Systems and Session Management Flaws within Web Interfaces.
15. **Experiment 15**: Compiling a Technical Penetration Testing Report mapping Findings, CVSS Scores, and Remediation Steps.

Text Books

1. Penetration Testing: A Hands-On Introduction to Hacking (1st Edition), Georgia Weidman, No Starch Press
2. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws (2nd Edition), Dafydd Stuttard and Marcus Pinto, John Wiley & Sons
3. The Hacker Playbook 3: Practical Guide to Penetration Testing (1st Edition), Peter Kim, Secure Planet LLC

Reference Books

1. RTFM: Red Team Field Manual (1st Edition), Ben Clark, CreateSpace Independent Publishing Platform
2. Hacking: The Art of Exploitation (2nd Edition), Jon Erickson, No Starch Press
3. Metasploit: The Penetration Tester's Guide (1st Edition), David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni, No Starch Press

E-Resources

1. OWASP Top 10 Vulnerability Mitigation Framework (https://owasp.org/www-project-top-ten/)
2. MITRE ATT&CK Adversary Tactics and Techniques Knowledge Base (https://attack.mitre.org/)
3. Kali Linux Official Penetration Testing Documentation Tools (https://www.kali.org/docs/)
4. PortSwigger Web Security Academy Exploitation Labs (https://portswigger.net/web-security)

5. Nmap Network Mapper Official Reference Guide and Documentation (https://nmap.org/book/man.html)

CSA3531 AI Applications in Cyber Security

<table>
<tr><td>Course Code:
CSA3531</td><td colspan="2">Course Name: AI Applications in Cyber Security
Type of Course: Theory Integrated Lab Course</td><td>L- T-P- C</td><td>1-0-4-3</td></tr>
<tr><td>Version No.</td><td colspan="4">1</td></tr>
<tr><td>Course pre-requisites</td><td colspan="4">Python Programming, Computer Networks, Operating Systems</td></tr>
<tr><td>Anti-requisites</td><td colspan="4">NIL</td></tr>
<tr><td>Course Description</td><td colspan="4">To equip students with knowledge of how artificial intelligence and machine learning techniques are applied to detect, prevent, and respond to cyber threats, enabling them to build intelligent security systems for real-world attack detection, malware analysis, and threat intelligence.</td></tr>
<tr><td>Course Objective</td><td colspan="4">Introduce students to the fundamental concepts of AI-driven cyber security including threat landscapes, attack taxonomies, and the role of ML in defense. Train students to apply supervised and unsupervised ML models for intrusion detection, anomaly detection, and malware classification. Enable students to use deep learning and NLP techniques for phishing detection, log analysis, and threat intelligence extraction. Equip students to design and evaluate AI-based security pipelines for network traffic analysis, vulnerability assessment, and incident response.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of the course the students shall be able to:<table>
<tr><td>CO1</td><td>Describe the cyber threat landscape, attack taxonomies, and the role of AI in modern cyber defence strategies.</td><td>Understand</td></tr>
<tr><td>CO2</td><td>Apply supervised and unsupervised machine learning algorithms for network intrusion detection and anomaly identification.</td><td>Apply</td></tr>
<tr><td>CO3</td><td>Analyze malware samples and phishing content using deep learning models and NLP-based feature extraction techniques.</td><td>Analyze</td></tr>
<tr><td>CO4</td><td>Design and implement AI-powered security monitoring systems for real-time threat detection and automated incident response.</td><td>Analyze</td></tr>
<tr><td>CO5</td><td>Evaluate the performance, limitations, and ethical implications of AI-based cyber security tools and adversarial attack scenarios.</td><td>Analyze</td></tr>
</table></td></tr>
<tr><td colspan="5">Course Content:</td></tr>
<tr><td>Module 1</td><td colspan="3">Introduction to AI Applications in Cyber Security</td><td>7 Sessions</td></tr>
<tr><td colspan="5">Topics:
Cyber security fundamentals: CIA triad, attack surfaces, and threat actors. Overview of AI and ML in security: supervised, unsupervised, and reinforcement learning. Cyber kill chain and MITRE ATT&CK framework. Feature engineering for security data: network logs, system calls, and packet captures. Introduction to security datasets: KDD Cup 99, NSL-KDD, CICIDS-2017, and UNSW-NB15.</td></tr>
<tr><td>Module 2</td><td colspan="3">Intrusion Detection and Anomaly Detection</td><td>8 Sessions</td></tr>
<tr><td colspan="5">Topics:
Network intrusion detection systems (NIDS): rule-based vs. ML-based approaches. Supervised classifiers for attack classification: Decision Trees, Random Forest, SVM, and XGBoost. Unsupervised anomaly detection: Isolation Forest,</td></tr>
</table>

Autoencoders, and One-Class SVM. Deep learning for intrusion detection: CNN and LSTM-based sequence models on network traffic.

Module 3	Malware Analysis and Phishing Detection	8 Sessions

Topics:

Static and dynamic malware analysis: PE header features, API call sequences, and behavioural patterns. ML-based malware classification: n-gram models, opcode analysis, and graph neural networks. NLP for phishing detection: URL feature extraction, email content analysis, and BERT-based classifiers. Adversarial malware: evasion attacks against ML-based detectors and defence strategies.

Module 4	Threat Intelligence, Adversarial AI and Ethics	7 Sessions

Topics:

NLP for cyber threat intelligence: extracting IOCs, TTPs, and threat actor profiles from threat reports. Log analysis and SIEM integration using ML for automated alert triage and false-positive reduction. Adversarial machine learning: evasion, poisoning, and model inversion attacks on security models. AI ethics in cyber security: bias in security models, explainability (SHAP/LIME), privacy, and responsible AI deployment.

List of Experiments	30 Sessions

Phase 1: Data Collection & Feature Engineering (6 Hours)

- **Experiment 1 (2 Hrs):** Setting up the cyber security lab environment; loading and exploring the CICIDS-2017 and NSL-KDD datasets using Pandas; perform exploratory data analysis to identify attack distributions, class imbalance, and key traffic features.
- **Experiment 2 (2 Hrs):** Network traffic feature engineering: extract statistical features (packet length, flow duration, IAT) from PCAP files using Scapy and CICFlowMeter; compare feature importance across benign and attack traffic classes.
- **Experiment 3 (2 Hrs):** Data preprocessing pipeline for security datasets: handle missing values, normalize features, encode categorical labels, and apply SMOTE oversampling to address class imbalance for minority attack categories.

Phase 2: Intrusion Detection Systems (8 Hours)

- **Experiment 4 (2 Hrs):** Building a supervised intrusion detection classifier using Random Forest and XGBoost on NSL-KDD; evaluate with accuracy, precision, recall, F1-score, and confusion matrix; compare performance across attack categories (DoS, Probe, R2L, U2R).
- **Experiment 5 (2 Hrs):** Implementing an Autoencoder-based anomaly detection model on network traffic data; train on benign traffic only, set reconstruction error threshold, and evaluate detection rate on unseen attack samples.
- **Experiment 6 (2 Hrs):** Deep learning-based intrusion detection using LSTM on sequential network flow data; train on CICIDS-2017 time-series traffic sequences and evaluate detection accuracy for DDoS and PortScan attack classes.
- **Experiment 7 (2 Hrs):** Implementing One-Class SVM and Isolation Forest for zero-day anomaly detection; simulate unknown attack traffic by withholding one attack type during training and measuring detection capability at inference time.

Phase 3: Malware Analysis & Phishing Detection (8 Hours)

- **Experiment 8 (2 Hrs):** Static malware analysis: extract PE header features, import table entries, and section entropy from benign and malicious executables using pefile; train a Random Forest classifier and evaluate on the EMBER malware dataset.
- **Experiment 9 (2 Hrs):** Dynamic malware analysis: extract API call sequences from sandbox reports; build an n-gram frequency model and train an SVM classifier to distinguish ransomware, trojans, and adware behaviour profiles.
- **Experiment 10 (2 Hrs):** Phishing URL detection: extract lexical, host-based, and content features from URLs; train and compare Logistic Regression, Random Forest, and a fine-tuned BERT model; evaluate on the PhiUSIIL phishing dataset.
- **Experiment 11 (2 Hrs):** Email phishing detection using NLP: preprocess email headers and body text, extract TF-IDF and BERT embeddings, train a classification model, and visualize top phishing indicators using SHAP explainability.

Phase 4: Threat Intelligence & Capstone (8 Hours)

- **Experiment 12 (2 Hrs):** NLP-based cyber threat intelligence extraction: use spaCy NER and regex patterns to extract IOCs (IPs, hashes, CVEs) and TTPs from APT threat reports; build a structured threat database and visualize attacker TTPs on the MITRE ATT&CK matrix.

- **Experiment 13 (2 Hrs):** Log analysis and anomaly detection using ML: parse Apache/syslog server logs, extract features (request frequency, status codes, user agents), apply Isolation Forest to detect brute-force and scanning attacks, and visualize anomaly scores.
- **Experiment 14 (2 Hrs):** Adversarial attack simulation: generate adversarial network traffic examples using FGSM to evade an ML-based intrusion detector; measure accuracy drop and implement adversarial training as a defence mechanism.
- **Experiment 15 (2 Hrs):** Capstone project: design and deploy an end-to-end AI-powered security monitoring system — ingest live network traffic or log data, detect anomalies in real time using a trained ML model, generate automated threat alerts, and present findings with a Streamlit dashboard, model evaluation report, and ethical use analysis.

Text Books

T1	Ismail Akkaya & Pelin Angin. *Machine Learning and Security: Protecting Systems with Data and Algorithms, O'Reilly Media*
T2	Charu C. Aggarwal. *Neural Networks and Deep Learning: A Textbook, Springer*

Reference Books

R1	Clarence Chio & David Freeman. *Machine Learning and Security, O'Reilly Media*

Reference Books

E-Resources

- https://attack.mitre.org
- https://www.unb.ca/cic/datasets/ids-2017.html

Track 5: Web Development & MAD

CSA3532 Fundamentals of Web Technologies

Course Code: CSA3532	Course Title: Fundamentals of Web Technologies Type of Course: Program Core –Theory	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces the fundamental concepts, architectures, and protocols that power the modern World Wide Web. Students will explore the core pillars of web development—including HTML, CSS, and JavaScript—along with client-server architecture, HTTP/HTTPS protocols, and basic database integration. The course emphasizes building responsive, accessible, and interactive user interfaces while providing a solid foundation in contemporary web design principles and deployment practices.					
Course Objective	The objective of this course is to equip students with a comprehensive understanding of core web technologies and architecture, enabling them to design, develop, and deploy functional and responsive websites. Students will master the foundational pillars of front-end development—HTML5 for semantic structuring, CSS3 for modern styling and layout design, and JavaScript for client-side interactivity and dynamic DOM manipulation. Additionally, the course aims to foster a strong grasp of client-server communication, HTTP protocols, and security best practices, ensuring students can build secure, user-friendly, and cross-browser compatible web applications.					
Course Out Comes	On successful completion of the course the students shall be able to: **CO1**: Explain fundamental web architectures, client-server models, and standard communication protocols. **(Understand)** **CO2**: Create structured and accessible webpage frameworks using semantic HTML5 specifications. **(Apply)** **CO3**: Design responsive user interfaces across multiple device screens using modern CSS3. **(Apply)**					

	CO4: Develop interactive client-side logic and handle browser events using JavaScript. **(Apply)** **CO5**: Implement asynchronous data exchanges within applications using structured API channels. **(Apply)** **CO6**: Evaluate deployed applications against security vulnerabilities, validation bugs, and performance anomalies. **(Analyze)**			
Course Content				
Module 1	Web Architecture & Foundational Markup	Assignment	Problem Solving	10 Sessions
Internet evolution, Client-Server architecture, DNS and URL structure, HTTP/HTTPS protocols, Semantic HTML5 structure, Hyperlinks and media embeds, Web accessibility fundamentals				
Module 2	Styling Principles & Responsive Design Theory	Assignment	Problem Solving	11 Sessions
CSS3 fundamentals, Cascading rules and specificity, CSS Box Model, Page positioning schemes, Flexbox and Grid layouts, Media queries and responsive design, Cross-browser compatibility				
Module 3	Client-Side Scripting & Dynamic DOM Logic	Assignment	Problem Solving	12 Sessions
JavaScript core variables and operators, Control structures and loops, Functions and execution scope, DOM tree traversal, Browser event handling, Client-side form validation, Error handling				
Module 4	Web Integration, Security & Deployment Fundamentals	Assignment	Problem Solving	12 Sessions
JSON data format, RESTful API concepts, Asynchronous web theory, Browser cookies and web storage, Common web vulnerabilities (XSS/CSRF), Web performance optimization, Hosting and deployment workflows				
Targeted Application & Tools that can be used: Firebase, GitHub Pages				

Case Study/Assignment: Assignment proposed for this course in CO1-CO4

1. Students will build a multi-page, unstyled website using semantic HTML5 tags (<nav>, <article>, <footer>) to create a clear content hierarchy. The project must include working internal hyperlinks, structured data tables, nested lists, and accessible media components with descriptive alternative text.

2. Students will write a standalone CSS3 stylesheet to transform their static HTML into a modern, responsive layout. The assignment requires using Flexbox for navigation bars, CSS Grid for content galleries, and media queries to ensure the entire design dynamically adapts to mobile, tablet, and desktop viewports.

3. Students will write client-side JavaScript to add behavior to their webpage, capturing user events to manipulate the DOM in real time. They must implement a functional dark-mode toggle and create a form validation script that uses regular expressions to catch input errors and display live, inline feedback.

4. Students will use asynchronous JavaScript (fetch) to pull live data from a public RESTful JSON API and securely render it on their site while preventing XSS vulnerabilities. The final project will incorporate local browser storage for state retention.

Problem Solving: Website be deployed to a live hosting platform like GitHub Pages or Firebase.
Text Book 1. Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics (5th Edition), Jennifer Niederst Robbins, O'Reilly Media 2. Developing Web Applications, Ralph Moseley and M. T. Savaliya, Wiley-India 3. HTML and CSS: Design and Build Websites, Jon Duckett, Wiley
References 1. Eloquent JavaScript: A Modern Introduction to Programming (3rd Edition), Marijn Haverbeke, No Starch Press 2. Web Design, Joel Sklar, Cengage Learning Publishing 3. JavaScript and jQuery: Interactive Front-End Web Development, Jon Duckett, John Wiley & Sons Web Based Resources and E-books 1. MDN Web Docs (https://developer.mozilla.org/en-US/) 2. W3Schools Online Web Tutorials (https://www.w3schools.in/) 3. The JavaScript Language Tutorial (https://javascript.info/) 4. Google Web Developers Portal (https://developers.google.com/)

CSA3533 Progressive Web Application Development

Course Code: CSA3533	Course Title: Progressive Web Application Development Type of Course: Program Core –Theory	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course explores the architecture, development, and deployment of Progressive Web Applications (PWAs), bridging the gap between traditional web pages and native mobile applications. Students will learn how to transform standard responsive web applications into high-performance, offline-capable, and installable digital experiences. The curriculum covers core PWA pillars—including Service Workers, the Web App Manifest, asynchronous data caching strategies, and push notifications—along with background synchronization and performance auditing. The course emphasizes building secure, resilient, and mobile-optimized web applications that deliver native-like user experiences across diverse device platforms and network conditions.					
Course Objective	The objective of this course is to equip students with the theoretical knowledge and practical engineering skills required to design, develop, and deploy production-ready Progressive Web Applications. Students will master the asynchronous lifecycle of Service Workers, implement advanced data caching strategies to ensure offline functionality, and configure platform-agnostic installation mechanics. Additionally, the course aims to instill a deep understanding of mobile optimization, modern browser APIs, security constraints (HTTPS requirements), and performance benchmarking tools, enabling students to build resilient web ecosystems that mimic native mobile application capabilities.					
Course Out Comes	On successful completion of the course the students shall be able to: **CO1:** Explain the architectural differences between web, native mobile, and Progressive Web Applications. **[Understand]** **CO2:** Implement Service Workers for asynchronous and event-driven background processing. **[Apply]** **CO3:** Design caching strategies using the Cache Storage API for offline functionality and performance optimization. **[Apply]**					

	CO4: Configure Web App Manifests for installation, discoverability, and standalone application support. **[Apply]** **CO5:** Integrate browser APIs such as Push, Notification, and Background Sync for user engagement. **[Apply]** **CO6:** Analyze and optimize PWA performance, security, and accessibility using diagnostic tools. **[Analyze]**			
Course Content				
Module 1	Foundational PWA Architecture & The Web App Manifest	Assignment	Problem Solving	10 Sessions
PWA core pillars, Native vs. Web app paradigms, Progressive enhancement philosophy, Application Shell Architecture, HTTPS security requirements, Web App Manifest structure, App icons and splash screens, Standalone display modes, Browser installation criteria, Custom installation prompts				
Module 2	Service Worker Lifecycle & Event Handling	Assignment	Problem Solving	11 Sessions
Service Worker architecture, Execution context and threads, Registering and installing service workers, Activation phase and cache clearing, Asynchronous control and scopes, Fetch event interception, Message passing between contexts, Service Worker update mechanics				
Module 3	Advanced Caching Strategies & Offline Data Management	Assignment	Problem Solving	12 Sessions
Cache Storage API, Cache-first strategy, Network-first strategy, Stale-while-revalidate pattern, Cache falling back to network, Dynamic caching routines, Persistent storage limits, IndexedDB for structured data, Offline transactional queues				
Module 4	Hardware Integration, Re-engagement & Performance Auditing	Assignment	Problem Solving	12 Sessions
Push Notification architecture, Notification API permissions, Background Sync API, Periodic Background Sync, Web Share API, Lighthouse performance auditing, Service worker debugging tools, Network throttling emulation, Production build optimization				
Targeted Application & Tools that can be used: Modern Web Browser Developer Tools (Application & Service Worker tabs), Workbox CLI/Libraries, IndexedDB wrappers (e.g., Idb, Dexie.js)				
Case Study/Assignment: Assignment proposed for this course in CO1-CO4 5. Students will analyze a traditional server-rendered web application and redesign it into an Application Shell Architecture. They will construct a production-ready Web App Manifest configuring standalone display configurations, adaptive icon arrays, and platform-specific shortcuts. The deliverable requires passing the baseline installability criteria across mobile and desktop browser engines. 6. Students will implement an event-driven Service Worker to manage the application's runtime environment. They must write custom event listeners to control the asynchronous lifecycle (install, activate, fetch) and gracefully update service workers without disrupting the user session. Students will implement a multi-tiered caching strategy using the Cache Storage API—deploying Cache-First layouts for static shell assets, Network-First layers for dynamic user profiles, and a Stale-While-Revalidate pattern for core task lists.				
Problem Solving: Students must resolve network-resiliency and local state issues by binding their application's offline caching layer to a persistent client-side transactional database (IndexedDB)				
Text Book 4. Building Progressive Web Apps: Bringing the Power of Native to the Browser (1st Edition), Tal Ater, O'Reilly Media				

5. Progressive Web Apps in Action: Building Fast, Reliable, and Offline-Ready Applications (1st Edition), Dean Alan Hume, Manning Publications
6. Progressive Web Application Development by Example: Develop fast, reliable, and engaging user experiences for the web (1st Edition), Chris Love, Packt Publishing

References

4. Learning Progressive Web Apps: Upgrade Your Websites to Deliver Instantly, Work Offline, and Engage Users (1st Edition), John M. Wargo, Addison-Wesley Professional
5. High Performance Browser Networking: What every web developer should know about networking and web performance (1st Edition), Ilya Grigorik, O'Reilly Media
6. Responsive Web Design with HTML5 and CSS: Develop future-proof responsive websites using the latest HTML5 and CSS techniques (4th Edition), Ben Frain, Packt Publishing

Web Based Resources and E-books

5. MDN Web Docs: Progressive Web Apps (PWA) Core Hub (https://developer.mozilla.org/en-US/docs/Web/Progressive_web_apps)
6. Google Developers: Learn Progressive Web Apps Curriculum (https://web.dev/learn/pwa/)
7. Workbox Libraries API Documentation (https://developer.chrome.com/docs/workbox)
8. W3C Technical Architecture: Web App Manifest Specification Hub (https://www.w3.org/TR/appmanifest/)

CSA3534 Front-End Development using React

Course Code: CSA3534	**Course Name:** Front-End Development using React **Type of Course: Elective**	L- T-P- C	2-0-2-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This intermediate course enables students to perform front-end development using React, with emphasis on employability skills. The course covers key technologies and architectures that enables the student to design and implement front-end. On successful completion of this course, the student shall be able to pursue a career in front end development. The students shall develop strong problem-solving skills as part of this course.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Front-end Development using React and attain Employability Skills through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Design static web pages using HTML5 elements and CSS3 [Apply] CO2 Develop responsive web pages using CSS. [Apply] CO3 Demonstrate the asynchronous programming paradigms (async/await, Promises). [Apply] CO4 Illustrate the complex application interactivity by managing local state variables. [Apply] CO5 Implement client-side multi-view routing and dynamic URL tracking. [Apply]		
Course Content:			
Module 1	Introduction to Front-End Development		7 Sessions
Topics: Web development basics, Introduction to HTML5 structure, Semantic elements, Forms and inputs, Introduction to CSS3 styling, Selectors and properties, Box model, Flexbox and Grid, Introduction to AdvancedJavaScript, Destructuring arrays and objects, Rest/Spread operators, Array methods (.map(), .filter(), .reduce()).			
Module 2	Introduction to React & Component Architecture		7 Sessions
Topics:			

DOM Manipulation to declarative component, Form validation, Local and session storage, JavaScript XML concepts Syntax, embedding expressions, and architectural rules., Components: Functional components, rendering UI elements, and the strict rules governing component purity.

Module 3	State Management & Component Lifecycle	8 Sessions

Topics:

Interactivity: Handling events (clicks, form inputs) within the virtual ecosystem. The useState Hook: Local component state, triggers for re-rendering, and managing updates correctly. The useState Hook: Local component state, triggers for re-rendering, and managing updates correctly. The useEffect Hook: Side effects, synchronizing with external APIs, and executing cleanup functions.

Module 4	Advanced Patterns & Navigation	8 Sessions

Topics:

Routing: Setting up multi-view navigation using react-router-dom, handling dynamic URLs (/user/:id), and configuring protected/private routes. Global State Management: Solving the "prop drilling" problem using the built-in Context API (useContext). Styling Strategies: Styling components cleanly using CSS Modules and utility-first frameworks like Tailwind CSS.

List of Experiments — 30 Sessions

1. Familiarization of HTML and CSS basics.
2. Create an HTML webpage showcasing biodata with CSS styling.
3. Design an interactive web page for a new restaurant using CSS3 features.
4. Create a simple web form to gather user information.
5. Practice setting up VS Code, Git, and GitHub. Write a script that refactors traditional JS functions into clean ES6 syntax..
6. Implement JavaScript exercises for form validation.
7. Create a student registration form using JSX.
8. Convert a static multi-page HTML design into a React app.
9. Create a single, highly reusable <ProductCard/> component. Pass data dynamically into it using loop mappings (.map()), ensuring every item has a unique, stable React key.
10. Create a structural item inventory system split into two sibling components.
11. Configure non-reloading multi-view browser history and application navigation.
12. Design a mini blog page. Create a path /blog showing a list of post titles.
13. Create a UserContext wrapper that stores an object called currentUser (containing username, role, and login status).
14. Write a component containing an intensive math filtering loop (e.g., finding prime numbers up to 50,000) alongside a simple input text field.
15. Set up an account with an API service (like Unsplash or OpenWeather).

Text Books

T1 Alex Banks and Eve Porcello, “Learning React: Modern Patterns for Developing React Apps”, O'Reilly Media, 2nd Edition

T2 Daniel Bugl, “Learn React Hooks”, Packt Publishing, 2019

Reference Books

R1 Biswas, N, “HTML to React: The Ultimate Guide”, 2024.

R2 An, J, “Building User Interfaces for Modern Web Applications: React Programming”, 2024

E-Resources

1. https://react.dev
2. https://vite.dev
3. https://reactrouter.com

CSA3535 NoSQL

Course Code: CSA3535	**Course Name:** NoSQL **Type of Course:**	L- T-P- C	2-0-2-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course provides an in-depth understanding of NoSQL databases, their architecture, and their applications in modern data-driven environments. Students will explore the key concepts, types, and use cases of NoSQL databases, focusing on their scalability, flexibility, and performance advantages over traditional relational databases. The course covers various NoSQL database models, including Key-Value, Document-Oriented, Column-Family, and Graph Databases, with practical examples and hands-on experience. Students will gain the skills to design, implement, and manage NoSQL databases for real-world applications such as Big Data, IoT, and E-commerce systems.		
Course Objective	The course No SQL aims to equip BCA students with foundational knowledge and practical skills in NoSQL databases, focusing on their architecture, types, and applications. Students will learn to design, implement, and manage scalable, distributed systems.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Understand NoSQL Fundamentals [Understand] CO2 Perform Practical NoSQL Operations [Apply] CO3 Apply NoSQL in Real-World Scenarios [Apply] CO4 Analyze distributed database architectures by implementing Replication strategies. [Analyze] CO5 Implement keyspaces and tables in Cassandra [Analyze] CO6 Design Scalable Systems [Analyze]		
Course Content:			
Module 1	Introduction to NoSQL Databases		7 Sessions
Topics: Overview of NoSQL and its importance, Differences between SQL and NoSQL databases, Installation and setup of NoSQL databases (MongoDB, Cassandra, Redis, Neo4j) , Introduction to basic NoSQL commands.			
Module 2	Document-Oriented and Key-Value Databases		7 Sessions
Topics: Understanding document-oriented databases (MongoDB) , CRUD operations in MongoDB, Data modeling and schema design in MongoDB, Introduction to key-value stores (Redis) , Working with Redis data structures (strings, lists, sets, and hashes).			
Module 3	Column-Family Databases (Cassandra)		8 Sessions
Topics: Introduction to column-family databases and their architecture, Basics of Apache Cassandra and its use cases , Creating keyspaces and tables in Cassandra, Performing CRUD operations using CQL (Cassandra Query Language) , Data partitioning, replication, and consistency in Cassandra.			
Module 4	Graph Databases (Neo4j)		8 Sessions
Topics: Introduction to graph databases and their applications Nodes, relationships, and properties in Neo4j , Querying graph databases using Cypher ,Real-world use cases of graph databases, Indexing, aggregation, and performance optimization in MongoDB, Sharding and replication in NoSQL databases, Security and access control in NoSQL databases.			
List of Experiments			30 Sessions
1. Install MongoDB, Cassandra , Redis , Neo4j Desktop. 2. Perform CRUD operations on MongoDB documents. 3. Design a MongoDB schema for an e-commerce application (products, users, orders).			

4. Perform indexing in MongoDB for faster search.
5. Insert and retrieve different data types (strings, lists, sets, hashes) in Redis.
6. Implement expiration (TTL) of keys in Redis.
7. Simulate a simple leaderboard using Redis Sorted Sets.
8. Create a session store system using Redis (e.g., for login sessions).
9. Create a keyspace and table in Cassandra using CQL.
10. Implement a Student Management System database in Cassandra.
11. Demonstrate partitioning by inserting data with different partition keys.
12. Demonstrate replication by setting replication factor and Query Cassandra using SELECT, WHERE clauses with clustering columns in Cassandra.
13. Create nodes and relationships in Neo4j (e.g., Students–Friends, Company–Employee).
14. Design a Movie Recommendation Graph database in Neo4j.
15. Analyze real-world case study: Supply Chain Management graph using Neo4j.

Text Books

T1 NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence by Pramod J. Sadalage and Martin Fowler.

T2 MongoDB: The Definitive Guide by Kristina Chodorow.

Reference Books

R1 Cassandra documentation: https://cassandra.apache.org/doc/latest/

R2 Adam Fowler, "NoSQL For Dummies", Wiley, 2015.

E-Resources

1. https://www.mongodb.com/resources/basics/databases/nosql-explained
2. https://nptel.ac.in/courses/106106243
3. https://cloud.google.com/discover/what-is-nosql

CSA3536 Full Stack Web Application Development

Course Code: CSA3536	**Course Name:** Full Stack Web Application Development **Type of Course:** Theory Integrated Lab Course	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	CSA3427		
Anti-requisites	NIL		
Course Description	This course provides comprehensive practical training in the design and development of modern full stack web applications. It covers frontend development, client-side scripting, backend programming, database integration, authentication mechanisms, RESTful API development, and cloud deployment techniques. Students will gain hands-on experience using contemporary technologies such as HTML5, CSS3, JavaScript, React, Node.js, Express.js, and MongoDB/MySQL to build responsive and scalable web applications. The course emphasizes experiential learning through laboratory experiments and project-based activities. Students will learn to develop dynamic user interfaces, create server-side applications, manage databases, implement security features, and deploy applications on cloud platforms. By the end of the course, learners will be capable of independently designing, developing, testing, and deploying complete full stack web solutions for real-world applications.		
Course Objective	The objective of the Full Stack Web Application Development course is to equip students with the knowledge and practical skills required to design, develop, test, and deploy complete web applications. The course focuses on both front-end and back-end development, enabling learners to build interactive user interfaces, manage databases, develop server-side logic, and integrate		

	application components effectively. Students gain hands-on experience with web technologies, programming frameworks, database management, APIs, and deployment techniques, helping them understand the entire web development lifecycle and prepare for real-world software development and industry requirements.		
Course Outcomes	**On successful completion of the course the students shall be able to:**		
	CO1	Understand the fundamentals of full stack web development, including frontend, backend, databases, and client-server architecture.	[Understand]
	CO2	Apply HTML, CSS, JavaScript, and frontend frameworks to design and develop interactive web interfaces.	[Apply]
	CO3	Develop server-side applications using backend technologies and integrate them with databases.	[Apply]
	CO4	Apply database operations and connectivity techniques to store, retrieve, and manage application data.	[Apply]
	CO5	Apply full-stack development tools and deployment methods to build and deploy web applications.	[Apply]

Course Content:

Module 1	Front-End Development Fundamentals	4 Sessions

Topics:
Introduction to Web Technologies, HTML5 Structure and Elements, CSS3 Styling and Layout, JavaScript Basics and DOM Manipulation, Responsive Web Design, Bootstrap and Front-End Frameworks.

Module 2	Back-End Development and Server-Side Programming	4 Sessions

Topics:
Introduction to Server-Side Development, Web Servers and Client–Server Architecture, Backend Languages (Node.js / ASP.NET / PHP), Routing and Middleware, Form Handling and Validation, Session and Cookie Management.

Module 3	Database and API Development	4 Sessions

Topics:
Database Fundamentals, SQL and NoSQL Databases, MySQL / MongoDB Operations, CRUD Operations, RESTful API Design, Database Connectivity and Data Exchange using JSON.

Module 4	Security, Deployment and Advanced Full Stack Concepts	3 Sessions

Topics:
Authentication and Authorization, Password Encryption and JWT, API Security, Cloud Deployment and Hosting, Version Control using Git and GitHub, Testing and Debugging, DevOps Basics and CI/CD.

List of Experiments	60 Sessions

1. Experiment 1: Create a Basic Full Stack Application
2. Experiment 2: User Registration and Login System
3. Experiment 3: CRUD Operations Application
4. Experiment 4: REST API Development
5. Experiment 5: Database Connectivity Experiment
6. Experiment 6 Form Validation
7. Experiment 7: Session and Cookie Management
8. Experiment 8: File Upload Application
9. Experiment 9: Responsive Web Application
10. Experiment 10: AJAX / Fetch API Implementation
11. Experiment 11: Full Stack Mini Project – E-Commerce or Blog System
12. Experiment 12: Deployment of Full Stack Application
13. Experiment 13: Authentication using JWT (JSON Web Token)
14. Experiment 14: Role-Based Access Control (RBAC)
15. Experiment 15: Password Encryption
16. Experiment 16: Search and Filter Functionality
17. Experiment 17: Pagination Implementation
18. Experiment 18: Email Integration
19. Experiment 19: Real-Time Chat Application
20. Experiment 20: Payment Gateway Integration

Text Books
T1 Nixon, R. (2021). *Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5* (6th ed.). O'Reilly Media.
T2 Banks, A., & Porcello, E. (2020). *Learning React: Modern patterns for developing React apps* (2nd ed.). O'Reilly Media.
Reference Books
R1 Brown, E. (2019). *Web development with Node and Express: Leveraging the JavaScript stack* (2nd ed.). O'Reilly Media.
E-Resources • https://developer.mozilla.org/?utm_source=chatgpt.com • https://www.w3schools.com/?utm_source=chatgpt.com • https://nodejs.org/?utm_source=chatgpt.com • https://react.dev/?utm_source=chatgpt.com • https://getbootstrap.com/?utm_source=chatgpt.com • https://docs.github.com/?utm_source=chatgpt.com • https://www.freecodecamp.org/?utm_source=chatgpt.com • https://www.coursera.org/?utm_source=chatgpt.com • https://www.coursera.org/?utm_source=chatgpt.com

CSA3537 Android Application Development using Kotlin

Course Code: CSA3537	**Course Name:** Android Application Development using Kotlin **Type of Course:** Theory Integrated Lab Course	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	CSA3426		
Anti-requisites	NIL		
Course Description	This course introduces students to the fundamentals and advanced concepts of Android Application Development using Kotlin. It focuses on designing, developing, testing, and deploying Android applications using the Kotlin programming language and modern Android development tools. The course covers Android architecture, user interface design, activity lifecycle, layouts, event handling, data storage, networking, and integration with device features. Students will gain practical experience in building interactive and responsive mobile applications using Android Studio, Kotlin, and Android SDK components. The course also explores modern development practices such as APIs, Firebase integration, and application deployment to prepare learners for real-world mobile application development.		
Course Objective	The course on Android Application Development using Kotlin aims to provide students with the knowledge and practical skills required to design, develop, and deploy Android applications using the Kotlin programming language. The course focuses on Android architecture, user interface design, activity and fragment management, data handling, database integration, API communication, and application testing. It enables learners to build interactive, secure, and efficient mobile applications while understanding modern Android development tools, frameworks, and best practices for real-world mobile application development.		

Course Outcomes	**On successful completion of the course the students shall be able to:**		
	CO1	Explain the fundamentals of Android architecture, Kotlin programming concepts, and Android Studio environment.	[Understand]
	CO2	Apply Kotlin programming constructs, UI components, and activity lifecycle methods to develop Android application.	[Apply]
	CO3	Develop Android applications using layouts, intents, fragments, and event handling techniques.	[Apply]
	CO4	Apply Kotlin programming concepts to develop basic Android applications.	[Apply]
	CO5	Apply APIs, permissions, and device features to develop functional Android mobile applications.	[Apply]

Course Content:

Module 1	Introduction to Kotlin and Android Fundamentals	4 Sessions

Topics:
Introduction to Mobile and Android Application Development, Android Architecture and Components, Setting up Android Studio, Introduction to Kotlin Programming, Variables, Data Types, Operators, Control Statements and Functions in Kotlin.

Module 2	User Interface Design and Activity Management	4 Sessions

Topics:
Android UI Components, Layouts (Linear, Relative, Constraint Layout), Buttons, Text View, Edit Text, Recycler View, Event Handling and Listeners, Activities and Activity Lifecycle, Intents and Navigation.

Module 3	Data Storage and Background Processing	4 Sessions

Topics:
Shared Preferences, SQLite and Room Database, File Storage Techniques, Content Providers, Background Tasks and Threads, Services and Broadcast Receivers.

Module 4	Advanced Android Development and Deployment	3 Sessions

Topics:
Permissions and Device Features, API Integration and Networking, Firebase Basics, Testing and Debugging, App Security Best Practices, APK Generation and Application Deployment to Play Store.

List of Experiments	60 Sessions

1. Experiment 1: Installation and Android Studio Setup
2. Experiment 2: Kotlin Basics Program
3. Experiment 3: User Interface Design using Layouts
4. Experiment 4: Event Handling in Android
5. Experiment 5: Text Input and Validation
6. Experiment 6 Activity Lifecycle Demonstration
7. Experiment 7: Intent and Activity Navigation
8. Experiment 8: RecyclerView/ListView Application
9. Experiment 9: Menu and Navigation Drawer
10. Experiment 10: Toast and Snackbar Messages
11. Experiment 11: Shared Preferences Implementation
12. Experiment 12: SQLite/Room Database Application
13. Experiment 13: File Handling in Android
14. Experiment 14: Media and Camera Integration
15. Experiment 15: Working with Sensors
16. Experiment 16: Location and GPS Services
17. Experiment 17: Networking and API Integration
18. Experiment 18: Firebase Integration
19. Experiment 19: Notifications and Background Services
20. Experiment 20: Mini Project and APK Deployment

Text Books

T1 Horton, J. (2021). *Android programming with Kotlin for beginners* (2nd ed.). Packt Publishing.

T2 Dawson, M. (2020). *Beginning Kotlin programming: Build and run Android apps using Kotlin* (2nd ed.). Apress.

Reference Books
R1 Phillips, B., Stewart, C., & Marsicano, K. (2019). *Android programming: The big nerd ranch guide* (4th ed.). Big Nerd Ranch.
E-Resources • https://developer.android.com/?utm_source=chatgpt.com • https://kotlinlang.org/docs/home.html?utm_source=chatgpt.com • https://developer.android.com/studio?utm_source=chatgpt.com • https://developer.android.com/courses?utm_source=chatgpt.com • https://firebase.google.com/docs?utm_source=chatgpt.com • https://developer.android.com/jetpack/compose?utm_source=chatgpt.com • https://docs.github.com/?utm_source=chatgpt.com • https://www.freecodecamp.org/?utm_source=chatgpt.com • https://play.kotlinlang.org/?utm_source=chatgpt.com

CSA3538 Agile software development

Course Code: CSA3538	**Course Name:** Agile software development **Type of Course:** Elective Course	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	CSA1505		
Anti-requisites	NIL		
Course Description	This intermediate course enables students to perform Agile software development using Java, with emphasis on employability skills. The course covers key technologies and architectures that enables the student to design and implement front-end. On successful completion of this course, the student shall be able to pursue a career in front end development. The students shall develop strong problem-solving skills as part of this course.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Agile software development using Java and attain Employability Skills through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain Agile philosophy, manifesto, principles, and frameworks [Understand] CO2 Apply Scrum artifacts, events, and roles in software projects [Apply] CO3 Perform Agile project planning, estimation, and release management [Apply] CO4 Develop software iteratively using Agile engineering practices [Apply] CO5 Use DevOps and CI/CD tools for Agile software delivery [Apply] CO6 Execute Agile team-based projects and evaluate sprint outcomes [Apply]		
Course Content:			
Module 1	Introduction to Agile Software Development		4 Sessions
Topics: Web Limitations of traditional SDLC models, Agile Manifesto and principles,Agile lifecycle,Agile vs Waterfall model,Incremental and iterative development,Agile methodologies ,Scrum			
Module 2	Scrum Framework		4 Sessions
Topics:			

Scrum values and pillars,Scrum roles:Product Owner,Scrum Master,Development Team,Scrum events:Sprint,Sprint Planning,Daily Scrum,Sprint Review		
Module 3	Agile Requirements and Estimation	4 Sessions
Topics: User stories,Story mapping,Acceptance criteria,INVEST principles,Estimation techniques:Planning Poker, Story Points,Velocity,Release planning		
Module 4	Agile Engineering Practices	3 Sessions
Topics: Extreme Programming (XP),Pair programming,Refactoring,Continuous Integration,Test Driven Development (TDD),Behavior Driven Development (BDD),Agile modeling,Coding standards,Agile testing strategies		
List of Experiments		60 Sessions

13. Installation and configuration of Git and GitHub
14. Creating repositories and performing version control operations
15. Agile team formation and Scrum role assignment
16. Creating Product Backlog using Jira/Trello
17. Writing effective User Stories using INVEST principles
18. Sprint planning and task allocation
19. Conducting Daily Scrum meetings and maintaining sprint logs
20. Story point estimation using Planning Poker
21. Pair programming implementation exercise
22. Refactoring existing codebase using Agile practices
23. Implementing Test Driven Development (TDD)
24. Unit testing using JUnit/PyTest

Text Books

T1 Orit Hazzan,Yael Dubinsky "Agile software engineering",Springer, 2008

T2 Ken Schwaber, Mike Beedle "Agile Software Development with Scrum",Prentice Hall, 2002

Reference Books

R1 Joachim Rossberg "Agile project mangement with Azure Devops" Apress,2019.

R2 Disha handa, Jarnail singh. "Agile and Beyond Software Development Practices",AKG GlobalPublishing House, 2023

E-Resources

5. Scrum Guide Official Website
6. Agile Alliance
7. Coursera Agile Development and Scrum
8. IIT Kanpur Agile Scrum Course

CSA3539 Devops and Microservices

Course Code: CSA3539	**Course Name:** Devops and Microservices **Type of Course:** Elective Course	L- T-P- C	2-0-2-3
Version No.	1		
Course pre-requisites	CSA1503		
Anti-requisites	NIL		

Course Description	This intermediate course enables students to perform Devopas and microservices development using python, with emphasis on employability skills. The course covers key technologies and architectures that enables the student to design and implement microservices. On successful completion of this course, the student shall be able to pursue a career in front end development. The students shall develop strong problem-solving skills as part of this course.
Course Objective	The objective of the course is to familiarize the learners with the concepts of Agile software development using Java and attain Employability Skills through Experiential Learning techniques.
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain Agile philosophy, manifesto, principles, and frameworks [Understand] CO2 Apply Scrum artifacts, events, and roles in software projects [Apply] CO3 Perform Agile project planning, estimation, and release management [Apply] CO4 Develop software iteratively using Agile engineering practices [Apply] CO5 Use DevOps and CI/CD tools for Agile software delivery [Apply] CO6 Execute Agile team-based projects and evaluate sprint outcomes [Apply]

Course Content:

Module 1	Introduction to Agile Software Development	4 Sessions

Topics:
Web Limitations of traditional SDLC models, Agile Manifesto and principles,Agile lifecycle,Agile vs Waterfall model,Incremental and iterative development,Agile methodologies ,Scrum

Module 2	Scrum Framework	4 Sessions

Topics:
Scrum values and pillars,Scrum roles:Product Owner,Scrum Master,Development Team,Scrum events:Sprint,Sprint Planning,Daily Scrum,Sprint Review

Module 3	Agile Requirements and Estimation	4 Sessions

Topics:
User stories,Story mapping,Acceptance criteria,INVEST principles,Estimation techniques:Planning Poker, Story Points,Velocity,Release planning

Module 4	Agile Engineering Practices	3 Sessions

Topics:
Extreme Programming (XP),Pair programming,Refactoring,Continuous Integration,Test Driven Development (TDD),Behavior Driven Development (BDD),Agile modeling,Coding standards,Agile testing strategies

List of Experiments — 60 Sessions

25. Installation and configuration of Git and GitHub
26. Creating repositories and performing version control operations
27. Agile team formation and Scrum role assignment
28. Creating Product Backlog using Jira/Trello
29. Writing effective User Stories using INVEST principles
30. Sprint planning and task allocation
31. Conducting Daily Scrum meetings and maintaining sprint logs
32. Story point estimation using Planning Poker
33. Pair programming implementation exercise
34. Refactoring existing codebase using Agile practices
35. Implementing Test Driven Development (TDD)
36. Unit testing using JUnit/PyTest

Text Books

T1 Orit Hazzan,Yael Dubinsky "Agile software engineering",Springer, 2008

T2 Ken Schwaber, Mike Beedle "Agile Software Development with Scrum",Prentice Hall, 2002

Reference Books
R1 Joachim Rossberg "Agile project mangement with Azure Devops" Apress,2019. **R2** Disha handa, Jarnail singh. "Agile and Beyond Software Development Practices",AKG GlobalPublishing House, 2023
E-Resources 9. Scrum Guide Official Website 10. Agile Alliance 11. Coursera Agile Development and Scrum 12. IIT Kanpur Agile Scrum Course

Track 6: Augmented Reality & Virtual Reality

CSA3540 Introduction to 3D graphics, VR workflows and Interactive Technologies

Course Code: CSA3540	Course Name: Introduction to 3D graphics, VR workflows and Interactive Technologies Type of Course: DSE	L-T-P-C	3-0-0-3
Version No.	1.0		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces the fundamental concepts of 3D computer graphics, virtual reality (VR), and interactive technologies used in game development, animation, visual effects, digital media, and immersive applications. Students will explore the complete 3D content creation workflow, including modelling, transformations, materials, texturing, lighting, cameras, rendering, and VR application pipelines. The course also provides an overview of industry-standard tools, rendering technologies, and career opportunities in computer graphics and immersive media.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of 3D Theories and Workflows and attain Employability Skills through Participative Learning techniques.		
Course Outcomes	On successful completion of the course the students shall be able to: **CO1:** Explain the fundamental concepts of 3D graphics, virtual reality systems, interactive technologies, and the 3D content creation workflow **[Understand]** **CO2:** Apply 3D object creation, geometric transformations, and modelling techniques to construct basic digital assets. **[Apply]** **CO3:** Apply materials, textures, shading, lighting, and rendering techniques to enhance the visual quality of 3D scenes. **[Apply]** **CO4:** Apply camera principles, rendering workflows, and interactive media concepts in the development of 3D and VR applications. **[Apply]**		

	CO5: Analyze 3D graphics workflows, rendering pipelines, and immersive technologies to evaluate their effectiveness in animation, gaming, VFX, visualization, and virtual reality applications. **[Analyze]**	
Course Content:		
Module 1	**Fundamentals of 3D Graphics and Virtual Reality**	10 Sessions
Topics: Introduction to computer graphics, fundamentals of 3D graphics, virtual reality (VR), augmented reality (AR), mixed reality (MR), components of VR systems, applications of 3D graphics and VR, interactive technologies, 3D content creation pipeline, manual modelling, procedural modelling, data-driven modelling, 3D asset creation workflows, industry-standard 3D software, game engines, overview of immersive media.		
Module 2	**3D Modeling and Object Transformation**	10 Sessions
Topics: Fundamentals of 3D geometry, Cartesian coordinate system, world and local coordinate systems, right-handed and left-handed coordinate systems, primitive object creation, polygonal modeling, additive and subtractive modeling, object selection techniques, component editing, translation, rotation, scaling, extrusion, bevel, inset, loop cut, polygon editing, object hierarchy, basic animation concepts.		
Module 3	**Materials, Texturing, Lighting, and Rendering**	12 Sessions
Topics: Rendering pipeline, material creation, material properties, shader fundamentals, Lambert shading, Phong shading, Blinn shading, texture mapping, UV mapping, UV unwrapping, procedural texturing, node-based materials, lighting fundamentals, types of light sources, shadows, reflections, rendering techniques, image formats, rendering output, scene optimization.		
Module 4	**Cameras, Rendering Workflows, and Interactive Media Applications**	13 Sessions
Topics: Camera fundamentals, perspective projection, orthographic projection, camera composition, field of view, depth of field, rendering engines, Arnold renderer, V-Ray renderer, RenderMan, Eevee, Cycles, NURBS overview, rendering optimization, interactive 3D workflows, VR application workflows, production pipelines, industry standards, animation workflows, visual effects workflows, game development workflows, immersive media applications, career opportunities, analysis of rendering pipelines and interactive technologies.		
Text Book T1: Kelly L. Murdock, Autodesk Maya 2022 Basics Guide, SDC Publications, 2022.		
References R1: Kelly L. Murdock, Autodesk Maya 2000 Basics Guide, SDC Publications, 2000.		

Web References
• https://sm-nitk.vlabs.ac.in/ • https://nptel.ac.in/courses

CSA3541 Introduction to Immersive Technologies

Course Code: **CSA3541**	Course Name: Introduction to Immersive Technologies Type of course: DSE	L-T-P-C	3-0-0-3
Version No.	1.0		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	The course aims to differentiate between various mixed reality systems, identify appropriate system components, understand immersion, calibration, tracking, challenges and health hazards associated with mixed reality, and predict the future direction of the Metaverse.		
Course Objective	To familiarize learners with the concepts of Introduction to Immersive Technologies and attain Skill Development through Participative Learning techniques.		
Course Outcomes	On successful completion of the course the students shall be able to: **CO1:** Explain the fundamental concepts, components, applications, and architectures of immersive technologies, including Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), and Extended Reality (XR) **[Understand]** **CO2:** Apply display technologies, tracking systems, sensor integration, and calibration techniques used in immersive environments. **[Apply]** **CO3:** Apply modelling, rendering, and scene creation techniques for developing immersive virtual and augmented reality environments. **[Apply]** **CO4:** Apply perception models, interaction techniques, user interface principles, and development frameworks to design immersive applications. **[Apply]** **CO5:** Analyze immersive technology ecosystems, Metaverse concepts, emerging trends, ethical considerations, and real-world applications to evaluate future opportunities and challenges. **[Analyze]**		
Course Content:			
Module 1	**Fundamentals of Immersive Technologies**		10 Sessions
Topics: Introduction to immersive technologies, virtual reality (VR), augmented reality (AR), mixed reality (MR), extended reality (XR), history and evolution of immersive technologies, components of immersive systems, characteristics of immersive environments, levels of immersion, presence and embodiment, applications of AR, VR, and MR in gaming, healthcare, education, manufacturing, architecture, tourism, entertainment, industrial training, collaborative environments, challenges and limitations of immersive technologies.			

Module 2	**Display Systems, Tracking, and Sensor Technologies**	10 Sessions
Topics: Display technologies, head-mounted displays, handheld displays, projection-based displays, stereoscopic displays, visual perception, depth perception, audio displays, haptic interfaces, tactile feedback, olfactory and gustatory displays, tracking systems, optical tracking, inertial tracking, magnetic tracking, GPS-based tracking, marker-based tracking, markerless tracking, sensor fusion, mobile sensors, calibration, registration, spatial mapping, motion capture, latency, distortion, performance optimization.		
Module 3	**Modelling, Rendering, and Immersive Content Development**	12 Sessions
Topics: 3D modelling fundamentals, geometric modelling, scene representation, transformation techniques, rendering pipeline, rendering algorithms, shading, lighting, texturing, animation concepts, physical modelling, kinematic modelling, behavioural modelling, scene management, asset optimization, real-time rendering, virtual environment creation, augmented reality content creation, immersive application development workflow, development platforms and software tools.		
Module 4	**Interaction Design, Metaverse, and Emerging Trends**	13 Sessions
Topics: Human perception models, cognition in immersive environments, interaction techniques, user interface design for VR and AR, gesture-based interaction, voice interaction, eye tracking, VR programming toolkits, AR development frameworks, mixed reality interaction, collaborative virtual environments, Metaverse concepts, digital avatars, virtual economies, digital twins, ethical issues, privacy and security, health and safety considerations, accessibility, industry standards, emerging trends, future directions of immersive technologies.		
Text Book T1: D. Schmalstieg and T. Höllerer, Augmented Reality, Pearson Education, 2016. T2: J. Jerald, The VR Book: Human-Centered Design for Virtual Reality, 2016. T3: Charlie Fink's Metaverse - An AR Enabled Guide To AR & VR, 2018.		
References R1: S. Aukstakalnis, Practical Augmented Reality, Pearson Education, 2017. R2: Burdea and Coffet, Virtual Reality Technology, Wiley, 2014.		
Web References Virtual Reality Engineering (NPTEL - IIT Madras) Introduction to Augmented Reality and ARCore (Coursera) https://presiuniv.knimbus.com/user#/home		

CSA3543 Character Modelling and Rigging

Course Code: **CSA3543**	**Course Title: Character Modelling and Rigging** **Type of Course: DSE**	**L- T-P- C**	1-0-4-3
Version No.	1		
Course Pre-requisites	Students should have basic knowledge of Graphic Design		
Anti-requisites	Nil		
Course Description	This course is designed, to fundamentals of Character modelling and rigging through the interface of the blender tool, this comprehensive course is packed with useful techniques that ease you into the workflow of the program to meet the industry's need for creating character designing and rigging methods to create models that are essential for research and study. A character rigger generates the internal structural frameworks and controls of a 3D model, defining how the student will be able to manipulate it. Their goal is to build a skeleton that will operate a character and bring it to real life.		
Course Objective	The objective of the course is to familiarize the learners with the concepts **Character Modelling and Rigging** and attain **Skill Development** through E**xperiential Learning** techniques.		
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1:** Explain the fundamental concepts and tools of Blender for 3D modelling and content creation. **[Understand]** **CO2:** Apply Blender modelling techniques to create 3D assets and characters for games and animation. **[Apply]** **CO3:** Develop original 3D character models with appropriate topology and design principles. **[Apply]** **CO4:** Implement rigging and character setup techniques for animation-ready 3D models. **[Apply]** **CO5:** Analyze and evaluate 3D character designs based on aesthetics, functionality, and animation requirements. **[Analyze]**		
Course Content:			

Module 1	**Blender Fundamentals and 3D Modelling Basics**	Assignment	Data Collection/Interpretation	**4 Sessions**
Introduction to Blender and its applications in game development and animation; Blender User Interface and Workspace Management; Navigation in 3D Viewport; Object Mode and Edit Mode; Selection and Transformation Tools; Mesh Editing (Vertices, Edges, Faces); Primitive Objects and Basic Modelling; Modifiers (Mirror,				

<table>
<tr><td colspan="5">Subdivision Surface, Solidify, Bevel); Materials and Basic Shading ; Lighting, Cameras, and Rendering Fundamentals; File Management and Project Organization</td></tr>
<tr><td>Module 2</td><td>Character Modelling and Asset Creation</td><td>Case studies / Case let</td><td>Case studies</td><td>4 Sessions</td></tr>
<tr><td colspan="5">Character Design Principles; Character Concept Development and Reference Images; Character Production Pipeline (Pre-production, Production, Post-production); Low-poly and High-poly Modelling Techniques; Head and Facial Modelling; Modelling Eyes, Mouth, Nose, and Ears; Modelling Torso, Arms, Hands, Legs, and Feet; Retopology Concepts; UV Unwrapping; Materials and Texture Mapping; Character Optimization for Games.</td></tr>
<tr><td>Module 3</td><td>Character Rigging and Animation Setup</td><td>Quiz</td><td>Case studies</td><td>4 Sessions</td></tr>
<tr><td colspan="5">Introduction to Rigging; Armatures and Bone Structure; Skeleton Creation; Bone Hierarchy and Parenting; Forward Kinematics (FK); Inverse Kinematics (IK); Constraints and Bone Constraints; Skinning and Weight Painting; Facial Rigging; Custom Rig Controls; Rig Testing and Troubleshooting</td></tr>
<tr><td>Module 4</td><td>Character Refinement, Animation Preparation, and Evaluation</td><td>Quiz</td><td>Case studies</td><td>3 Sessions</td></tr>
<tr><td colspan="5">Shape Keys and Facial Expressions; Character Posing; Basic Character Animation Preparation; Walk Cycle Preparation; Cloth and Hair Simulation Basics; Exporting Characters for Unity and Unreal Engine; Character Optimization for Real-Time Applications; Rendering and Presentation; Evaluation of Character Design, Rig Quality, and Animation Readiness; Mini Project: Complete Character Modeling and Rigging.</td></tr>
<tr><td colspan="5">List of Laboratory Tasks:
1. Introduction to Blender Interface and Workspace Management
2. Basic 3D Modelling Using Primitive Objects and Mesh Editing
3. Applying Transformations, Modifiers, Materials, and Lighting
4. Designing a Character Concept Using Reference Images
5. Modelling a Low-Poly Character
6. Modelling Facial Features (Eyes, Nose, Mouth, and Ears)
7. Modelling the Complete Character Body with Proper Topology
8. UV Unwrapping and Applying Materials and Textures
9. Creating an Armature and Basic Character Skeleton
10. Implementing Forward Kinematics (FK) and Inverse Kinematics (IK)
11. Skinning, Weight Painting, and Bone Constraint Setup
12. Creating Facial Rigging and Custom Rig Controls
13. Testing Rig Functionality through Character Posing and Basic Animation</td></tr>
</table>

14. Exporting an Animation-Ready Character for Unity/Unreal Engine
15. Mini Project: Design, Model, Rig, and Present a Fully Functional 3D Character

Targeted Application & Tools that can be used

Blender

Project work/Assignment:

Assignment:

1. Modeling a simple, low-poly character and rigging it with a basic skeleton rig.
2. Experimenting with different rigging techniques, such as forward kinematics, inverse kinematics, and constraint-based rigging.
3. Rigging a character for basic body animations, such as walking, running, jumping, etc.
4. Rigging a character's face for simple facial expressions, such as smiling and frowning.
5. Integrating character animation with basic special effects, such as particle effects or light sources.

Text Book

T1 Oliver Villar, "Learning Blender: A Hands-On Guide to Creating 3D Animated Characters", Pearson, second edition, 2015.

References

1. 3D Totol Publisher, "beginner's Guide to Creating Characters in Blender Paperback", 3DTotal Publishing 2021.

2. Xury Greer "Sculpting the Blender Way: Explore Blender's 3D sculpting workflows and latest features, including Face Sets, Mesh Filters, and the Cloth brush", Packet Publishing, 2022.

CSA3544 Programming in C# with Unity

Course Code: **CSA3544**	**Course Title: Programming in C# with Unity** **Type of Course: DSE**	**L- T-P- C**	**1-0-4-3**
Version No.	1		
Course Pre-requisites	Object Oriented Programming fundamentals, Mathematical Concepts		
Anti-requisites	Nil		

Course Description	This course introduces the fundamentals of C# programming and scripting for interactive application and game development using the Unity Game Engine. Students will learn object-oriented programming concepts, Unity scripting APIs, event-driven programming, game object manipulation, physics-based interactions, user interface development, and scene management. Through hands-on laboratory exercises and project-based learning, students will develop interactive Unity applications while applying debugging, testing, and scripting best practices to create efficient, reusable, and maintainable game logic.	
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Programming in C# with Unity** and attain **Skill Development** through E**xperiential Learning** techniques.	
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1: Describe the fundamental concepts of C# programming, object-oriented programming, and Unity scripting required for interactive application development. [Understand] CO2: Apply C# programming constructs and Unity scripting APIs to implement object transformations, input handling, and game object behaviours in Unity. [Apply] CO3: Apply Unity physics components, including Rigidbody, Colliders, and Triggers, to implement physics-based interactions and event-driven gameplay. [Apply] CO4: Apply Unity game objects, scene management, user interface components, and scripting techniques to develop interactive Unity applications and game scenes. [Apply] CO5: Analyze Unity applications and game scenes to evaluate scripting efficiency, gameplay functionality, performance, and user experience for improvement. [Analyze]	
Course Content:		
Module 1	Fundamentals of C# Programming and Unity Scripting	**3 Sessions**
Topics: Introduction to Unity Game Engine and Unity Project Structure; Introduction to C#; Variables, Data Types, Operators, and Expressions; Control Statements (if-else, switch); Loops (for, while, foreach); Methods and Functions; Creating and Attaching C# Scripts in Unity; MonoBehaviour and Script Lifecycle (Awake, Start, Update); Debugging and Console Output.		
Module 2	Object-Oriented Programming and Game Object Manipulation	**5 Sessions**
Topics: Object-Oriented Programming Concepts - Classes and Objects, Constructors, Encapsulation, Inheritance, Polymorphism; Unity Game Objects and Components; Transform Component (Position, Rotation, Scale); Input Handling; Object Movement and Rotation; Prefabs and Tags; Basic Animation using Scripts		
Module 3	Creating events in unity	**3 Sessions**

Topics:

Unity Physics Engine; Rigidbody Components; Colliders and Collision Detection; Trigger Events; Raycasting; Event-Driven Programming; Collision Layers; Audio Sources and Sound Effects; Particle Systems; Interactive Game Objects..

Module 4	Scene Management, User Interface, and Unity Application Development	**4 Sessions**

Topics:

Scene Management; UI Components (Canvas, Text, Button, Image, Slider); Event System; Game Manager; Score and Health Management; Saving Game States; Project Organization; Testing and Debugging Unity Applications; Build Settings and Application Publishing; Performance Optimization and User Experience Evaluation

List of Laboratory Tasks:

- Introduction to C# Programming and Unity IDE
- Writing Basic C# Programs using Variables, Operators, and Control Statements
- Creating and Attaching C# Scripts to Unity Game Objects
- Implementing Methods, Loops, and Functions in Unity Scripts
- Working with Classes, Objects, and Object-Oriented Programming Concepts
- Manipulating Game Objects using Transform (Position, Rotation, and Scale)
- Implementing Keyboard and Mouse Input for Object Control
- Creating Interactive Game Objects using Prefabs and Tags
- Implementing Rigidbody Components for Physics-Based Movement
- Working with Colliders, Collision Detection, and Trigger Events
- Developing User Interfaces using Canvas, Buttons, Text, and Images
- Implementing Scene Management and Game Manager Scripts
- Integrating Audio, Particle Effects, and Basic Animations
- Testing, Debugging, and Publishing a Unity Application
- Mini Project: Development of an Interactive Unity Game/Application

Targeted Application & Tools that can be used

IDEs, VS Extensions, Compilers, Editors & Serializers, Decompilers & Code Conversion Tools, Build Automation & Merge Tools, Version Control, Testing Tools & VS Extensions, Profilers.

Project work/Assignment:

Assignment:

1. Writing the Scripts for C# fundamentals. 2. Writing the programs for unity basic operations. 3. Writing the programs to develop the game in unity.
Text Book T1: Patrick Felicia, "Mastering C# with Unity", Epackt 2017 T2: Jeff W Murrey "C# Game Programming for Unity 3D" , CRC Press 2019.
Reference 1. https://unity.com/how-to/programming-unity 2. https://learn.unity.com/course/create-with-code

CSA3545 Augmented Reality Development

Course Code: **CSA3545**	**Course Title: Augmented Reality Development.** **Type of Course: DSE**	**L- T-P- C**	**1-0-4-3**
Version No.	1		
Course pre-requisites	Introduction to Immersive Technologies. Unity Engine.		
Anti-requisites	Nil		
Course Description	This course provides practical knowledge and skills for designing and developing Augmented Reality (AR) applications using modern cross-platform frameworks and the Unity Game Engine. Students will explore the complete AR development workflow, including AR scene creation, image and plane tracking, spatial mapping, anchors, environmental understanding, interaction design, and mobile deployment. The course introduces AR Foundation, ARCore, ARKit, XR Interaction Toolkit, and related development tools to create immersive AR experiences for Android and iOS devices. Through project-based learning, students will design, implement, test, and evaluate interactive AR applications while applying industry-standard development practices and user experience principles.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Augmented Reality Development and attain SKILL DEVELOPMENT of student by using EXPERIENTIAL LEARNING techniques		

<table>
<tr><td>Course Out Comes</td><td colspan="4">On successful completion of the course the students shall be able to:

CO1: Explain the fundamental concepts, architectures, components, and applications of Augmented Reality systems and mobile AR technologies. [Understand]
CO2: Apply AR development workflows, Unity AR Foundation, and spatial understanding techniques to create immersive AR experiences. [Apply]
CO3: Apply image tracking, plane detection, anchors, environment understanding, and sensor integration to develop interactive AR applications. [Apply]
CO4: Apply Unity tools, AR frameworks, user interface components, and interaction techniques to implement complete mobile AR applications. [Apply]
CO5: Analyze the functionality, usability, performance, and user experience of Augmented Reality applications to identify improvements and optimize application quality. [Analyze]</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Fundamentals Of Augmented Reality Development</td><td>Assignment</td><td>Data Collection/Interpretation</td><td>4 Sessions</td></tr>
<tr><td colspan="5">Topic:

Introduction to Augmented Reality, history and evolution of AR, AR, VR, MR, and XR ecosystem, components of AR systems, mobile AR architecture, applications of AR in gaming, healthcare, education, retail, manufacturing, tourism, digital marketing, Industry 4.0, AR development workflow, Unity XR ecosystem, Unity AR Foundation, Google ARCore, Apple ARKit, OpenXR, project setup, Android and iOS deployment requirements.</td></tr>
<tr><td>Module 2</td><td>AR Scene Creation, Tracking, and Spatial Understanding</td><td>Case studies / Case let</td><td>Case studies / Case let</td><td>4 Sessions</td></tr>
<tr><td colspan="5">Topics:

Unity AR Foundation project setup, AR Session and AR Session Origin, camera configuration, plane detection, raycasting, image tracking, marker-based AR, markerless AR, object placement, anchors, persistent anchors, environment understanding, spatial mapping, feature point detection, light estimation, occlusion, depth sensing, environmental probes</td></tr>
<tr><td>Module 3</td><td>Interactive AR Application Development</td><td>Quiz</td><td>Case studies / Case let</td><td>4 Sessions</td></tr>
<tr><td colspan="5">Topics

User interaction in AR, gesture recognition, touch interaction, object manipulation, UI integration, animation in AR, audio integration, particle systems, physics engine, Rigidbody, Colliders, Triggers, object spawning, virtual object persistence, scripting interactive AR applications, navigation and scene management, optimization for mobile devices.</td></tr>
<tr><td>Module 4</td><td>Advanced AR Applications, Deployment, and Evaluation</td><td>Quiz</td><td>Case studies / Case let</td><td>3 Sessions</td></tr>
</table>

Topics

Face tracking, body tracking, object tracking, cloud anchors, shared AR experiences, location-based AR, geospatial APIs, XR Interaction Toolkit, application testing, debugging, performance optimization, memory management, battery optimization, APK and IPA deployment, user experience evaluation, accessibility considerations, security and privacy in AR, case studies, future trends in Augmented Reality and Spatial Computing.

List of Laboratory Tasks:

- Installation and configuration of Unity, AR Foundation, ARCore XR Plugin, and Android Build Support.
- Creating the first AR Foundation project and deploying it to an Android device.
- Plane detection and virtual object placement using touch interaction.
- Developing a marker-based AR application using image tracking.
- Implementing markerless AR using plane detection and anchors.
- Object manipulation using translation, rotation, and scaling gestures.
- Creating interactive AR scenes using UI elements and event handling.
- Applying lighting estimation, environmental probes, and occlusion.
- Developing an AR application with animation and particle effects.
- Implementing physics-based interactions using Rigidbody, Colliders, and Triggers.
- Building an AR face filter application using face tracking.
- Developing a location-based AR application using GPS and geospatial data.
- Optimizing AR applications for mobile performance and battery efficiency.
- Testing, debugging, and deploying AR applications on Android devices.
- **Mini Project:** Design and develop a complete mobile AR application integrating tracking, interaction, animation, physics, and user interface components.

Targeted Application & Tools that can be used

IDEs Unity Engine. Vuforia Databases, AR Foundation, AR core, Android 11 + mobile Phones

Project work/Assignment:

Assignment:

4. Create a Apk file that shows Dragon Stimulator Using Image target
5. Create a Apk file that Changes the colours by choosing the button

Text Book

1. Jesse Glover, Jonathan Linowes "*Complete Virtual Reality and Augmented Reality Development with Unity*" , 1st ed., Packt Publishing, 2019.

2. Jesse Glover "*Unity 2018 Augmented Reality Projects: Build four immersive and fun AR applications using ARKit, ARCore, and Vuforia*" , 1st ed., Packt Publishing Limited, 2018

References

3. Jonathan Linowes "*Unity Virtual Reality Projects*",2nd ed., Packt Publishing Limited, 2018.
4. https://www.vttresearch.com/sites/default/files/pdf/science/2012/S3.pdf
5. https://www.softwaretestinghelp.com/what-is-augmented-reality/

CSA3546 Virtual Reality Development

Course Code: **CSA3546**	**Course Title: Virtual Reality Development** **Type of Course:** DSE	**L-T-P- C**	1-0-4-3
Version No.	1.0		
Course Pre-requisites	Introduction to immersive Technologies, Programming in C#		
Anti-requisites	NIL		
Course Description	This course provides practical knowledge and skills for designing and developing immersive Virtual Reality (VR) applications using modern XR technologies and the Unity Game Engine. Students explore the complete VR development workflow, including XR project setup, 3D interaction, locomotion, spatial user interfaces, physics, environmental design, user experience, optimization, and deployment for standalone and PC-based VR headsets. The course introduces OpenXR, Unity XR Interaction Toolkit, VR input systems, hand tracking, teleportation, spatial audio, and immersive user interface design while emphasizing human factors, usability, performance optimization, and best practices. Through project-based learning, students develop, test, and evaluate complete VR experiences for gaming, education, simulation, healthcare, and industrial training.		
Course Objective	This course is designed to improve the learners **EMPLOYABILITY** of the students by using **EXPERIENTIAL LEARNING** Methodologies		
Course Out Comes	On successful completion of the course the students shall be able to: **CO1:** Explain the fundamental concepts, architectures, hardware components, interaction techniques, and applications of modern Virtual Reality systems. **[Understand]** **CO2:** Apply Unity XR development tools, OpenXR, XR Interaction Toolkit, and VR interaction techniques to develop immersive virtual environments. **[Apply]** **CO3:** Apply locomotion systems, physics interactions, spatial user interfaces, and scripting techniques to create interactive Virtual Reality applications. **[Apply]**		

	CO4: Analyze Virtual Reality interaction techniques, locomotion methods, usability, and user experience to improve immersion, accessibility, and user comfort. **[Analyze]** **CO5:** Analyze the performance, functionality, deployment strategies, and application of Virtual Reality systems across gaming, education, healthcare, industrial training, and simulation environments. **[Analyze]**			
Course Content:				
Module 1	**Fundamentals of Virtual Reality and XR Development**	Assignments	Study on VR HMD Device Architecture	**4 Sessions**
Topics: Introduction to Virtual Reality, Extended Reality (XR) ecosystem, history and evolution of VR, VR hardware architecture, head-mounted displays (HMDs), standalone and PC-based VR systems, OpenXR architecture, VR system components, controllers, sensors, tracking technologies, six degrees of freedom (6DoF), room-scale VR, spatial computing, applications of VR in gaming, healthcare, education, manufacturing, architecture, simulation, digital twins, Unity XR ecosystem, VR development workflow.				
Module 2	**VR Environment Design and Interaction Development**	Assignments	Assignment on "Challenges in VR Movement"	**4 Sessions**
Topics: Unity XR project setup, XR Interaction Toolkit, XR Origin, VR camera rig, controller input, object interaction, ray interactors, direct interaction, grab interaction, UI interaction in VR, virtual object manipulation, teleportation, continuous locomotion, snap turning, climbing systems, environment design, lighting, spatial audio, physics, colliders, rigidbody components, VR scene management.				
Module 3	**Interactive VR Application Development**	Project	VR Experience (Locomotion)	**4 Sessions**
Topics: C# scripting for VR, event-driven programming, hand tracking, gesture interaction, physics-based interaction, virtual user interfaces, world-space canvas, animation in VR, particle systems, environmental effects, optimization techniques, performance profiling, frame rate optimization, latency reduction, comfort guidelines, accessibility features, mobile VR optimization, standalone headset deployment.				
Module 4	**User Experience, Evaluation, and Applications**	Project	VR Game Development	**3 Sessions**
Topics: Human perception in VR, presence, immersion, cybersickness, user comfort, cognitive load, usability evaluation, VR testing methodologies, interaction evaluation, user experience metrics, collaborative virtual environments, multiplayer VR, digital twins, VR simulations, serious games, industrial training applications,				

healthcare applications, educational VR, deployment to Meta Quest devices, case studies, ethical issues, privacy, future trends in virtual reality and spatial computing.

List of Laboratory Tasks:

1. Installing and configuring Unity XR, OpenXR Plugin, and XR Interaction Toolkit.
2. Creating a VR project and configuring XR Origin.
3. Designing a basic virtual environment with lighting and navigation.
4. Implementing VR locomotion using teleportation and continuous movement.
5. Developing object interaction using grab and release mechanics.
6. Implementing ray-based interaction and world-space user interfaces.
7. Developing physics-based interactions using Rigidbody and Colliders.
8. Creating interactive VR environments using C# scripting.
9. Integrating spatial audio and environmental effects into VR scenes.
10. Implementing hand tracking and gesture-based interactions.
11. Developing VR menus and user interface systems.
12. Optimizing VR applications for performance and user comfort.
13. Building and deploying VR applications to Meta Quest or compatible OpenXR devices.
14. Evaluating VR usability, immersion, and accessibility through user testing.
15. **Mini Project:** Design, develop, optimize, and deploy a complete Virtual Reality application for gaming, education, healthcare, simulation, or industrial training.

Targeted Application & Tools that can be used:

Unity3D, Blender

Assignment:

1. Assignments are given after completion of each module which the student need to submit within the stipulated deadline.

Text Book

T1. LaValle, Steven M. Virtual reality. Cambridge university press, 2023.

T2. D.A. Bowman et al., “3D User Interfaces: Theory and Practice”2017, Addison Wesley.

T3. GJ Kim, “Designing VR Systems: The Structured Approach”,2011, Springer.

References

R1 Tacgin, Z. (2020). Virtual and augmented reality: an educational handbook. Cambridge Scholars Publishing.

R2 Linowes, J. (2020). Unity 2020 Virtual Reality Projects: Learn VR development by building immersive applications and games with Unity 2019.4 and later versions. Packt Publishing Ltd.

Web Resources
W1. https://unity.com/solutions/vr
W2. https://docs.unity3d.com/Manual/VROverview.html

CSA3547 Mixed Reality Development

Course Code: **CSA3547**	**Course Title: Mixed Reality Development** **Type of Course:** DSE	**L-T-P- C**	1-0-4-3
Version No.	1.0		
Course Pre-requisites	CSA3546		
Anti-requisites	NIL		
Course Description	This course provides practical knowledge and hands-on experience in designing, developing, and deploying Mixed Reality (MR) applications using modern spatial computing technologies and industry-standard development frameworks. Students explore the complete Mixed Reality development lifecycle, including spatial mapping, scene understanding, environmental awareness, object anchoring, hand and eye tracking, gesture and voice interactions, and immersive user interface design. The course introduces Unity, OpenXR, Mixed Reality Toolkit (MRTK3), XR Interaction Toolkit, and cloud-based spatial services for developing cross-platform Mixed Reality applications. Through project-based learning, students create, optimize, test, and evaluate immersive applications for education, healthcare, manufacturing, digital twins, architecture, remote collaboration, and industrial training while applying modern user experience, accessibility, and performance optimization principles.		
Course Objective	The objective of the course is to enable learners to design, develop, and deploy Mixed Reality applications using industry-standard tools and frameworks while attaining practical development skills through experiential learning and project-based activities.		
Course Out Comes	On successful completion of the course the students shall be able to: **CO1:** Explain the principles, architectures, hardware components, interaction techniques, and applications of Mixed Reality and spatial computing systems. **[Understand]** **CO2:** Apply Unity, OpenXR, Mixed Reality Toolkit (MRTK3), and XR Interaction Toolkit to develop interactive Mixed Reality environments. **[Apply]** **CO3:** Apply spatial mapping, scene understanding, environmental sensing, object anchoring, and multimodal interaction techniques to develop immersive Mixed Reality applications. **[Apply]** **CO4:** Analyze Mixed Reality interaction methods, user interface design, accessibility, usability, and collaborative experiences to improve user engagement and application effectiveness. **[Analyze]**		

	CO5: Analyze the performance, deployment strategies, scalability, security, ethical considerations, and industrial applications of Mixed Reality systems for real-world problem solving. **[Analyze]**	
Course Content:		
Module 1	**Fundamentals of Mixed Reality and Spatial Computing**	**4 Sessions**
Topics: Introduction to Mixed Reality, evolution of Virtual Reality, Augmented Reality, Mixed Reality and Extended Reality (XR), Mixed Reality continuum, spatial computing concepts, components of Mixed Reality systems, OpenXR architecture, Mixed Reality hardware platforms, head-mounted displays, sensors, depth cameras, environmental sensing, coordinate systems, applications of Mixed Reality in education, healthcare, manufacturing, architecture, digital twins, industrial training, remote collaboration, entertainment, emerging trends in spatial computing.		
Module 2	**Mixed Reality Application Development**	**4 Sessions**
Topics: Unity for Mixed Reality development, OpenXR, Mixed Reality Toolkit (MRTK3), XR Interaction Toolkit, project setup and configuration, XR Origin, scene creation and management, world-space user interfaces, spatial coordinate systems, object placement, object manipulation, controller interaction, hand tracking, gesture recognition, gaze interaction, voice interaction, scripting for Mixed Reality applications, development workflow, debugging, best practices		
Module 3	**Spatial Understanding and Environmental Interaction**	**4 Sessions**
Topics: Spatial mapping, scene understanding, environmental awareness, surface detection, plane detection, object recognition, environmental meshing, spatial anchors, cloud anchors, persistent content placement, lighting estimation, occlusion, real-world object interaction, physics integration, collision detection, shared spatial experiences, collaborative Mixed Reality, optimization for real-time Mixed Reality applications.		
Module 4	**User Experience, Evaluation, and Advanced Mixed Reality Applications**	**3 Sessions**
Topics: Human factors in Mixed Reality, immersive user experience design, multimodal interaction, accessibility and inclusive design, usability evaluation, performance profiling, latency reduction, power optimization, security and privacy in Mixed Reality, deployment on Microsoft HoloLens and Meta Quest devices, enterprise Mixed Reality applications, digital twins, smart manufacturing, collaborative workspaces, AI-assisted spatial computing, ethical considerations, future trends in Mixed Reality.		
List of Laboratory Tasks: 1. Installation and configuration of Unity, OpenXR, XR Interaction Toolkit, and Mixed Reality Toolkit (MRTK3). 2. Creating and configuring a Mixed Reality project with XR Origin and OpenXR. 3. Designing a basic Mixed Reality environment with interactive 3D objects. 4. Implementing object placement, translation, rotation, and scaling using C# scripts.		

5. Creating world-space user interfaces and interactive menus.
6. Implementing hand tracking and gesture-based interactions.
7. Developing gaze-based interaction and eye-tracking interfaces.
8. Integrating voice commands and speech recognition into Mixed Reality applications.
9. Performing spatial mapping and environmental scanning.
10. Detecting surfaces and placing persistent virtual content using spatial anchors.
11. Implementing scene understanding and environmental awareness.
12. Developing collaborative or shared Mixed Reality experiences using cloud anchors.
13. Applying physics, collision detection, and real-world object interaction.
14. Testing, debugging, optimizing, and deploying Mixed Reality applications on HoloLens or Meta Quest devices.
15. Mini Project: Design, develop, optimize, and evaluate a complete Mixed Reality application for education, healthcare, industrial training, digital twins, architecture, or collaborative workspaces.

Targeted Application & Tools that can be used:

Unity3D, Blender

Assignment:

Assignments are given after completion of each module which the student need to submit within the stipulated deadline.

Text Book

T1. Steve Aukstakalnis, *Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR*, Addison-Wesley Professional, 2016.

T2. Jason Jerald, *The VR Book: Human-Centered Design for Virtual Reality*, ACM Books, 2016.

References

R1. Dieter Schmalstieg and Tobias Höllerer, *Augmented Reality: Principles and Practice*, Addison-Wesley Professional, 2016.

R2. Grigore C. Burdea and Philippe Coiffet, *Virtual Reality Technology*, 2nd Edition, Wiley India, 2017.

Web Resources

- https://learn.microsoft.com/en-us/windows/mixed-reality/develop/development
- https://learn.microsoft.com/en-us/windows/mixed-reality/mrtk-unity/mrtk3-overview/
- https://learn.unity.com/
- https://developers.meta.com/horizon/develop/

Track 7: Gaming Technology

CSA3548 Fundamentals of Game Design, Game Mechanics and Dynamics

Course Code: **CSA3548**	**Course Title:** Fundamentals of Game Design, Game Mechanics and Dynamics **Type of Course: DSE**	**L- T- P- C**	3-0-0-3

Version No.	1.0			
Course Pre-requisites				
Anti-requisites	**NIL**			
Course Description	This course introduces the fundamental principles of game design, game mechanics, and gameplay dynamics that underpin engaging interactive experiences. Students will explore the relationship between game aesthetics, mechanics, dynamics, and player experience while learning the core concepts of game systems, rules, balance, progression, and level design. The course covers the physics principles essential for designing realistic and interactive game environments, along with an understanding of player psychology, game genres, and user engagement. By adopting a holistic and iterative design approach, students will develop the analytical and creative skills required to conceptualize, evaluate, and communicate effective game design solutions for contemporary digital games.			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Introduction to Game Design** and attain **Skill Development** through **Participative Learning** techniques.			
Course Out Comes	On successful completion of the course the students shall be able to: **CO1:** Describe the fundamental concepts, principles, and elements of game design, including game mechanics, dynamics, aesthetics, and player experience. **[Understand]** **CO2:** Apply storytelling principles and narrative design techniques to develop engaging game stories, characters, and gameplay scenarios. **[Apply]** **CO3:** Apply game design frameworks, mechanics, and balancing techniques to design interactive and engaging gameplay systems. **[Apply]** **CO4:** Apply physics, and game environment concepts to design realistic and interactive game worlds and gameplay experiences. **[Apply]** **CO5:** Analyze game mechanics, player engagement, game balance, and ethical considerations to evaluate the effectiveness of game designs. **[Analyze]**			
Course Content:				
Module 1	Overview of Games and their Design	Assignment	Programming	**10 Sessions**
Topics: Introduction to Games and the Gaming Industry – Evolution of Digital Games – Game Genres and Platforms – Overview of the Game Development Life Cycle –Rules, Goals, Challenges, Feedback and Player Interaction, Business models – Fundamentals of Game Systems – Player Experience (PX) and Player Motivation.				
Module 2	Storytelling for Games	Assignment/Case Study	Programming/Simulation	**10 Sessions**

Topics:

Introduction to Storytelling in Games – Ideation and Concept Development – Elements of an Engaging Story – Narrative Structure: Plot, Story Arc and Timelines – Themes and World Building – Character Design and Character Development – Scenarios, Scenes and Mission Design – Hooks, Twists and Player Motivation – Interactive Storytelling, Branching Narratives and Player Choice – Narrative Design Tools and Storyboarding for Games.

Module 3	Games Mechanics	Assignment	Programming	**15 Sessions**

Topics:

Game Mechanics and Core Gameplay Loops – Mechanics, Dynamics and Player Interaction – Rules, Objectives, Rewards and Progression Systems – Game Balancing: Difficulty Curves, Risk–Reward and Economy Design – Physics Concepts in Games: Motion, Collision, Gravity and Simulation – Game Worlds and Environmental Design – Designing Interactive Gameplay Systems using Game Mechanics and Physics Principles.

Module 4	Player Experience and Game Evaluation	Assignment	Programming/Simulation	**10 Sessions**

Topics:

Player Experience (PX) and Player Engagement – Motivation, Flow and Immersion – Evaluation of Game Mechanics and Game Balance – Goals, Rewards, Penalties and Feedback Systems – Challenge Design: Difficulty Curves, Obstacles and Risk–Reward Balance – Time and Pacing in Gameplay – Communication with Players through Interface and Visual Cues – Common Game Design Patterns and Clichés – Accessibility, Inclusivity and Ethical Considerations in Game Design – Case Studies and Critical Analysis of Successful Games.

Text Book

1. Michael Moore, Basics of Game Design, CRC Press, 2016

2. Scott Rogers, “Level Up! The Guide to Great Video Game Design,” John Wiley Publishers, 2010

References

1. Ernest Adams, “Fundamentals of Game Design”, Pearson Education, 2012.
2. Jesse Schell, “The Art of Game Design: A book of lenses”, Morgan Kauffman Pub

Web References

1. https://presiuniv.knimbus.com/user#/home
2. https://game-developers.org/what-is-a-game-mechanic
3. https://vsquad.art/blog/what-are-game-mechanics-design-importance-and-real-examples

Course Code: **CSA3549**	**Course Title:** Preproduction Techniques and Interactive Media **Type of Course: DSE**	**L-T- P-C**	3-0-0-3
Version No.	1.0		
Course Pre-requisites			
Anti-requisites	**NIL**		
Course Description	This course introduces the principles and practices of preproduction for game development and interactive media projects. Students will learn the processes involved in concept development, ideation, narrative planning, game design documentation, storyboarding, prototype planning, and production workflow management. The course also covers project planning, feasibility analysis, team collaboration, and interactive media design principles required to transform creative ideas into structured and executable development plans. By the end of the course, students will be able to evaluate preproduction artifacts and apply industry-standard techniques to support efficient game and interactive media production.		
Course Objective	The Objective of the Course Is To Familiarize The Learners With The Concepts Of Preproduction Techniques and Interactive Media and attain **Skill Development** Through **Participative Learning** Techniques.		
Course Out Comes	On successful completion of the course the students shall be able to: **CO1:** Describe the principles, stages, and workflows involved in game preproduction and interactive media development. **[Understand]** **CO2:** Apply concept development, narrative design, and creative ideation techniques to develop game and interactive media concepts. **[Apply]** **CO3:** Develop game design documents, storyboards, concept art specifications, and prototype plans using standard preproduction practices. **[Apply]** **CO4:** Analyze game mechanics, level designs, user experience, and interactive media elements to enhance player engagement. **[Analyze]** **CO5:** Evaluate preproduction plans, documentation, project feasibility, and design decisions to ensure technical, creative, and production viability. **[Evaluate]**		
Course Content:			
Module 1	Game Concepts and Ideation		**12 Sessions**

Topics:

Introduction to the Game Development Pipeline – Preproduction Process and Workflow – Game Genres and Platforms – Concept Development and Ideation Techniques – Target Audience Analysis – Market Research and Competitive Analysis – Value Proposition – Brainstorming and Creative Thinking Techniques – Defining the Game Vision, Core Gameplay Loop and Design Goals.

Module 2	Storytelling and Game Design Documentation	**12 Sessions**

Topics:

Interactive Storytelling Fundamentals – Narrative Structures and Story Arcs – Character Development and World Building – Storyboarding and Narrative Visualization – Game Design Document (GDD) – Functional and Technical Specifications – Concept Art, Mood Boards and Style Guides – Documentation Standards and Collaborative Design Practices.

Module 3	Game Mechanics and Level Design	**10 Sessions**

Topics:

Core Game Mechanics and Gameplay Systems – Rules, Rewards and Progression Systems – Balancing Gameplay Mechanics – Principles of Level Design – Player Flow, User Experience (UX) and Accessibility – Prototype Planning and Low-Fidelity Prototyping – Iterative Design and Prototype Evaluation.

Module 4	Preproduction Planning and Project Evaluation	**11 Sessions**

Topics:

Project Planning and Scheduling – Resource Estimation and Budgeting – Team Structure, Roles and Responsibilities – Risk Assessment and Mitigation – Feasibility and Scope Analysis – Production Pipeline Planning – Design Reviews and Preproduction Milestones – Ethics and Intellectual Property in Game Development – Evaluation of Preproduction Artifacts and Pitch Presentation

Text Book

T1. Ernest Adams, *Fundamentals of Game Design*, 4th Edition, Pearson Education, 2021.

T2. Jesse Schell, *The Art of Game Design: A Book of Lenses*, 4th Edition, CRC Press, 2019.

References

R1. Katie Salen and Eric Zimmerman, *Rules of Play: Game Design Fundamentals*, MIT Press, 2004.

R2. Scott Rogers, *Level Up! The Guide to Great Video Game Design*, 3rd Edition, Wiley, 2014.

CSA3554 2D Game Design and Development

Course Code: **CSA3554**	**Course Title: 2D Game Design and Development** **Type of Course: DSE**	**L-T-P-C**	1-0-4-3
Version No.	1.0		
Course Pre-requisites	**Nil**		
Anti-requisites	NIL		
Course Description	This course introduces the principles and practical techniques required for designing and developing 2D games using the Unity Game Engine and C#. Students will learn the complete workflow of 2D game development, including sprite creation and animation, physics, scripting, level design, user interface development, asset management, and game deployment. Through hands-on laboratory exercises and project-based learning, students will develop playable 2D games while applying industry-standard development practices, debugging techniques, and iterative testing methodologies.		
Course Objective	The objective of the course is skill development of student by using Participative Learning techniques.		
Course Out Comes	At the end of the course the student should be able to: **CO1:** Describe the 2D game development workflow, game design process, and the features of the Unity Game Engine. **[Understand]** **CO2:** Apply the Unity Editor, project structure, game objects, components, and asset management for 2D game development. **[Understand]** **CO3:** Develop interactive gameplay using C# scripting, Unity APIs, physics, animation, and input systems. **[Apply]** **CO4:** Develop complete 2D game levels by integrating sprites, physics, user interfaces, audio, and gameplay mechanics. **[Apply]** **CO5:** Analyze and evaluate gameplay mechanics, level design, performance, and user experience to improve game quality. **[Analyze]**		
Course Content:			
Module 1	**Essentials of Game Design**		**4 Sessions**
Topics: Introduction to Game - Basic Elements of Play- Basic elements of games- Basic Game Design Tools- Constraint-Direct and indirect actions- Goals-Challenge- Skill, strategy, chance, and uncertainty- Decision-making and Feedback-Abstraction-Theme-Storytelling-Context of Play.			
Module 2	**The Kinds of Play & Working with Unity API**		**4 Sessions**

Topics:

The Kinds of Play- Competitive play, Cooperative play, Skill-based play, Experience-based play, Games of chance and uncertainty, Whimsical play, Role-playing, Player Experience -Introduction to fundamentals of game, Storytelling - basic programming using C#, Game Theory, Unity Interface- Tools- Windows – Game Objects, Components, Camera – Lightning -Building Platform and Project Preferences. Unity Editor Interface: Main Menu- Tool bar- Scene View-Game View-Hierarchy Window-Project Window-Inspector Window-Console Window-Status Bar -Primitive 2D Game Objects.

Assignment: Game Design Activities

Module 3	**Game Design Process and Working with Game Object in Unity**	**4 Sessions**

Topics:

Iterative Game Design Process – Conceptualize- Prototype- Playtest and Evaluate Game Play in 2D, 2D graphics – Sprites- Sprite Editor- Sprite Renderer - Sprite Creator - 2D physics - Rigidbody 2D, Box Collider 2D and Hinge Joint 2D. Sorting Layer and Order in Layer - Material/Shader.

Assignment: Game Programming

Module 4	**Game Prototyping, Design Values, Evaluation and 2D Game Development**	**3 Sessions**

Topics:

Paper prototypes - Physical Prototypes Playable prototypes - Art and sound prototypes - Core game prototypes - Complete game prototypes – Evaluation - Game Design Values: Experience – Theme - Point of view – Challenge - Decision-making - Skill, strategy, chance, and uncertainty - Introduction to Vectors, Game design- The structure of games, Materials and Textures, Game Objects, Components- Scripting: Unity Mono Behaviour Class-Mono Behaviour Methods / Messages - Rotations, Translations - Layers, Tags- Colliders, Collisions, Triggers- Physics, Physic Material, Vector Math Material, Texture, Shader – Lighting.

Case study: 2D Game Development

List of Laboratory Tasks:

1. Introduction to Game Design
2. Introduction to Unity Game Engine
3. I/O and Object Handing in Unity using C#
4. 2D Game Development Tools
5. Introduction 2D graphics – Sprites- Sprite Editor
6. Primitive 2D Game Objects. and Basic Tools
7. Working with Primitive Game Objects & Introduction Vector in 2D Game Design
8. Game Object Components and Materials and Textures
9. 2D Game Platform and Asset Management
10. Transformation of Objects
11. Colliders, Collisions, Triggers
12. Asset Management and Application
13. Advanced Unity Programming, & Menus.
14. 2D Platformer, Creating UI

15. 2D Game Development
Targeted Application & Tools that can be used: Unity 3D, Visual Studio
Project work/Assignment:
1. 2D Platformer Design 2. Game Development **3.** UI/UX Design
Textbook(s): 1. Jeff W Murray, "2D Unity", William Pollock 2015, 2. Alan Thorn, "Learn Unity for 2D Game Development", Tia 2017.
References 1. Jodessiah Sumpter, "Make a 2D Arcade Game in a Weekend With Unity", Apress 2015. 2. Ernest Adams, "Fundamentals of Game Design", Pearson Education, 2012. **Weblinks:** https://unity.com/solutions/2d https://docs.unity3d.com/Manual/index.html https://learn.unity.com/

CSA3555 3D Game Design and Development

Course Code: **CSA3555**	**Course Title: 3D Game Design and Development** **Type of Course:** Theory & Integrated Laboratory	**L-T-P-C**	1	0	4	3
Version No.	1.0					
Course Pre-requisites	2D Game Design and Development, Programming in C#					
Anti-requisites	NIL					
Course Description	This course provides practical knowledge and skills in designing and developing immersive 3D games using modern game engines such as Unity and Unreal Engine. Students will explore the complete 3D game development workflow, including scene creation, 3D asset integration, lighting, animation, physics, scripting, artificial intelligence, user interfaces, and gameplay programming. The course also introduces project organization, version control, optimization, testing, and deployment techniques for professional game development. Through project-based learning, students will design, implement, test, and evaluate complete 3D game prototypes while applying industry-standard tools, workflows, and best practices.					
Course Objective	This course is designed to improve the learners **EMPLOYABILITY of the students** by using **EXPERIENTIAL LEARNING** Methodologies					

Course Out Comes	On successful completion of the course the students shall be able to: **CO1:** Describe the components, behaviour, and workflow of 3D game objects and scenes in the Unity Game Engine. **[Understand]** **CO2:** Apply first-person and third-person player movement techniques, camera controls, and input systems to create interactive 3D gameplay. **[Apply]** **CO3:** Apply animation systems, character controllers, and scripting techniques to implement interactive 3D characters and game objects. **[Apply]** **CO4:** Apply Unity tools and programming techniques to integrate environments, gameplay mechanics, user interfaces, and interactive elements in 3D game levels. [**Create]** **CO5:** Analyze the functionality, gameplay mechanics, level design, performance, and user experience of 3D games to identify improvements in game quality and playability. **[Create]**			
Course Content:				
Module 1	**Introduction to 3D Game Development and Unity Fundamentals**	Assignments	Story Telling – Game Preproduction	**4 Sessions**
Introduction to 3D game development workflow; Overview of game engines: Unity and Unreal Engine; Unity Interface: Scene View, Game View, Hierarchy, Inspector, Project, Console; project structure and asset management; Game Objects, Components, Prefabs, Tags, Layers; Coordinate systems, Transforms (Position, Rotation, Scale); Importing and managing 3D assets (FBX, textures, materials); Creating and organizing 3D scenes; Lighting (Directional, Point, Spot, Area Lights); Cameras and Skyboxes; Terrain creation and environmental setup; Introduction to Physics Engine: Rigidbody and Colliders.				
Module 2	**Player Controllers, Cameras, Physics, and Gameplay Interaction**	Assignments	3D World – Game Analysis	**4 Sessions**
Unity Input System; Keyboard, Mouse, and Controller Inputs; First-Person Character Controller; Third-Person Character; Camera Systems -First-Person Camera, Third-Person Follow Camera, Cinemachine; Physics-based Movement; Collision Detection and Trigger Events; Raycasting and Object; Pick-up Systems and Interactive Objects; Collectibles, Doors, Switches, and Checkpoints; Basic Audio Integration				
Module 3	**Character Animation, AI, and Gameplay Programming**	Project	3D Character Animation	**4 Sessions**

Introduction to C# Scripting in Unity; MonoBehaviour Lifecycle; Variables, Methods, Classes, and Object-Oriented Concepts; Character Animation - Animator Controller, Animation States, Blend Trees, Animation Parameters; Character Controllers; Root Motion; NPC Development; Navigation Mesh (NavMesh); Enemy, Event-driven Programming; Particle Systems and Visual Effects.

Module 4	**Level Design, Optimization, Testing, and Deployment**	Project	Endless Runner Game	**3 Sessions**

Principles of 3D Level Design; Game Mechanics Integration; User Interface – Canvas, Buttons, Score, Menus, etc. ; Saving and Loading Game Data; roject Organization and Version Control (Git); Performance Optimization – Occlusion, Texture Optimization, etc.; Debugging and Testing; Game Build and Deployment; Playtesting and User Experience Evaluation; Game Quality Assessment and Improvement; Capstone Mini Project: Complete 3D Game Prototype.

List of Laboratory Tasks:

16. Explore the Unity interface, create primitive 3D objects, and understand Game Objects, Components, and Prefabs.
17. Apply translation, rotation, scaling, parenting, and coordinate transformations to 3D objects.
18. I Implement keyboard and mouse input to control object movement and perform object interactions.
19. Explore Unity's Terrain tools, terrain settings, brushes, textures, trees, and grass.
20. Design a complete outdoor environment using terrain sculpting, painting, vegetation, and lighting.
21. Create, organize, duplicate, and manage Game Objects using Prefabs and asset organization techniques.
22. Create animations using the Animator Controller, Animation Clips, and Blend Trees.
23. Implement First-Person and Third-Person player movement along with camera follow and mouse look functionality.
24. Implement physics-based interactions using Colliders, Rigidbody components, collision events, and trigger zones.
25. Create game menus including Main Menu, Pause Menu, HUD, Health Bar, Score Display, and Game Over screen.
26. Import external 3D models, textures, audio, animations, and organize multiple scenes within a Unity project.
27. Develop an Endless Runner game featuring player movement, obstacle generation, collectibles, scoring, and game-over logic.
28. Develop a Survival Game incorporating health management, resource collection, enemy AI, inventory, and environmental hazards
29. Design an FPS game featuring player controls, shooting mechanics, enemy AI, weapon systems, health, and scoring.
30. Develop a Third-Person game with character controller, combat system, NPC interaction, quests, animations, and level completion objectives

Targeted Application & Tools that can be used:

Unity3D, Blender

Assignment:

2. Assignments are given after completion of each module which the student need to submit within the stipulated deadline.

Text Book

T1. Learning C# by Developing Games with Unity 2020: An enjoyable and intuitive approach to getting started with C# programming and Unity, 5th Edition, Harrison Ferrone, 2020.

T2. Learning C# from Developing Games with Unity 5.x, Greg Lukosek, 1St Edition, Packt Publishing Limited, 2021.

References

R1. Unity Game Development Cookbook- Paris Buttfield-Addis, Jonathan Manning, and Tim Nugent, Publisher - O'Reilly, 2019

R2. Nicoll, B., Keogh, B., Nicoll, B., & Keogh, B. (2019). The Unity game engine and the circuits of cultural software (pp. 1-21). Springer International Publishing.

E-Resources:

W1. https://learn.unity.com/course/beginning-3d-game-development

W2. https://assetstore.unity.com/packages/templates/tutorials/3d-game-kit-115747

Track 8: AI Extra Edge Course

CSA3804 Prompt Engineering and AI Tools for Productivity

Course Code: CSA3804	**Course Name:** Prompt Engineering and AI Tools for Productivity **Type of Course:** Elective Course	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	CSA1202		
Anti-requisites	NIL		
Course Description	This course explores prompt engineering and AI tools to boost productivity in professional and personal tasks. It focuses on crafting effective prompts, integrating AI-powered applications, and automating workflows. Practical exercises refine communication with language models and implement AI solutions for content creation, data analysis, and decision-making. Ethical use and troubleshooting are emphasized throughout the hands-on experience.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Prompt Engineering and AI Tools for Productivity and attain Employability through Experiential learning.		

Course Outcomes	**On successful completion of the course the students shall be able to:**		
	CO1	Explain the fundamental concepts of prompt engineering and AI tools for productivity	[Understand]
	CO2	Describe the structure of prompts using AI platforms	[Understand]
	CO3	Apply AI tools to automate tasks data summarization	[Apply]
	CO4	Implement AI-assisted workflows that improve task efficiency	[Apply]
	CO5	Analyze prompt variations and troubleshoot issues to enhance AI-generated responses.	[Apply]

Course Content:

Module 1	Foundations of Prompt Engineering	12 Sessions

Topics:

- Introduction to AI-driven tools for productivity.
- Overview of prompt engineering: structure, context, and intent.
- Understanding language models, embeddings, and tokenization.
- Crafting prompts for text generation, summarization, translation, and analysis.
- Fine-tuning inputs using temperature, max tokens, and instruction framing.
- Best practices for improving output relevance and minimizing hallucinations.

Module 2	AI Tools and Platforms for Productivity	12 Sessions

Topics:

- Introduction to popular AI platforms: OpenAI API, ChatGPT, GPT-4, and open-source alternatives.
- Exploring AI writing assistants, code helpers, and document summarizers.
- Integration of AI tools with productivity suites like Google Workspace, Microsoft 365, and task management platforms.
- Hands-on work with APIs: authentication, making requests, and interpreting responses.
- Managing large data inputs, templates, and context windows.

Module 3	Automation and Workflow Enhancement	10 Sessions

Topics:

- Automating repetitive tasks using AI scripts and macros.
- Combining AI tools with cloud services and APIs for enhanced workflows.
- Designing user interactions with chatbots, voice assistants, and custom dashboards.
- Applying AI for email drafting, meeting scheduling, and content organization.
- Monitoring, logging, and debugging automated processes.

Module 4	Ethical, Legal, and Practical Considerations & Project Implementation and Real-World Applications	11 Sessions

Topics:

- AI bias, fairness, and misinformation in automated workflows.
- Data privacy, security, and responsible AI use policies.
- Intellectual property concerns related to AI-generated content.
- Evaluating risks in decision-making and ensuring human oversight.
- Case studies on misuse and how to mitigate risks.
- Students select a productivity challenge and design an AI-supported solution.
- Prompt refinement through iterative testing and evaluation.
- Demonstration of solution integration with APIs, chatbots, or workflow automation tools.
- Presentation and peer review of projects.

Text Books	
T1	Jurafsky, D., Martin, J. H. (2023). Speech and Language Processing. An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition. (n.p.): Youcanprint.
T2	Prompt Engineering: Hands-on Guide to Prompt Engineering for AI Interactions (English Edition). (2025). India: Bpb Publications.
Reference Books	
R1	Prompt Engineering: Mastering the Language of AI to Create, Build, and Innovate. (2025). (n.p.): NestFame Creations Pvt Ltd..
R2	How to become a prompt engineer - A comprehensive Guide to start your prompt engineer career. (2024). (n.p.): Bernhard Gaum.
E-Resources	
1. https://cloud.google.com/discover/what-is-prompt-engineering 2. https://www.deeplearning.ai/short-courses/chatgpt-prompt-engineering-for-developers/ 3. https://learnprompting.org/docs/introduction?srsltid=AfmBOorCoynvMRgqOscOfyhHMmtNRjP2x52MGZ63Q8y8EWpia7vO52OL	

CSA3805 Responsible AI and Bias Auditing

Course Code: CSA3805	**Course Name:** Responsible AI and Bias Auditing **Type of Course:** Elective Course	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course focuses on implementing AI solutions responsibly by identifying, auditing, and mitigating bias in algorithms. It covers fairness metrics, ethical frameworks, and governance models across industries. Practical exercises guide the evaluation of AI systems, ensuring transparency, accountability, and inclusiveness while balancing innovation, regulation, and data integrity in real-world applications where bias can impact decisions and outcomes.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Responsible AI and Bias Auditing and attain Employability through Experiential learning.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain key concepts, types of bias, and ethical frameworks in AI [Understand] CO2 Explain how bias emerges in datasets, models, and decision-making processes. [Understand] CO3 Implement bias detection and mitigation techniques in AI workflows. [Apply] CO4 Apply governance strategies to enhance accountability and transparency in AI applications [Apply] CO5 Examine auditing methodologies and fairness metrics for AI systems [Apply]		
Course Content:			
Module 1	Foundations of Responsible AI and Ethical Frameworks		11 Sessions
Topics: • Understanding ethical principles in AI development. • Types of bias: data, algorithmic, and societal. • Fairness, accountability, transparency, and privacy considerations. • Governance models and global regulations. • Case studies of biased AI outcomes.			

Module 2	Bias in Data and Algorithms	10 Sessions

Topics:

- Identifying bias in datasets and labeling.
- Historical, cultural, and sampling biases.
- Impact of skewed data on models.
- Preprocessing techniques and data augmentation.
- Building awareness through scenario-based analysis.

Module 3	Fairness Metrics and Auditing Techniques	12 Sessions

Topics:

- Overview of fairness metrics: demographic parity, equal opportunity, etc.
- Statistical tests for detecting bias.
- Tools and frameworks for bias auditing.
- Interpreting audit reports and correcting bias.
- Benchmarking fairness across models.

Module 4	Bias Mitigation and Explainable AI & Governance, Accountability, and Future Challenges	12 Sessions

Topics:

- Techniques for bias mitigation: reweighting, adversarial training.
- Model explainability and interpretability methods.
- Balancing performance and fairness goals.
- Incorporating feedback loops and human oversight.
- Integrating ethical audits into AI pipelines.
- Developing governance frameworks for responsible AI.
- Privacy-preserving approaches and compliance.
- Reporting, documentation, and stakeholder communication.
- Emerging trends in AI regulation and ethics.
- Strategies for fostering trust and inclusivity.

Text Books

T1 Barocas, S., Hardt, M., Narayanan, A. (2023). Fairness and Machine Learning: Limitations and Opportunities. United Kingdom: MIT Press.

T2 Lu, Q., Zhu, L., Whittle, J., Xu, X., CSIRO. (2023). Responsible AI: Best Practices for Creating Trustworthy AI Systems. United Kingdom: Pearson Education

Reference Books

R1 Human Values, Ethics, and Dignity in the Age of Artificial Intelligence. (2025). United States: IGI Global Scientific Publishing.

R2 Agarwal, S., Mishra, S. (2021). Responsible AI: Implementing Ethical and Unbiased Algorithms. Switzerland: Springer International Publishing.

E-Resources

1. https://www.coursera.org/learn/responsible-ai-and-ethics
2. https://research.aimultiple.com/ai-bias/
3. https://www.coursera.org/learn/responsible-ai-for-developers-fairness--bias
4. https://onlinecourses.nptel.ac.in/noc25_cs118/preview

CSA3806 Project Management and MLOps

Course Code: CSA3806	**Course Name:** Project Management and MLOps **Type of Course:** Elective Course	L- T-P- C	3-0-0-3

Version No.	1	
Course pre-requisites	NIL	
Anti-requisites	NIL	
Course Description	This course introduces learners to the principles of Project Management and Machine Learning Operations (MLOps) for managing and deploying AI/ML solutions in real-world environments. The course covers project planning, workflow management, collaboration strategies, model lifecycle management, CI/CD pipelines, deployment architectures, monitoring systems, and governance practices. Practical exposure is provided through version control, automation tools, cloud platforms, and deployment frameworks to ensure scalable, reliable, and maintainable AI systems. Ethical AI practices, risk mitigation, and continuous improvement methodologies are also emphasized to support successful AI/ML project execution.	
Course Objective	The objective of the course is to familiarize learners with Project Management methodologies and MLOps practices for AI/ML systems, enabling them to develop skills in planning, deploying, monitoring, and maintaining scalable machine learning solutions while promoting responsible AI practices and industry-oriented experiential learning.	
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Identify key components, workflows, and lifecycle stages in AI/ML project management and MLOps — **Understand** CO2 Describe best practices for project planning, scheduling, collaboration, and risk management in AI projects — **Understand** CO3 Implement CI/CD pipelines, containerization, and deployment strategies for ML models — **Apply** CO4 Integrate monitoring, tracking, and scalability tools for efficient ML operations — **Apply** CO5 Analyze version control, model governance, and maintenance strategies for reliable AI/ML systems — **Analyze**	
Course Content:		
Module 1	Fundamentals of Project Management and MLOps	12 Sessions
Topics: • AI/ML project lifecycle stages • Roles and responsibilities in AI/ML teams • Agile methodologies and sprint planning • Planning, scheduling, and resource estimation • Risk management frameworks and mitigation strategies • Ethical AI practices and compliance standards		
Module 2	Version Control, Experiment Tracking, and CI/CD	12 Sessions
Topics: • Version control using Git and DVC • Tracking datasets, experiments, and model versions • Documentation and reproducibility best practices • CI/CD pipelines for ML workflows • Automation using GitHub Actions/Jenkins • Model update, rollback, and release strategies		
Module 3	ML Deployment and Infrastructure Management	11 Sessions
Topics: • Cloud deployment using AWS, Azure, and GCP • Containerization using Docker • Kubernetes orchestration for ML applications • Serverless deployment architectures		

• Scalability, load balancing, and fault tolerance • Security protocols and access management		
Module 4	Monitoring, Maintenance, and Optimization	10 Sessions
Topics: • Monitoring model performance and drift detection • Logging systems and automated alerts • Resource optimization and cost management • Feedback loops and continuous retraining • Model governance and compliance monitoring • Continuous improvement and maintenance strategies		
Text Books **T1** *Artificial Intelligence in Project Management: AI Tools, Use Cases, and Prompts for Driving Project Efficiency, Innovation and Success.* (2024). PMIP. **T2** Boudreau, P. (2019). Applying Artificial Intelligence to Project Management. United States: Independently Published.		
Reference Books **R1** Revolutionizing Project Management: Harnessing the Power of Artificial Intelligence. (2023). (n.p.): Enlighten Publications. **R2** Kanabar, V. (2023). The AI Revolution in Project Management: Elevating Productivity with Generative AI. United Kingdom: Pearson Education.		
E-Resources 1. https://www.coursera.org/articles/ai-project-management-tools 2. https://www.atlassian.com/work-management/project-management/ai-project-management 3. https://www.coursera.org/learn/ai-project-management-aipm		

Value Added Courses

CSA1204 Design thinking and Innovation

Course Code: CSA1204	**Course Name:** Design thinking and Innovation **Type of Course:** VAC	L- T-P- C	2-0-0-2
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	The course aims to introduce students to the fundamental principles and processes of Design Thinking and will learn to apply Design Thinking methodologies to real-world challenges. The course emphasizes empathy, creativity, and collaboration, equipping students with essential skills for successful engineering practice.		
Course Objective	This course is designed to develop and familiarize the learners with the concepts of Design thinking and Innovation and attain Entrepreneurship by using Participative Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain the core principles, mindset, and historical context of Design Thinking and its importance in fostering innovation [Understand] CO2 Explain common ideation techniques and their role in generating creative solutions and initial prototypes [Understand] CO3 Explain the distinct stages of the Design Thinking process and differentiate it from traditional problem-solving methodologies [Understand]		

	CO4	Apply empathy and research tools to deeply understand user needs and effectively define complex problems from a human-centered perspective	[Apply]
	CO5	Analyze user feedback to identify improvements in design solutions and understand the importance of iterative innovation.	[Apply]
	CO6	Examine the implementation of Design Thinking in organizations by interpreting innovation culture, success metrics	[Analyze]

Course Content:

Module 1	Introduction to Design Thinking & Mindset	6 Sessions

Topics:

Definition and Introduction to Design Thinking: What it is, its origins, and its relevance in today's complex world.

The Design Thinking Mindset: Empathy, curiosity, embracing ambiguity, iterative thinking, collaborative spirit, optimism.

Importance of Design Thinking for innovation, problem-solving, and user-centricity in various sectors.

Differentiating Design Thinking from traditional linear problem-solving approaches.

Brief overview of the 5 stages of the Design Thinking Process: Empathize, Define, Ideate, Prototype, Test.

Module 2	Empathize and Define - Understanding the User	6 Sessions

Topics:

Empathize Stage:

1) Introduction to human-centered design principles.
2) User research methods: Interviews (structured, semi-structured), observation, ethnographic research, contextual inquiry.
3) Tools for Empathy: Empathy Maps, Persona creation, User Journey Mapping.
4) Ethical considerations in user research.

Define Stage:

- Synthesizing research findings to uncover user needs and insights.
- Problem Framing: Crafting compelling Point-of-View (POV) statements and "How Might We" (HMW) questions.
- Identifying pain points and opportunities for innovation.
- Understanding use cases of Design Thinking in consumer tech, home tech, personal tech, auto tech, or extended reality.

Module 3	Ideate - Generating Creative Solutions	6 Sessions

Topics:

1) Introduction to the Ideate stage: Principles of divergent thinking.
2) Brainstorming Techniques: Rules for effective brainstorming, individual vs. group brainstorming.
3) Ideation Tools and Methods: SCAMPER, Mind Mapping, Crazy Eights, Sketching, Worst Possible Idea.
4) Prioritization Matrix: Selecting promising ideas for further development.
5) Encouraging radical ideas and breaking conventional thinking.
6) Techniques for combining and refining ideas.

Module 4	Prototype and Test - Bringing Ideas to Life	6 Sessions

Topics:

Prototype Stage:

- Purpose of Prototyping: Learning quickly, testing assumptions, getting feedback.
- Types of Prototypes: Low-fidelity (sketches, paper prototypes), mid-fidelity (wireframes, click-throughs), high-fidelity.
- Prototyping tools for physical and digital products/services.
- Building prototypes iteratively.

Test Stage:

- Conducting User Testing: Planning, recruiting, executing tests.
- Gathering Feedback: Observing user behavior, active listening, asking non-leading questions.
- Analyzing Feedback and Synthesizing Learnings.
- Iterating based on feedback: The importance of refinement and continuous improvement.

Module 5	Implementation, Innovation Culture & Future Trends	6 Sessions

Topics:

Transitioning from Design Thinking to Implementation: Scaling solutions, pilot projects.

Measuring Impact: Metrics for success in design-driven innovation.

Building an Innovation Culture: Fostering creativity, psychological safety, cross-functional coll

Text Books

T1 Thinking Design by S Balaram. New Delhi [India]: Sage Publications Pvt. Ltd. 2010. eBook., Database: eBook Collection (EBSCOhost)

T2 Design Thinking for Innovation: Research and Practice. (2016). Germany: Springer International Publishing.

Reference Books

R1 Design Thinking and Innovation in Learning. (2021). United Kingdom: Emerald Publishing Limited.

R2 Design Thinking Research: Making Design Thinking Foundational. (2015). Germany: Springer International Publishing

E-Resources

1. https://nptel.ac.in/courses/110106124?utm_source=chatgpt.com
2. https://www.coursera.org/learn/uva-darden-design-thinking-innovation?utm_source=chatgpt.com
3. https://www.ideou.com/pages/design-thinking?utm_source=chatgpt.com

Mandatory Courses

CHE7601 Environmental Studies

Course Code: CHE7601	**Course Name:** Environmental Studies **Type of Course:** Elective Course	L- T-P- C	1-0-0-0
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course aims to familiarize students with fundamental environmental concepts and their relevance to business operations, preparing them to address forthcoming sustainability challenges. It is designed to equip students with the knowledge and skills needed to make decisions that account for environmental consequences, fostering environmentally sensitive and responsible future managers. This course is designed to cater to Environment and Sustainability		
Course Objective	The Objective Of The Course Is 'Skill Development' Of The Student By Using 'Participative Learning' Techniques		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Describe the basic environmental concepts and issues relevant to the business and management field. [Understand] CO2 Explain the interdependence between environmental processes and socio-economic dynamics. [Understand] CO3 Explain the role of business decisions, policies, and actions in minimizing environmental degradation. [Understand] CO4 Identify possible solutions to curb environmental problems caused by managerial actions. [Apply] CO5 Apply skills to address immediate environmental concerns through changes in business operations, policies, and decisions. [Apply]		
Course Content:			
Module 1	Ununderstanding Environment, Natural Resources, and Sustainability		4 Sessions
Topics: Classification of natural resources, issues related to Population growth and their overutilization, and strategies for their conservation. Water, air, soil, mineral, energy and food source. Effect of human activities on natural resources. Concept of sustainability- Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs; Sustainable practices in managing resources, including deforestation, water conservation, Desalination – types, energy security, and food security issues, Life Cycle thinking and Circular Economy.			
Module 2	Ecosystems, Biodiversity, and Sustainable Practices		4 Sessions
Topics: Ecosystems and ecosystem services: Various natural ecosystems, Major ecosystem types in India and their basic characteristics; forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. The importance of biodiversity, Biodiversity and Climate Change, the threats it faces, hotspots, and the methods used for its conservation. Strategies for in situ and ex situ conservation, nature reserves, and the significance of India as a mega diverse nation.			
Module 3	Environmental Pollution, Waste Management, and Sustainable Development		4 Sessions
Topics: Types of pollution- Chemical, - Biological, Biomedical, noise, air, water, soil, thermal, radioactive and marine pollution, and their impacts on society. Urbanization and Urban environmental problems; effects, and mitigation.			

Causes of pollution, such as global climate change, ozone layer depletion, the greenhouse effect, and acid rain, with a particular focus on pollution episodes in India. Importance of adopting cleaner technologies; Solid waste management; Sustainable Materials and Technologies: Biodegradable and compostable materials, Recycled and reclaimed materials (E-waste management), Sustainable manufacturing processes.

Module 4	Political Issues, Legislation, and Practical Applications	3 Sessions

Topics:

Overview of key environmental legislation and the judiciary's role in environmental protection, including the Water (Prevention and Control of Pollution) Act of 1974, the Environment (Protection) Act of 1986, and the Air (Prevention and Control of Pollution) Act of 1981. Environmental management system: ISO 14001. National Biodiversity Action Plan (NBAP), Environmental Impact Assessment (EIA): Objectives of EIA, Environmental Impact Statement (EIS), Life cycle Assessment (LCA) and application.

Major International Environmental Agreements: Convention on Biological Diversity (CBD), United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement.

Major International organisations and initiatives: United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC).

Text Books

T1 Rajagopalan, R. Environmental studies: from crisis to cure (4th ed.). Oxford University Press.

T2 G. Tyler Miller and Scott Spoolman (2020), Living in the Environment, 20th Edition, Cengage Learning, USA

Reference Books

R1 Poonia, M.P. Environmental Studies (3rd ed.), Khanna Book Publishing Co.

R2 Pritwani, K. Sustainability of business in the context of environmental management. CRC Press

E-Resources

1. https://nptel.ac.in/courses/109105203
2. https://archive.nptel.ac.in/courses/120/108/120108004/
3. https://nptel.ac.in/courses/127105018
4. https://onlinecourses.nptel.ac.in/noc23_lw06/preview

LAW7601 Indian Constitution

Course Code: LAW7601	**Course Name:** Indian Constitution **Type of Course:** Elective Course	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course provides a comprehensive understanding of the Indian Constitution and its foundational elements. It begins with a critical analysis of the historical background, the Preamble, Fundamental Rights, and the basic structure doctrine, enabling students to appreciate the constitutional vision of justice, liberty, equality, and fraternity. The course then delves into the framework of governance at both the central and state levels, highlighting the roles, responsibilities, and interplay between key institutions such as the President, Prime Minister, Parliament, Governors, Chief Ministers, and State Secretariats. Additionally, the course offers insights into the structure and functioning of local self-governments, including District Administration, Municipal Corporations, and Zila Panchayats, thus fostering an understanding of grassroots democracy. Finally, the course assesses the pivotal role of the Election Commission in safeguarding democratic values through the conduct of free and fair elections.		
Course Objective	This course is designed to enhance learners' understanding of the Indian Constitution through participatory learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 To analyse the history, Preamble, Fundamental Rights, and basic structure of the Indian Constitution. [Analyze] CO2 To describe the roles of the President, Prime Minister, and legislative bodies (Lok Sabha and Rajya Sabha). [Understand] CO3 To Analyse the powers and functions of the Governor, Chief Minister, and State Secretariat [Analyze] CO4 To assess the functioning of local government bodies like District Administration, Municipal Corporations, and Zila Panchayats. [Analyze] CO5 To analyse the role of the Election Commission in conducting free and fair elections. [Analyze]		
Course Content:			
Module 1	The Constitution - Introduction		08 Sessions
Topics: History of the Making of the Indian Constitution, Preamble and Basic Structure, and its interpretation, Fundamental Rights and Duties and their interpretation, State Policy Principles.			
Module 2	Union Government		08 Sessions
Topics: Structure of the Indian Union, President – Role and Power, Prime Minister and Council of Ministers, Lok Sabha and Rajya Sabha.			
Module 3	State Government		06 Sessions
Topics: Governor – Role and Power, Chief Minister and Council of Ministers, State Secretariat.			
Module 4	Local Administration		04 Sessions
Topics: District Administration, Municipal Corporation Zila Panchayat.			
Module 5	Election Commission		04 Sessions
Topics: Role and Functioning, Chief Election Commissioner, State Election Commission.			

Text Books **T1** Ethics and Politics of the Indian Constitution – Rajeev Bhargava, Oxford University Press, New Delhi, 2008 **T2** The Constitution of India – B.L. Fadia, Sahitya Bhawan, 2017 (New Edition)
Reference Books **R1** Introduction to the Constitution of India – D.D. Basu, Lexis Nexis, 2018 (Twenty-Third Edition) **R2** M. P. Jain, Indian Constitutional Law, 8th ed. Gurgaon, India: LexisNexis, 2018.
E-Resources 1. https://www.indiacode.nic.in/handle/123456789/1362?utm 2. https://prsindia.org/policy/report-summaries/constitution-india?utm 3. https://www.legalserviceindia.com/articles/const.htm?utm

CSA7602 Indian Knowledge System

Course Code: CSA7602	**Course Name:** Indian Knowledge System **Type of Course:** MAC	L- T-P- C	0-0-0-0
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces students to the rich and diverse heritage of the Indian Knowledge System (IKS), encompassing ancient wisdom, scientific advancements, philosophical traditions, and cultural practices developed over centuries. It explores foundational concepts from Vedas, Upanishads, and classical texts, along with contributions in fields such as mathematics, astronomy, medicine, architecture, governance, and ecology. The course emphasizes the relevance of traditional knowledge in contemporary contexts, promoting holistic thinking, sustainability, and ethical living. It also highlights India's contributions to global knowledge systems and encourages critical appreciation of indigenous knowledge frameworks.		
Course Objective	his course aims to provide learners with a comprehensive understanding of Indian Knowledge Systems and their applications in modern interdisciplinary contexts through experiential and participatory learning.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 To analyze the evolution and significance of Indian Knowledge Systems and their historical foundations. [Analyze] CO2 To understand key concepts from Vedas, Upanishads, and classical Indian philosophies. [Understand] CO3 To analyze contributions of ancient India in science, mathematics, medicine, and technology. [Analyze] CO4 To evaluate the role of Indian traditional knowledge in sustainable development and environmental practices. [Evaluate] CO5 To assess the relevance of Indian Knowledge Systems in contemporary society and global context. [Analyze]		
Course Content:			
Module 1	Introduction to Indian Knowledge System		08 Sessions
Topics: • Definition and scope of Indian Knowledge System			

- Historical evolution and sources (Vedas, Upanishads, Smritis)
- Key characteristics and principles
- Importance and relevance in modern education

Module 2	Indian Philosophy and Knowledge Traditions	08 Sessions

Topics:

- Overview of six schools of Indian philosophy (Darshanas)
- Concepts of Dharma, Karma, Moksha
- Epistemology (Pramana) and metaphysics
- Ethics and value systems in Indian thought

Module 3	Contributions to Science and Technology	06 Sessions

Topics:

- Indian mathematics (zero, decimal system, Aryabhata, Brahmagupta)
- Astronomy and cosmology
- Ayurveda and traditional medicine systems
- Metallurgy, architecture, and engineering (e.g., temples, town planning)

Module 4	Indian Knowledge in Society and Governance	04 Sessions

Topics:

- Education systems (Gurukul tradition, Nalanda, Takshashila)
- Governance and polity (Arthashastra concepts)
- Economic ideas and trade practices
- Social organization and cultural diversity

Module 5	Indian Knowledge System and Sustainability	04 Sessions

Topics:

- Environmental ethics in Indian traditions
- Sustainable practices in agriculture and water management
- Yoga and holistic health systems
- Relevance of IKS in modern global challenges

Text Books

T1 *Indian Knowledge System* – Kapil Kapoor, Indian Institute of Advanced Study, 2006

T2 *Knowledge Traditions and Practices of India* – Kapil Kapoor & Michel Danino, CBSE Publication

E-Resources

1. https://iksindia.org
2. https://www.sanskrit.nic.in
3. https://www.indianheritage.gov.in

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