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
2024-2026

MASTER OF COMPUTER APPLICATIONS (MCA)

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

Regulations No.: PU/ AC-24.6/SOIS07/MCA/2024-2026

Resolution No.6 of the 24th Meeting of the Academic Council held on 03rd August 2024, and ratified by the Board of Management in its 24th Meeting held on 05th August, 2024.

(As *amended upto 26th Meeting of the Academic Council held on 25th July 2025, and ratified by the Board of Management in its 27th Meeting held on 28th July 2025.*)

AUGUST-2024

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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 future-focused, ethically grounded School of Information Science, dedicated to nurturing globally proficient professionals, driving technological innovation, and contributing meaningfully to societal transformation.

1.4 Mission of Presidency School of Information Science

- Create a practical learning environment that combines modern teaching methods, interdisciplinary knowledge, and research to equip students with global skills.
- Bring together excellent faculty and advanced facilities to support quality teaching, innovation, and learning.
- Develop entrepreneurial and leadership skills in students to help them solve societal, environmental, and technological problems responsibly.

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 MCA 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 Master of Computer Applications (MCA) Degree Program Regulations and Curriculum 2024-2026
b. These Regulations are subject to, and pursuant to the Academic Regulations.
c. These Regulations shall be applicable to the MCA Degree Programs of the 2024-2026 batch, and to all other MCA Degree Programs which may be introduced in future.
d. These Regulations shall supersede all the earlier MCA Degree Program Regulations and Curriculum, along with all the amendments thereto.
e. These Regulations shall come into force from the Academic Year 2024-2025.

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 / Director 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 MCA 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 MCA Degree Program Regulations and Curriculum, 2024-2026;
ff. “Program” means the Master of Computer Applications (MCA) 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 Programme shall be called Master of Computer Applications, abbreviated as MCA. The MCA Degree Program Regulations and Curriculum 2024-2026 are subject to, and, pursuant to the Academic Regulations. These Program Regulations shall be applicable to the ongoing MCA Degree Program of 2024-2026 offered by the Presidency School of Information Science.

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 MCA Degree Program is a Two-Year, Full-Time Semester based program. The minimum duration of the MCA Program is Two (02) years and each year comprises of two academic Semesters (Odd and Even Semesters) and hence the duration of the MCA program is four (04) 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 two years of successful completion of the program, the graduates shall be able to:

PEO1: apply software engineering concepts and practices to design, develop, test, and maintain software systems that meet user requirements and industry standards.

PEO2: communicate technical information effectively to diverse audiences, both verbally and in writing, facilitating clear and concise interaction within project teams and with stakeholders.

PEO3: engage in quality research and lifelong learning, keeping up with global emerging technologies and industry trends to adapt to evolving demands in the field of computer science.

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: Computational Knowledge: Apply knowledge of computing fundamentals, computing specialisation, mathematics, and domain knowledge appropriate for the computing specialisation to the abstraction and conceptualisation of computing models from defined problems and requirements.

PO 2: Problem Analysis: Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.

PO 3: Design /Development of Solutions: Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex Computing problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.

PO 6: Professional Ethics: Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.

PO 7: Life-long Learning: Recognise the need, and have the ability, to engage in independent learning for continual development as a computing professional.

PO 8: Project management and finance: Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 9: Communication Efficacy: Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.

PO 10: Societal and Environmental Concern: Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practices.

PO 11: Individual and Team Work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.

PO 12: Innovation and Entrepreneurship: Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

8.2 Program Specific Outcomes (PSOs):

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

PSO 1: Disciplinary Knowledge: Design, develop, test and maintain desktop, web, mobile and cross-platform software applications using modern tools, technologies, skills and computing models.

PSO 2: Problem Solving: Solve real-world computing problems of various industries by empathize and apply the principles of Software Engineering, Mathematics and other associated disciplines to meet stockholder's business objectives.

PSO 3: Research and Development: Conduct research, explore emerging technologies, and contribute to the field of computer applications through innovative solutions, research papers and projects.

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 MCA Program is listed in the following Sub-Clauses:

9.1 An applicant who has successfully completed BCA/ Bachelor Degree in Computer Science Engineering or equivalent Degree. OR Passed B.Sc./ B.Com./ B.A. with Mathematics at 10+2 Level or at Graduation Level (with additional bridge Courses as per the norms of the concerned University).

9.2 The applicant must have appeared Karnataka PG-CET or any other State-level Entrance Examinations.

9.3 Reservation for the SC / ST and other backward Sessions 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

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

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

10.1.1 Candidates seeking transfer may be required to complete specified bridge Courses, if any, as prescribed by the University. Such bridge Courses shall not be included in the CGPA computations.

10.1.2 All the existing Regulations and Policies of the University shall be binding on all the students admitted to the Program through the provision of transfer.

10.1.3 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 Presidency University no later than July 10 of the concerned year for admission to the 2nd Year (3rd Semester) MCA Program commencing on August 1 on the year concerned.

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

10.1.5 The transfer may be provided on the condition that the Courses and Credits completed by the concerned student in the 1st Year of the MCA 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 MCA Program of the University.

11. Mandatary Bridge Course for Non-Computer Science Discipline Students

Students who have completed their undergraduate degree with Mathematics at the 10+2 level or at the graduation level, but have not undergone Computer Science related courses, are required to enrolled for Bridge Course. This course is designed to provide them with foundational knowledge in computer science.

Requirement: Students must successfully complete the Bridge Course and obtain a minimum of 50% marks in the qualifying examination to proceed with their regular academic 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 Grade (Clause 8.10 of Academic Regulations) 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)	Continuous Assessments	50%
	End Term Examination	50%

(Examples: 3-0-0; 3-0-2; 2-1-0; 2-0-2, 2-0-4 etc.)		
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 the 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 13.3 (as per 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 13.3 (as per 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 MCA Program Structure (2024-2026) totalling 88 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: MCA 2024-2026: Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets

Sl. No.	Baskets	Credit Contribution
1	School Core (SC)	27
2	Program Core (PC)	34
3	Discipline Elective (DL)	21
4	Open Elective (OL)	6
	Total Credits	**88**

In the entire Program, the practical and skill-based course component contribute to an extent of approximately 60% out of the total credits of 88 for MCA Computer Applications program of Two-year duration.

15. Minimum Total Credit Requirements of Award of Degree

A minimum of 88 credits is required for the award of a MCA 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 5.0 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 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

List of Courses Tabled – aligned to the Program Structure
(Course Code, Course Name, Credit Structure (LTPC), Contact Hours, Course Basket, Type of Skills etc., as applicable).

Table 3.1: List of SCHOOL CORE

Sl. No.	Course Code	Course Name	L	T	P	C
SCHOOL CORE -						
1	ENG5001	English for Employability	2	1	0	3
2	MAT3001	Mathematical foundations of Computer Applications	2	1	0	3
3	MAT3002	Applied Statistics	2	1	0	3
4	PPS3019	Corporate Communications	0	0	2	1
5	CSA4097	Coding training-1	0	0	2	1
6	CSA4098	Coding Training-2	0	0	2	1
7	PPS3001	Problem Solving through Aptitude	0	0	2	1
8	PPS4008	Quantitative skills and logical reasoning	1	0	2	2
9	BBA1055	Managerial Economics and Financial Accounting	3	0	0	3
10	CSA4100	Mini project	0	0	0	5
11	CSA4103	Major Project	0	0	0	10
						33

Table 3.2: List of Program Core

Sl. No.	Course Code	Course Name	L	T	P	C	Pre-Requisite
PROGRAM CORE							
1	CSA4001	Web Technology	1	0	4	3	-
2	CSA4002	Advanced Data Structures and Algorithms	3	0	2	4	-
3	CSA4003	Software Engineering	3	0	0	3	-
4	CSA4004	Advanced Python Programming	1	0	4	3	-

5	CSA4006	Advanced Database Technology	2	0	2	3	-
6	CSA4007	Object Oriented Programming Using Java	1	0	4	3	-
7	CSA4005	Cloud Computing	2	0	2	3	CSA4025
8	CSA4009	Artificial Intelligence and Machine Learning	2	0	2	3	CSA4004
9	CSA4008	Full Stack Development	1	0	4	3	CSA4007
						28	

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, 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 MCA 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). The same shall be prescribed in the Course Handout.

18.1 Mini Project

A student may opt to do a Project Work for a period of 6-8 weeks in an Industry / Company or academic / research institution or the University Department(s) as an equivalence of Internship during the 3rd Semester as applicable, subject to the following conditions:

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

18.1.2 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 18.1.1). 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.

18.2 Major Project

A student may undergo a Project for a period of 12-14 weeks in an industry / company or academic / research institution in the 4th Semester as applicable, subject to the following conditions:

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

18.2.2 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;

18.2.3 The number of 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 18.2.2 above.

18.2.4 A student may opt for 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 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 Internship Policy of the University.

18.2.5 Student selected for a 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.

18.3 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 Major Project, subject to the following conditions:

18.3.1 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 18.3.1). 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 3.3: List of Discipline Electives

Sl. No.	Course Code	Course Name	L	T	P	C	Pre-requisite
General Basket							
1	CSA4010	Internet of Things	1	0	4	3	CSA4025
2	CSA4011	Software Project Management	2	0	2	3	CSA4003
3	CSA4012	Programming in C#	2	0	2	3	CSA4004
4	CSA4013	Soft Computing Techniques	3	0	0	3	-
5	CSA4014	Software Testing and Quality Assurance	3	0	0	3	CSA4003
6	CSA4015	DevOps and Microservices	3	0	0	3	-
7	CSA4016	UI/UX Design	2	0	2	3	-
8	CSA4017	Parallel Computing	3	0	0	3	-
9	CSA4018	Quantum Computing	3	0	0	3	-
10	CSA4019	Introduction to Bioinformatics	3	0	0	3	-
11	CSA4020	Distributed Systems	3	0	0	3	-
12	CSA4021	Search Engine Optimization	3	0	0	3	-
13	CSA4024	Mobile Application Development	2	0	2	3	CSA4007
Network & Cloud Computing Basket							
1	CSA4025	Computer Networks	3	0	0	3	CSA4025
2	CSA4026	Wireless Ad Hoc Networks	3	0	0	3	CSA4025
3	CSA4027	Wireless sensor Networks	3	0	0	3	CSA4025
4	CSA4028	Network and Information Security	3	0	0	3	CSA4025
5	CSA4029	Edge Computing	3	0	0	3	-
6	CSA4032	Web 3.0	2	0	2	3	-
Data Science & Big Data Basket							
1	CSA4033	Data Analytics and Visualization	1	0	4	3	CSA4004
2	CSA4034	Information Retrieval and Recommended System	3	0	0	3	CSA4002
3	CSA4035	Mean Stack Development	2	0	2	3	CSA4001

4	CSA4036	R Programming for Data Science	2	0	2	3	-
5	CSA4037	Social Network Analysis	3	0	0	3	-
6	CSA4038	Data Mining and Warehousing	3	0	0	3	-
7	CSA4068	MERN Full Stack Development	2	0	2	3	CSA4001
AI & ML Basket - Maximum Credit to be earned from this Basket							
1	CSA4039	Computer Vision	2	0	2	3	-
2	CSA4040	Natural Language Processing	2	0	2	3	-
3	CSA4041	Deep Learning	2	0	2	3	-
4	CSA4042	Reinforcement Learning	2	0	2	3	-
5	CSA4043	Generative AI	2	0	2	3	-
Metaverse & Blockchain Basket-							
1	CSA4049	Cyber Digital Twin	3	0	0	3	-
2	CSA4051	Distributed Ledger Technology	2	0	2	3	-
Cyber Security Basket							
1	CSA4053	Cyber Forensics	2	0	2	3	-
2	CSA4055	Ethical Hacking	2	0	2	3	-
3	CSA4056	Cyber Threats for IoT and Cloud	3	0	0	3	-
4	CSA4057	Vulnerability Assessment and Penetration Testing	3	0	0	3	-
5	CSA4059	Digital Watermarking and Steganography	3	0	0	3	-
6	CSA4060	Malware Analysis	3	0	0	3	-

20. List of Open Electives to be offered by the School / Department:

Table 3.4: List of Open Electives

Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
		Civil Engineering Basket				
1.	CIV5001	Sustainable Smart Cities	3	0	0	**3**
2.	CIV5002	Systems Design for Sustainability	3	0	0	**3**
3.	CIV5003	Self-Sustainable Buildings	3	0	0	**3**
4.	CIV5004	Energy and Buildings	3	0	0	**3**

		Law Basket				
1.	LAW5001	International Trade Law	3	0	0	**3**
2.	LAW5002	Law relating to Business Establishment	3	0	0	**3**
3.	LAW5003	Data Protection Law	3	0	0	**3**
4.	LAW5004	Law Relating to Consumer Protection	3	0	0	**3**
5.	LAW5005	Law Relating to Infrastructure Projects	3	0	0	**3**
		Electronics and Communication Engineering Basket				
1.	ECE5001	Wearable Computing	3	0	0	**3**
2.	ECE5002	MEMS and Nanotechnology	3	0	0	**3**
3.	ECE5003	Advanced Computer Networks	3	0	0	**3**
4.	ECE5004	Pervasive Computing	3	0	0	**3**
		Mechanical Engineering Basket				
1	MEC5001	Optimization Techniques	3	0	0	**3**
2	MEC5002	Industry 4.0	3	0	0	**3**
3	MEC5003	Six Sigma for Engineers	3	0	0	**3**
4	MEC5004	Design for Internet of Things	3	0	0	**3**
5	MEC2003	Supply Chain Management	3	0	0	**3**
		Management Basket				
1.	MBA3026	Essentials of Leadership	3	0	0	**3**
2.	MBA3037	Fundamentals of Accounting	3	0	0	**3**
3.	MBA3038	Sales Techniques	3	0	0	**3**
4.	MBA3039	Principles of Management	3	0	0	**3**
		Media Studies Basket				
1	BAJ5001	Media and Entertainment Business	3	0	0	**3**
2	BAJ5002	TV Journalism and News Management	2	0	2	**3**
		NPTEL Courses				
1	BBB2015	Artificial Intelligence (AI) for Investments	3	0	0	**3**
2	BBB2016	Business Analytics For Management Decision	3	0	0	**3**
3	BBA2021	E-Business	3	0	0	**3**
4	BBA2022	Supply Chain Digitization	3	0	0	**3**
		Research Basket				
1.	RES5001	Research Methodology	3	0	0	**3**
2.	URE7001	University Research Experience	-	-	-	3
3.	URE7002	University Research Experience	-	-	-	0

21. List of MOOC Courses

21.1 Presidency University students are given the opportunity to study abroad in International Universities through a selection process coordinated by the Office of International Affairs (OIA). Such selected students need to complete their credits for the semester that they are abroad in the following way:

21.1.1 The student needs to study and complete School Core and Program Core Courses in offline mode only.

21.1.2 Massive Open Online Course (MOOC) courses maybe given for Open Elective and Discipline Elective Courses. These courses need to be approved by the concerned BOS and Academic Council from time to time.

21.1.3 SWAYAM/NPTEL/ other approved MOOCs shall be approved by the concerned Board of Studies and placed in the concerned PRC.

21.1.4 Student shall register for these courses in the ERP of Presidency University.

21.1.5 For these MOOC courses faculty coordinators are identified. These faculty should have undergone similar MOOC courses and therefore should be familiar with the mode of class conduction, types of assessments and evaluation procedures.

21.1.6 Study materials shall be provided to the students as video lectures shared by the MOOCs Coordinator(s), or the students may access the approved MOOCs Portal directly. The mode of class conduction is determined by the MOOCs coordinator(s) as detailed in the Course Catalogue and Course Plan.

21.1.7 The question paper shall be prepared by the MOOCs coordinator(s).

21.1.8 Students write the exams in online mode. These exams are scheduled and conducted by the School.

21.1.9 Results are evaluated by School and given to the Office of the Controller of Examinations (CoE).

21.1.10 The details of the duration, credits and evaluation are given below:

Sl	Duration	Credits	Evaluation
1.	12 weeks	3	Continuous Assessment –50 Marks Mid Term –50 Marks End Term-100 Marks
2.	8 weeks	2	Mid Term-50 Marks End Term-100 Marks
3	4 weeks	1	End Term-100 Marks

21.2 MOOC Courses for MCA Program

Table 3.9: MOOC Discipline Elective Courses **Discipline Elective Courses duration is 4 weeks (01 credit)/ 8 weeks (02 credits)/ 12 weeks (03 credits)**				
Sl.No	**NPTEL Course Code**	**Course Code**	**Course Name**	**Credits**
1	NOC25_GE70	CSA4721	Learning Analytics Tools	3
2	NOC25-CS203	CSA4722	Introduction to Industry 4.0 and Industrial Internet of Things	3

Table 3.10: MOOC Open Elective Courses **Discipline Elective Courses duration is 4 weeks (01 credit)/ 8 weeks (02 credits)/ 12 weeks (03 credits)**						
1	BBB2015	Artificial Intelligence (AI) for Investments	3	0	0	3
2	BBB2016	Business Analytics for Management Decision	3	0	0	3
3	BBA2021	E-Business	3	0	0	3
4	BBA2022	Supply Chain Digitization	3	0	0	3

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

Semester 1:

Bridge Courses

Sl. No.	**Course Code**	**Course Name**	**Credit Structure**				**Contact Hours**	**Type of Course**
			L	**T**	**P**	**C**		
1	*CSA9001	C PROGRAMMING AND DATA STRUCTURES	-	-	-	-		BC
2	*CSA9002	Fundamentals of Information Technology	-	-	-	-		BC
		TOTAL	**-**	**-**	**-**	**-**		

*** Only for Non-Computer Science students**

Sl. No.	Course Code	Course Name	Credit Structure				Contact Hours	Type of Course
			L	T	P	C		
1	ENG5001	English for Employability	2	1	0	3	3	SC
2	MAT3001	Mathematical foundations of Computer Applications	2	1	0	3	3	SC
3	CSA4001	Web Technology	1	0	4	3	5	PC
4	CSA4002	Advanced Data Structures and Algorithms	3	0	2	4	5	PC
5	CSA4003	Software Engineering	3	0	0	3	3	PC
6	CSA4097	Coding training-1	0	0	2	1	2	SC
7	CSAXXXX	Discipline Elective-I	3	0	0	3	3	DL
		TOTAL	14	**2**	8	20	**24**	

*** Only for Non-Computer Science students**

Semester 2:

Sl. No.	Course Code	Course Name	Credit Structure				Contact Hours	Type of Course
			L	T	P	C		
1	MAT3002	Applied Statistics	2	1	0	3	3	SC
2	CSA4004	Advanced Python Programming	1	0	4	3	5	PC
3	CSA4006	Advanced Database Technology	2	0	2	3	4	PC
4	CSA4007	Object Oriented Programming Using Java	1	0	4	3	5	PC
5	CSAXXXX	Discipline Elective -II	2	0	2	3	4	DL
6	CSAXXXX	Discipline Elective -III	3	0	0	3	3	DL
7	PPS3019	Corporate Communications	0	0	2	1	2	SC
8	CSA4098	Coding Training-2	0	0	2	1	2	SC
9	PPS3001	Problem Solving through Aptitude	0	0	2	1	2	SC
		TOTAL	11	**1**	18	21	**30**	

Semester 3:

Sl. No.	Course Code	Course Name	Credit Structure				Contact Hours	Type of Course
			L	T	P	C		
1	CSA4005	Cloud Computing	2	0	2	3	4	PC
2	CSA4008	Full Stack Development	1	0	4	3	5	PC
3	CSA4009	Artificial Intelligence and Machine Learning	2	0	2	3	4	PC
4	CSAXXXX	Discipline Elective - IV	2	0	2	3	4	DL
5	CSAXXXX	Discipline Elective -V	1	0	4	3	5	DL
6	XXXXXX	Open Elective-I	3	0	0	3	3	OE
7	CSA4100	Mini project	0	0	0	5		SC
8	PPS4008	Quantitative skills and logical reasoning	1	0	2	2	3	SC
		TOTAL	15	0	16	**25**	**31**	

Semester 4:

Sl. No.	Course Code	Course Name	Credit Structure				Contact Hours	Type of Course
			L	T	P	C		
1	CSAXXXX	Discipline Elective - VI	3	0	0	3	3	DL
2	XXXXXX	Open Elective-II	3	0	0	3	3	OE
3	CSAXXXX	Discipline Elective -VII	3	0	0	3	3	DL
4	BBA1055	Managerial Economics and Financial Accounting	3	0	0	3	3	SC
5	CSA4103	Major Project	0	0	0	10	0	SC
		TOTAL	**9**	**0**	**0**	**19**	**9**	

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.

Semester 1:

Course Code: ENG5001	**Course Title: English for Employability**		**L- T-P- C**	**2**	**1**	**0**	**3**
Version No.	3.0						
Course Pre-requisites	**Graduate Level English Language Proficiency**						
Anti-requisites	**NIL**						
Course Description	The purpose of this course is to enable students enhance their vocabulary, pronunciation and accentand thus ensuring employability. The course is designed in a structured format so as to help students internalize the content. The modules provide adequate scope for internalization through meaningful and relevant activities. Assessments are built at regular intervals to facilitate learning. They also acquire research writing skills which enables them in academic writing.						
Course Outcomes	**On successful completion of the course the students shall be able to:** **1. Interpret main ideas and supporting details while listening attentively** **2. Develop speaking ability in English both in terms of fluency and comprehensibility** **3. Discover reading skills, reading speed and read to analyze and interpret information** **4. Adapt the knowledge of mechanics of research writing and write a research article.**						
Module 1	**Active Listening**	**Listening to audio clips and answering the questions**	**Listening skills and Vocabulary Building**				**10**

1. Listening to Speeches for Vocabulary and Intonation- TED TALKS and Podcasts. 2. Barriers to Effective Listening 3. Types of Listening – Informational, Discriminative, Critical, Empathetic, Appreciative 4. Listening and Note Taking- Activity 1.				1
Module 2	**Effective Speaking**	**Presentation**	**Speaking Skills**	**12**
1. Workplace Communication and Communication Etiquette 2. Practical frameworks to improve speaking 3. Attending Interviews 4. Asking and responding to questions, Formal and Informal Communication 5. Expressing views, opinions and preferences 6. Presentation Skills 7. Short speeches				
Module 3	**Reading Strategies**	**Reading Research Articles**	**Reading Skills**	**12**
1. Components of reading 2. Improving thinking skills, analytical abilities, and decision making through Reading 3. Reading Strategies 4. **Reading and Note Making- Activity**				
Module 4	**Scientific Writing/Writing dissertation**	**Writing Reports**	**Writing Skills**	**10**
1. Report Writing- Types of reports, Components of a Report, Structuring a Technical Report. 2. Referencing Skills for Academic Report Writing 3. Writing a Research Article. 4. Writing bibliography				
Texts: 1. Redman, Stuart. English Vocabulary in Use. Cambridge University Press, 1997. 2. MacCarthy, Michael, and Felicity O'Dell. English Vocabulary in Use, Cambridge University Press **3.** Turton, Nigel D. ABC of Common Grammatical Errors. Macmillan India, 1995 https://1filedownload.com/wp-content/uploads/2020/12/Abc-Of-Common-				

Grammatical-Errors-.pdf	
References: 1. Hart, Steve, Aravind R Nair, and Veena Bhambhani. Embark: English for Undergraduates. Cambridge University Press 2. Hari Prasad, M., John Verghese, R.Kishore Kumar, Komali Prakash, and U. Saraswati Rao. Strengthen Your Steps: A Multimodal Course in Communication Skills. Maruti Publications.	3

Course Code: MAT3001_v01	**Course Title: Mathematical Foundations for Computer Applications** **Type of Course: Program Core**	**L-T-P-C**	2	1	0	3
Version No.	1.0					
Course Pre-requisites	Undergraduate level Mathematics					
Anti-requisites	**Nil**					
Course Description	This course focuses on fundamental concepts and tools of discrete mathematics with emphasis on their applications to computer science. The course covers topics such as group codes, logic and Boolean circuits, graphs, trees and graph theoretic algorithms.					
Course Objective	The objective of the course is **Skill Development** of student by using **Problem Solving Techniques.**					
Course Outcomes	On successful completion of the course the students shall be able to: CO1: Apply the concept of a group action to deal with practical problems such as coding. CO2: Comprehend the concepts and ideas of mathematical logic. CO3: Elucidate the concepts of lattices and Boolean algebra. CO4: Adopt the principles of graph theory to solve real-life problems.					
Course Content:						
Module 1	**Groups and Applications**			**12 Sessions**		
Groups, subgroups, semi groups, monoids, homomorphism's, codes, group codes, error detecting and correcting codes.						
Module 2	**Mathematical Logic**			**10 Sessions**		
Logical Equivalence, normal forms, statement calculus, inference theory for the statement calculus, predicate calculus, inference theory for the predicate calculus.						
Module 3	**Lattices and Boolean Algebra**			**10 Sessions**		
Posets, lattices, special lattices, Boolean algebra, Boolean functions.						

Module 4	**Graph Theory**			**10 Sessions**
Introduction, undirected and directed graphs, paths and circuits, trees and fundamental circuits, cut sets and cut vertices, matrix representation of graphs, Graph theoretic algorithms.				
Targeted Application & Tools that can be used: The objective of the course is to familiarize students with the concepts of Mathematics for computer applications. Tools used: R Software / MS-Excel / Matlab / Mathematica / Maple				
Text Books: 1. Kenneth H.Rosen, Discrete Mathematics and its applications with combinotronics and graph theory, Tata McGraw Hill, 6th edition. 2. J. P. Tremblay and R Manohar, "Discrete Mathematical Structures with applications to Computer Science", Tata McGraw Hill, 1997.				
References: 1. C.L.Liu: Elements of Discrete Mathematics, McGraw Hill. 2. Lipschutz, Seymour: Discrete Mathematics, Schaum's series. 3. Babu Ram: Discrete Mathematics, Vinayek publishers, New Delhi.				

Course Code: **CSA4001**	**Course Title: Web Technology** **Type of Course: Program core** **Theory & Integrated Laboratory**	**L-T- P- C**	1	0	4	3
Version No.	1.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	The purpose of this Course is to introduce the basic concepts and architecture of the World Wide Web. The course contains concepts that enable students to build web pages using various web technologies such as Hypertext Markup Language and Cascading Style Sheets. Students will be trained to plan and design effective web pages by writing codes using current leading trends in the web domain, and enhancing web pages with the use of page layout techniques, text formatting, graphics, images, and multimedia. The focus is on niche technologies that will help students to build Internet- and web-based applications that interact with other applications and with databases.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Web Technology** and attain **Skill Development** through **Experiential Learning** techniques.					
Course Outcomes	On successful completion of this course, the students shall be able to: CO1: Define the fundamental concepts of the Internet, Protocols, Webservers and working of WWW. **[Remember]** CO2: Apply HTML tags and CSS features to develop a website. **[Apply]** CO3: Build web-based applications using client-side scripting languages. **[Apply]** CO4: Develop database driven applications with server-side scripting language using PHP [**Apply]**					

Course Content:				
Module 1	**Introduction to Internet Standards**	Quiz		**[L-4, P-16=20 Sessions**
Topics: Basics Of Internet Client/Server Computing: Introduction to WWW, WWW Architecture, Web Browsers, Web servers, SMTP, POP3, MIME, File Transfer Protocol, Overview of HTTP, HTTP request-response, Types of Web servers, Error Response Codes				
Module 2	UI Design	Assignment		**[L-4, P-16=20 Sessions**
Markup Language (HTML): Introduction to HTML and HTML5, Formatting, Commenting, Anchors, Images, Hyperlinks, Lists, Tables, HTML Forms. **Cascading Style Sheet (CSS):** The need for CSS, Introduction to CSS, Basic syntax and structure, Inline Styles, Embedding Style Sheets, Linking External Style Sheets, Levels of CSS, Selectors, Font, color and Text Properties, BOX Model Backgrounds, Manipulating text, Margins, and Padding - Positioning using CSS. Responsive Design, CSS frameworks. **Introduction to Bootstrap**: containers, Bootstrap elements: colors, tables, images, buttons, button groups, progress bars, Forms, utilities, Sessions, alerts, custom forms, Grid System.				
Module 3	**Introduction to JavaScript**	Assignment		**[L-3, P-12=15 Sessions**
Topics : Introduction to Client Side Scripting, JavaScript Features, Programming Constructs, Arrays and Functions, Document Object Model, Event Handling, Browser functions, Form handling and Validation. Introduction to JQuery, Syntax, selectors, events				
Module 4	Server-Side Development	Mini Project		**[L-4, P-16=20 Sessions**
Topics: Introduction to server-side Development with PHP, PHP structure, Data Types, Arrays, $GET and $ POST, Reading/Writing Files, PHP Sessions and Objects, Object Oriented Design, Working with Databases, SQL, Database APIs, Managing MySQL Database. Accessing MySQL in PHP.				
List of Laboratory Tasks: **Experiment No. 1: Demonstration of HTML features** Level 1: Demonstration of various HTML formatting Tags				

Level 2: Design and develop static web pages for an online Book store

Experiment No. 2: Demonstration of HTML tags

Level 1: Demonstrate the various courses of the university and link those courses using table and link tag.

Level2: Design a HTML registration form for the course registration in a university

Experiment No. 3: Application of CSS in web designing

Level 1: Design a document using HTML and CSS to create a catalog of items for online shopping.

Level 2: Create a HTML document for employees' information and display the same using a cascaded style sheet.

Experiment No 4: Demonstration of JavaScript

Level 1: Write a JavaScript code to change the background color at frequent intervals

Level 2: Design a document to show the blinking Text using JQuery

Experiment No. 5: JavaScript in Webpage Validation

Level 1: Write a JavaScript program for Name,Email,password, mobile number validation

Level 2: Write a JavaScript program to give access to some web pages only by presidency University students.

Experiment No 6: Web design using PHP

Level 1: Write a PHP program to read the personal information of a person such as first name, last name, age, permanent address, and pin code entered by the user into a table created in MySQL. Read the same information from the database and display it on a web page

Level 2: Using PHP develop a web page that accepts book information such as ISBN number, title, authors, edition, and publisher and store information submitted through the web page in MySQL database.

Experiment No. 7: Building a website.

Level 1: Build a website for organizing an International Conference. The conference website must be able to collect the author's details and upload a file.

Level 2: Develop the PHP code for partial web pages for ordering vegetables from Bigbasket

Targeted Application & Tools that can be used:

Xampp web server to be used to demonstrate PHP.

Project work/Assignment:

Mini Web application development in a group

Textbook(s):

1) Paul Deitel, Harvey Deitel, Abbey Deital,"*Internet & World Wide Web How to Program*", Fifth Edition, Pearson Education, 2021.
2) Randy Connolly, Ricardo Hoar ," Fundamentals of Web Development", Second Edition, Pearson Education,2018

References

1. Ivan Bay Ross, "HTML, DHTML, Javascript, Perl CGI", BPB Publication, 5th Revised Edition, 2022
2. Dr C Xavier ,"Web Technology And Design", New Age International (P) Ltd,2017
3. John Pollock , "JavaScript: A Beginner's Guide", TMH, 5th Edition, 2020
4. Ben Frain,"Responsive Web Design with HTML5 and CSS", Packt Publishing,4th Edition 2022
5. Dean, John," Web Programming with HTML5, CSS and Java Script", 2nd edition, Jones & Bartlett Learning Publishers, 2019

Web references :

1. W3Schools Online Web Tutorials

2. https://www.tutorialspoint.com/internet_technologies

Topics relevant to "SKILL DEVELOPMENT":

Client Server Computing, HTML for skill development through Experiential Learning techniques. This is attained through the assessment component mentioned in the course handout.

<table>
<tr><td>Course Code:
CSA4002</td><td colspan="3">Course Title:
Advanced Data Structure and Algorithms

Type of Course: Program Core & Theory and Laboratory Integrated</td><td>L-T-P-C</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>Version No.</td><td colspan="8">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">This course will provide exposure to understand the ADT/libraries, the necessary mathematical abstraction and choose appropriate data structures. It familiarizes students with advanced data structures and paradigms. Course includes theory as well as practical components.
Topics to Include: Review of traditional data structures, Dictionaries, Implementation of Dictionaries. Hashing, Skip Lists, Trees, Text Processing and introduction to Computational Geometry</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of Advanced Data Strucuture and Algorithms and attain Skill Development through Experiential Learning techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">On successful completion of the course the students shall be able to:
[1] Review the fundamental concepts and implementation of basic data structures. [Remember]
[2] Practice a variety of advanced abstract data type (ADT) and Data structures using various searching and hashing techniques. [Apply]
[3] Write algorithms for some of the trees, graphs. [Remember]
[4] Apply the basic principles of different string-matching algorithms [Apply]</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="3">Review of traditional Data Structures</td><td>Quiz</td><td>Data Collection</td><td colspan="3">11 Sessions</td></tr>
<tr><td colspan="9">Based on the background of students, revise programming in C/C++, Stacks, Queues, Lists and Graphs (Dijekstra’s algorithm, Spanning tree algorithms).</td></tr>
</table>

Module 2	**Dictionaries and Hash Tables**	Assignment	Programming Task	**11 Sessions**
Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing.				
Module 3	**Skip Lists AND Trees**	Quiz	Programming Task	**11 Sessions**
Need for Randomizing Data Structures and Algorithms , Binary Search Trees, AVL Trees, Splay Trees, Heap				
Module 4	**Text Processing**	Assignment	Programming Task	**12 Sessions**
String Operations, Brute-Force Pattern Matching, The Boyer - Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS).				

List of Experiments: These experiments can be done using C++ Programming

Lab Experiments are to be conducted on the following topics

1. Implementing Lists, Stacks and queues and graph in C++
2. Implementations of dictionaries &hash Tables
3. Implementing Tree algorithms and heap
4. Knuth-Morris-Pratt Algorithm
5. Compressed Tries, Suffix Tries
6. Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS

Targeted Application & Tools that can be used:

C++ Editors

Project Work / Assignment / Case Study

1. Hashing
2. Binary Search Tree, AVL Tree
3. String Matching

Text Books

T1. Mark Allen Weiss, "*Data Structures and Algorithm Analysis in C++*", 2nd Edition, Pearson, 2004.
http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=5882&query_desc=kw%2Cwrdl%3A%20Data%20Structures%20and%20Algorithm%20Analysis%20in%20C%2B%2B

T2. M T Goodrich, Roberto Tamassia, "Algorithm Design: foundations, analysis and Internet examples", John Wiley, 2014.
http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=13008&query_desc=kw%2Cwrdl%3A

References

R1. Thomas Coremen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third edition, MIT Press, 2009.
https://sd.blackball.lv/library/Introduction_to_Algorithms_Third_Edition_(2009).pdf

R2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 2013.
http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=5884&query_desc=kw%2Cwrdl%3A

R3. Adam Drozdek, "Data Structures and Algorithms in C++", Fourth Edition, Cengage Learning, 2013.
https://itlectures.ro/wp-content/uploads/2016/04/AdamDrozdek__DataStructures_and_Algorithms_in_C_4Ed.pdf

E-Resources

W1. https://sites.cs.ucsb.edu/~suri/cs130a/cs130a
W2. https://www.seas.upenn.edu/~swati/ee22003.html

Topics relevant to "SKILL DEVELOPMENT":

Stacks, Queues, hashing for Skill development through Experiential Learning techniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSA4003	Course Title: Software Engineering Type of Course: Program Core - Theory	L-T P- C	3	0	0	3

Version No.	1
Course Pre-requisites	**NIL**
Anti-requisites	**NIL**
Course Description	In this course, students are introduced to the fundamental theories and concepts of software engineering. Software engineering emerged in the late 1960s as a new engineering discipline concerned with all aspects pertaining to software production. It encompasses concepts, principles, theories, techniques and tools that can be used for developing high-quality professional software. A software product is said to have a life-cycle, or undergo a software process, which in software engineering terms consists essentially of two parts: development and evolution. Both involve traditional engineering phases, software development consisting primarily of concept creation, requirements specification, design, implementation, integration, testing, and deployment. On the other hand, software evolution involves operation and maintenance as well as some limited development activities aimed at improving the software. Students who want to focus on software engineering are expected to gain and integrate knowledge from various subject areas including computer programming, data structures, algorithms, numerical methods, statistics, design patterns, human-computer interaction, computer graphics, information visualization, database systems, web development, software project management, and software engineering.
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Software Engineering** and attain **Skill Development** through **Participative Learning** techniques.
Course Outcomes	On successful completion of this course the students shall be able to: 1. Understand of the role and impact of software engineering in contemporary business, global, economic, environmental and societal context and Elicit the requirements for real, time problems. Analyze and use open source tools for project designing. **[Knowledge]** 2. Develop User Interface design for the given system. **[Application]** 3. Analyze and resolve information technology problems through the application of systematic approaches and diagnostic tools. **[Application]**

	4. Apply software management principles and understand the issue of Software Quality and activities present in typical Quality management process. **[Comprehension]**			
Course Content:				
Module 1	**Process And Software Requirements**	Assignment	**Selection of suitable software process models for a given software specification**	11 Sessions
Topics: Product and Process – Evolution Process and Activities – Software Development Lifecycle Models: Waterfall Model – Incremental Models – Evolutionary Models – Spiral Model – Unified model – Prototype model – Agile methods. Functional and Non Functional Requirements – Software Requirements Document – Requirements Specification – Requirements Engineering Processes – Requirements Elicitation & Analysis – Requirements Validation – Requirements Management.				
Module 2	**ANALYSIS AND DESIGN**	Assignment	**Determine the flow of data/events among the processes in the application under consideration**	11 Sessions
Topics: Analysis Modeling Approaches: Scenario Based Modeling – UML Models – Data Modeling Concepts: Class Based Modeling, Flow Oriented Modeling – Design Process and Concepts – Design Model – Architectural Design – Pattern Based Design – Web App Design – Real Time Software Design – System Design – Data flow Oriented Design – Designing for Reuse – User Interface Design: Interface analysis, Interface Design – Component level Design: Designing Class Based Components, Traditional Components.				
Module 3	**SOFTWARE TESTING**	Case Study	**Based on any real time application projects**	11 Sessions

Topics: Software Testing Strategies – White Box Testing – Black Box Testing – Basis Path Testing – Control Structure Testing – Regression Testing – Unit testing – Integration Testing – Validation Testing – System testing – Art of Debugging.				
Module 4	**MANAGEMENT AND METRICS**	Assignment	**Preparation of Software Configuration Management template for a software project**	12 Sessions
Topics: Multimodal Interfaces; Visual sensation, perception, cognition; Distortions and illusions; Visual Design including iconography, bread crumbing, negative space, typography and color; Auditory sensation, perception, and cognition; Text-to-speech and speech-to-text; Haptics including cutaneous, kinesthetic, and haptic; Mechanoreceptors and touch-based interfaces; patterns of hand movement; Types of touch-based interface; Brain-Computer Interfaces; Medical and Commercial application of BCI; ubiquitous computing and ambient intelligence; Wearable devices and the miniaturization of computing platforms;				
Targeted Application & Tools that can be used: MatLab, Python, Netbeans and AWS etc.,				
Project work/Assignment:				
Assignment 1: Testing sample application using Black box and White box approaches and understand the differences in selecting of test cases from the test suite. **Assignment 2:** Preparation of Software Configuration Management template for a software project. • Calculation of Test metrics for Sample application. **Project 1:** Designing UI of Sample application				
Textbooks: T1 : Roger S. Pressman, *"Software Engineering: A Practitioner's Approach", Seventh Edition,* McGraw Hill International edition, 2009.				
References: R1 : Ian Sommerville, *"Software Engineering, Ninth Edition",* Pearson Education, 2008. R2 : Watts S.Humphrey, *"A Discipline for Software Engineering"*, Pearson Education, 2007. **Web references:** https://www.studocu.com/row/document/lead-city-university/software-engineering/software-engineering-lecture-note/10888094 https://www.youtube.com/watch?v=WxkP5KR_Emk https://www.youtube.com/watch?v=OVZYOItkUUs https://unimelb.libguides.com/c.php?g=931690&p=6734359				

Topics relevant to "SKILL DEVELOPMENT":

Visual sensation, perception for **skill development** through **Experiential Learning t**echniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSA4097	**Course Title: Coding Training 1** **Type of Course:**	**L- T-P- C**	0	0	2	1
Version No.	1.0					
Course Pre-requisites	Basic Programming Skills					
Anti-requisites	NIL					
Course Description	This course covers mastering object-oriented concepts in Python, including Sessions, inheritance, polymorphism, and encapsulation. Students will learn to design and implement robust, reusable code using real-world examples. Ideal for those with basic Python knowledge, it enhances problem-solving skills and software development proficiency.					
Course Objective	To mastering the programming concepts in Python. Students will explore topics such as inheritance, polymorphism, encapsulation, and design patterns. Emphasis is placed on practical application through hands-on projects, enabling participants to create robust and maintainable software solutions in Python.					
Course Out Comes	CO1: Apply the principles of OOP by creating Python Sessions, objects, inheritance, encapsulation, and polymorphism that model real-world entities and their interactions. [Apply] CO2: Analyze various exception handling scenarios, including how exceptions are propagated through the class hierarchy and the impact of exception handling on program stability. Compare different strategies for handling exceptions and their effectiveness in managing error conditions. [Analyze] CO3: Assess various file handling techniques in Python, such as reading and writing files synchronously, using context managers, and handling large files efficiently. Critique the advantages and limitations of each technique, considering factors like performance, memory usage, and error handling. [Evaluate]					
Course Content:						
Module 1	**Introduction to OOPS, Methods**	Experiential Learning			**10 Sessions**	
Sessions and Objects, Constructors, Namespaces, Encapsulation, Abstraction, Creating a Class, The self variable, Constructor - Types of Methods: Instance Method, Class Method, Static Method, Passing members of one class to another class - Create a Parent Class, Create a Child Class, Add the __init__() Function, Use the super() Function, Add Properties						

Module 2	**Python Inheritance, Polymorphism & Exception Handling**	Experiential Learning		**10 Sessions**
Topics: Types on inheritance, Single Inheritance, Multiple Inheritance, Method overloading and Method Overriding, Method Resolution Order(MRO), Duck Typing Philosophy of Python Abstract method and Abstract Class, Interfaces in Python - Compile time errors, Runtime Errors, Logical Errors, Exception, Exception handling, Types of Exception.				
Module 3	**Files & Threads**	Experiential Learning		**10 Sessions**
Types of Files, Opening a file, Closing a file, Working with text files containing strings, Working with Binary files, The with statement, Seek() and Tell() methods, Random accessing, Understand Thread based application process, Single Tasking, Multitasking, Creating and Working with Threads.				
TEXT BOOKS: T1. John Zelle, "Python Programming: An Introduction to Computer Science", Franklin Beedle & Associates Inc., 3rd edition, 2016. T2. Eric Matthes, "Python Crash Course: A Hands-On, Project-Based Introduction to Programming", No Starch Press, 2nd edition, 2019. T3. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2nd edition, 2017				
Lab Experiment: Focus on case studies and scenario-based questions derived from real-world industry challenges. These experiments aim to provide practical exposure by solving problems aligned with current industry standards and practices.				
Topics relevant to "EMPLOYABILITY SKILLS": Topics of all four modules will help in developing **Employability Skills** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.				

Bridge Course:

Course Code: **CSA4101**	**Course Title: C Programming And Data Structures** **Type of Course: Bridge course** **Theory & Integrated Laboratory**	LTPC – 1-0-0-0
Version No.	1.0	
Course Pre-requisites	**NIL**	
Anti-requisites	**NIL**	
Course Description	The course offers a comprehensive introduction to C programming and data structures, focusing on foundational and advanced concepts crucial for software development. It begins with C basics—data types, variables, operations, control flow, functions, and arrays—before advancing to complex features like pointers, file handling, and pre-processor directives. Students will explore linear data structures (lists, stacks, queues) and non-linear structures (binary trees, hashing), gaining hands-on experience in implementation and applications. The course also covers key sorting and searching algorithms, emphasizing efficient problem-solving. By course end, students will have solid skills in designing, implementing, and optimizing algorithms and data structures in C.	
Course Objective	This course aims to introduce the fundamentals of C programming, explore its advanced features, understand ADTs and linear data structures, learn non-linear data structures and hashing, and become familiar with sorting and searching techniques.	
Course Outcomes	On successful completion of this course, the students shall be able to: CO1: Understand fundamental programming concepts, including data types, variables, control statements, functions, and array structures, to solve basic computational problems. CO2: Apply advanced features of C programming such as structures, unions, pointers, and file handling to manage and manipulate complex data. CO3: Implement and analyse linear data structures like linked lists, stacks, and queues, along with their applications, to efficiently handle and organize data.	

	CO4: Demonstrate proficiency in non-linear data structures and algorithms, including trees, hashing, and sorting techniques, to enable efficient searching and data retrieval operations.			
Course Content:				
Module 1	**Programming Fundamentals**	Assignment		**4 Sessions**
Topics: Data Types – Variables – Operations – Expressions and Statements – Conditional Statements – Functions – Recursive Functions – Arrays – Single and Multi-Dimensional Arrays.				
Module 2	**C Programming – Advanced Features**	Quiz		**3 Sessions**
Topics: Structures – Union –Pointers: Pointers to Variables, Arrays and Functions – File Handling				
Module 3	**Linear Data Structures**	Assignment		**4 Sessions**
Topics : Linked List – Doubly- Linked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue ADT – Priority Queues – Queue Implementation – Applications.				
Module 4	**Non-Linear Data Structures And Searching and Sorting Techniques**	Assignment		**4 Sessions**
Topics: Trees – Binary Trees – Tree Traversals – Binary Search Tree – Hashing - Hash Functions - Bubble Sort – Linear Search – Binary Search				
List of Laboratory Tasks: Experiment 1: Write a program to read two numbers and find the largest of the two. Experiment 2: Write a program to check if a given number is even or odd. Experiment 3: Write a program to check whether a given number is negative, positive, or zero. Experiment 4: Write a program to read three numbers and find the largest among them. Experiment 5: Write a program to read a number between 1 and 7 and display the corresponding day of the week (1 for Monday, 2 for Tuesday, etc.). Experiment 6: Write a program to read a number and find the sum of its digits.				

Experiment 7: Write a program to calculate the factorial of a number using a non-recursive function.
Experiment 8: Write a program to calculate the factorial of a number using a recursive function.
Experiment 9: Write a program to read an array of integers and print the elements in reverse order.
Experiment 10: Write a program to read a matrix of size mXn and display the sum of principal diagonal elements.
Experiment 11: Write a program to swap two variables using pointers.
Experiment 12: Implement a stack using an array with basic push and pop operations.
Experiment 13: Implement a queue using an array with enqueue and dequeue operations.
Experiment 14: Write a program to perform linear search on an array of integers, where the user provides the array and the target element.
Experiment 15: Write a program to perform bubble sort on an array of integers and display the sorted array.

Targeted Application & Tools that can be used:

System software and Application software

Programming Professionally Used Software : MinGW / C/C++ IDE

Textbook(s):

1) Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1997.
2) Reema Thareja, "Programming in C", Second Edition, Oxford University Press, 2016.

References

1. Brian W. Kernighan, Rob Pike, "The Practice of Programming", Pearson Education, 1999.
2. Paul J. Deitel, Harvey Deitel, "C How to Program", Seventh Edition, Pearson Education, 2013.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms",Pearson Education,1983.
4. Ellis Horowitz, SartajSahni and Susan Anderson, "Fundamentals of Data Structures",Galgotia, 2008.

Web references :

1. https://www.coursera.org/specializations/data-structures-algorithms
2. https://nptel.ac.in/courses/112107243
3. https://nptel.ac.in/courses/112105598

Topics relevant to development of "Foundation Skills": Fundamentals of Data structure**,**

“Skill Development”: Implementation Linear and non-linear data structure**,**
“Employability”: Linear & Non-linear Data Structure

Course Code: **CSA4102**	**Course Title: Fundamentals of Information Technology** **Type of Course: Bridge Course** **Theory**	**L- T- P- C**	1	0	0	0
Version No.	1.0					
Course Pre-requisites	**Nil**					
Anti-requisites	**NIL**					
Course Description	This course provides an introduction to the foundational concepts of information technology. Key topics include computer arithmetic and number systems, primary and secondary storage systems, and data storage/retrieval methods. The course explores object-oriented programming concepts such as Sessions, objects. It also covers relational database management systems, SQL, database design. Additionally, students will learn about operating systems, and various processing methods. Networking fundamentals, data communication, and key networking devices and protocols are also discussed. This course aims to build a comprehensive understanding of IT principles and their practical applications in modern computing.					
Course Objective	The objective of this course is to provide students with a fundamental understanding of key information technology concepts, including computer arithmetic, number systems, and data storage methods. It aims to introduce essential principles of object-oriented programming, relational databases, and software engineering, while also covering the basics of operating systems, system performance, and data communication. Through these topics, students will develop a solid foundation in IT fundamentals and gain practical insights into networking and database management systems.					
Course Outcomes	On successful completion of this course, the students shall be able to: CO1: Define fundamental concepts of computer arithmetic, number systems, data storage methods, and basic networking principles. [Remember] CO2: Apply object-oriented programming concepts, relational database management principles, and SQL to solve real-world problems. [Apply]					

	CO3: Develop an understanding of operating systems, system performance, and data communication protocols. [Apply] CO4: Implement and manage basic networking devices, communication modes, and protocols for efficient data transmission. [Apply]			
Course Content:				
Module 1	**Computer arithmetic & storage fundamentals**	Quiz		**4 Sessions**
Topics : Binary, Binary Arithmetic, Number System: Positional & Non Positional, Binary. Primary Vs Secondary Storage, Data storage & retrieval methods. Primary Storage:. Secondary Storage				
Module 2	**Object oriented concepts**	Assignment		**4 Sessions**
Topics : Concepts of object oriented programming, Managing software complexity abstraction, class, object, member data, member methods, encapsulation, data hiding, inheritance, polymorphism, binding.				
Module 3	**Relational Database management**	Assignment		**4 Sessions**
Topics : Basic RDBMS concepts, database design, SQL comments, embedded SQL concepts, OLTP concepts.				
Module 4	**Operating system and Data communication**	Mini Project		**3 Sessions**
Topics: Functions, features, Single Processor & Multiprocessor systems, Real-Time System, Data, Communication, Basic Networking Devices, Communication Process, Types of Networks, LAN Topologies, Concepts relating to networking.				
Targeted Application & Tools that can be used: **Vs code can be used to demonstrate Html/css**				
Project work/Assignment:				
Mini Web application development in a group				
Textbook(s):				

3) Andrew. S. Tanenbanum, “Structured Computer Organization”, Fourth Edition, PHI, 2018.
4) Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Fourth Edition, Tata McGraw, 2014.
5) Roger S. Pressman, “Software Engineering – A practitioner’s approach”, Sixth Edition, McGraw Hill Publishers, 2004.

References

1) Andrew S. Tanenbaum, "Structured Computer Organization", PHI, 4th Edition, 2018.
2) Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", Tata McGraw-Hill, 4th Edition, 2014.
3) Roger S. Pressman, "Software Engineering: A Practitioner’s Approach", McGraw-Hill, 6th Edition, 2004.
4) Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", Wiley, 10th Edition, 2018.
5) Jon Duckett, "HTML and CSS: Design and Build Websites", Wiley, 1st Edition, 2011.

Web references :

1. W3Schools Online Web Tutorials

2. https://www.tutorialspoint.com/internet_technologies

Topics relevant to “SKILL DEVELOPMENT”:

Operating system concepts and Networking for skill development through Experiential learning techniques. This is attained through the assessment component mentioned in the course handout.

Semester 2

Course Code:	Course Title: Applied Statistics					
MAT3002_v01	Type of Course: Program Core	L-T-P-C	2	1	0	3

Version No.		1.0
Course Pre-requisites		Undergraduate level statistical methods and techniques
Anti-requisites		None
Course Description		Applied Statistics course is designed to provide a solid foundation in statistical methods and their practical applications. The course emphasizes the practical aspects of statistics, focusing on the use of statistical techniques to analyze and interpret data in various fields and industries. Topics such as probability distributions, correlation and regression analyses, sampling distributions, estimation and hypothesis testing for small and large samples are covered in the course.
Course Objective		The objective of the course is **Skill Development** of student by using **Problem Solving Techniques.**
Course Outcomes:		On successful completion of this course, the students will be in a position to **CO1:** Comprehend the ideas of random variables and probability distributions. **CO2:** Adopt appropriate statistical techniques to analyze data. **CO3:** Assess the validity of a claim based on evidence by controlling the errors. CO4: Apply appropriate statistical methods to handle sampling tests.

Module 1	**Probability Distributions**				**12 Sessions**
	Random Variables, Discrete Distributions: Binomial, Poisson, Negative Binominal Distributions and Their properties; Continuous Distributions: Uniform, Normal, Exponential Distributions and Their Properties. Joint Probability Distributions and their Properties, Transformation Variables, Mathematical Expectations, Probability Generating Functions.				
Module 2	**Multivariate Analysis**				**10 Sessions**
	Correlation, Correlation Coefficient, Rank Correlation, Regression Analysis, linear regression, Multiple Regression, Attributes, Coefficient of Association, Chi Square Test For Goodness of Fit.				

Module 3	**Estimation & Testing of Hypothesis**				**10 Sessions**
	Sample, Population, Statistic, Parameter, Sampling Distribution, Standard Error, Unbiasedness, Efficiency, Maximum Likelihood Estimator, Interval Estimation, confidence Interval, Formulation of Null hypothesis, critical region, level of significance, power of the test.				
Module 4	**Sample Tests**				**10 Sessions**
	Small Sample Tests: Testing equality of means, testing equality of variances, test for correlation coefficient, Test for Regression Coefficient. Large Sample tests: Tests based on normal distribution.				
	Targeted Applications & Tools that can be used: The objective of the course is to familiarize students with the concepts of Probability and Statistics. Tools used: R Software / MS-Excel / Matlab / Mathematica / Maple				
	Text Books: T1: Douglas.C. Montogomery and G. C. Runger, Applied Statistics and Probability for engineers, New Jersey, John Wiley and Sons, 3rd edition, 2003. T2: J. Susan Milton and Jesse Arnold, Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, McGraw Hill, 2017.				
	References R1: Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying E. Ye, Probability and Statistics for Engineers and Scientists, Pearson Education Inc, 9th Edition, 2012. R2: Berenson and Levine, Basic Business Statistics, New Jersey, 6th edition, Prentice-Hall India, 1996. R3: Kishore S. Trivedi, Probability and Statistics with Reliability, Queuing and Computer Applications, Prentice Hall of India, 1999. R4: S. C. Gupta, Fundamentals of Statistics, 7th Edition, Himalaya Publishing House. R5: Schaum Series – Statistics and Probability, McGraw Hill Publications.				

Course Code: CSA4004	**Course Title:** Advanced Python Programming **Type of Course: Program Core – Lab Integrated**	**L-T- P- C**	1	0	4	3
Version No.	1.0					
Course Pre-requisites	**NIL**					
Anti-requisites	Nil					
Course Description	The advanced Python course covers a wide range of topics and skills to enhance your proficiency in Python programming. Throughout the course, you will delve into advanced concepts such as web scraping, data analysis, natural language processing, image processing, and data visualization. By completing this course, student will have a solid understanding of advanced Python techniques and be well-equipped to tackle complex programming tasks, analyze data, build applications, and work on projects in various domains of AI, machine learning, deep learning and reinforcement learning.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Advance Python and attain **Skill Development** through **Experiential Learning** techniques.					
Course Outcomes	**On successful completion of this course, the students shall be able to:** **CO1:** Understand the concepts of python programming for advanced applications. (Understand) **CO2:** Apply advanced python concepts for AI/ML based applications. (Apply) **CO3:** Apply optimization and parameter tuning techniques for improved Machine Learning algorithms. (Apply) **CO4:** Apply python to niche and specialised applications such as Speech, image and Business Analytics. (Apply)					
Course Content:						
Module 1	**Review- Basic Python Concepts**	Assignment		**21 Sessions (L5 + P16)**		

Overview of Python basics and syntax , IDEs, Colab, Variables, data types ,conditional statements, Lists, Tuples, Sets, Dictionary, Functions, Overview of object-oriented programming (OOP) concepts and principles				
Module 2	**Advanced Python Concepts**	Assignment		**20 Sessions (L4 + P16)**
Python modules, Creating and importing own modules, working with JSON objects, Decorators, Multithreading, Multiprocessing, Sharing Data between processes, python Testing Frameworks, Library Integration ,Introduction to NLTK, OpenCV, RESTful API, Computer Vision				
Module 3	**Python essentials for Data Analysis and Machine Learning**	Case Study		**20 Sessions (L4 + P16)**
Topics: NumPy- Array Vs Lists, Array operations, Slicing, Stacking, Indexing, nditer. Pandas- Data cleaning, manipulation, concat, merge, reshape, handling large datasets, Memory optimization. Pandas time series analysis. Working with web scraping libraries (Beautiful Soup, Scrapy). Data Visualization using Matplotlib, Seaborn, Plotly. NLTK,				
Module 4	**Case Study and Project**	Case Study and Project		**14 Sessions (L2 + P12)**
Python for Speech Recognition Python for Data Visualisation and Interactive Dashboards Text pre-processing techniques (tokenization, stemming, etc.)				

Basics: Use UCI repository and Kaggle dataset for each experiments. Introduction to Python Stack for Data Science, Core Python Libraries for data analysis, Anaconda platform and its installation, Executing programs on Jupiter IDE.

Experiment 1

Laboratory Familiarization

LO1: Write and execute Python programs in Colab, showcasing features like code cells, Markdown, and integration with Google Drive.

LO2: Run basic Python programs demonstrating variable assignments, data types, and arithmetic operations.

Experiment 2

Speech-to-Text Converter

LO1: Use the SpeechRecognition library to convert speech to text from multiple audio sources (e.g., .wav files and microphone input).

LO2: Train a simple neural network (using TensorFlow/Keras) on an audio dataset (e.g., LibriSpeech) to recognize basic words. Visualize accuracy and loss graphs.

Experiment 3

Web Scraping and Data Analysis

LO1: Scrape data from a live website (e.g., weather data, product prices) using BeautifulSoup or Scrapy. Save the data as a CSV.

LO2: Use Pandas to clean, manipulate, and analyze the scraped data. Visualize findings with Matplotlib and Seaborn.

Experiment 4

Natural Language Processing (NLP) Project

LO1: Build a text classification model using spaCy or NLTK. Use a labeled dataset like IMDB reviews or Twitter sentiment data.

LO2: Visualize text insights (e.g., word clouds, token frequency histograms). Evaluate the model's accuracy using confusion matrices and classification reports.

Experiment 5

Image Processing and Computer Vision

LO1: Implement edge detection (using cv2.Canny) and image filters (e.g., Gaussian blur) on sample images from Colab.

LO2: Build a basic object detection model using a pre-trained network (e.g., MobileNet or YOLO).

Experiment 6

Data Visualization with Interactive Dashboards

LO1: Create interactive dashboards using Plotly or Dash (hosted in Colab via ngrok). Add charts and sliders for dynamic interaction.

LO2: Use maps (via Plotly) to visualize geospatial data, such as COVID-19 cases by region.

Experiment 7

Exploring Data Structures in Python

LO1: Demonstrate creation and manipulation of Lists, Tuples, Sets, and Dictionaries. Showcase Pythonic operations like list comprehensions and dictionary merging.
LO2: Perform operations like sorting a list of dictionaries, filtering sets, and aggregating data (e.g., summing values).

Experiment 8
Basic OOP Concepts
LO1: Define Sessions and objects to represent entities like Students or Products, with attributes and methods.
LO2: Implement inheritance and polymorphism by creating a class hierarchy (e.g., Vehicle -> Car, Truck).

Experiment 9
Building a Custom Python Module
LO1: Develop a Python module with utility functions for mathematical operations (e.g., prime checking, matrix addition).
LO2: Import and use this module in another Colab notebook. Add proper docstrings and comments.

Experiment 10
Multithreading and Multiprocessing
LO1: Implement multithreading to perform tasks like downloading multiple files simultaneously.
LO2: Use multiprocessing to perform heavy computations (e.g., matrix multiplication) on a dataset.

Experiment 11
Advanced Pandas Operations
LO1: Demonstrate data cleaning by handling missing values, duplicates, and outliers in a large dataset.
LO2: Analyze temporal trends in stock price data using Pandas time series methods.

Experiment 12
Machine Learning Basics
LO1: Train a simple linear regression model using Scikit-learn to predict house prices. Visualize the line of best fit.
LO2: Extend the project to classification (e.g., binary classification on a dataset like Titanic survival).

Experiment 13

Sentiment Analysis Pipeline

LO1: Collect tweets using Twitter API (via tweepy) and preprocess the text (tokenization, stemming, removing stopwords).

LO2: Train a sentiment analysis model on the data using sklearn or NLTK. Evaluate accuracy with test data.

Experiment 14

End-to-End Data Analysis Project

LO1: Identify a dataset from Kaggle (e.g., Global Warming Data). Scrape, clean, and preprocess the data in Colab.

LO2: Visualize insights using an interactive dashboard or multi-chart report. Include predictive analysis using a simple ML model.

Experiment 15

Micro Level Project

Targeted Application & Tools that can be used:

Google Colab / Jupyter Notebooks, IDEs, Anaconda / Jupyter Lab, SpeechRecognition (Python Library), Flask / Django.

Project work/Assignment: Choose and analyse a network from any organization/Assignment proposed for this course in CO1-CO4

Topics related to

1. Problem Solving: Give any problem to solve using Python.

2. Employability: Doing mini project in Machine Learning using Python.

Text Books

1. **Core Python Programming, Dr R Nageswara Rao , Second edition ,Dreamtech press, 2018.**
2. **Python Data Analytics with Pandas, NumPy and Matplotlib,Fabio Nelli , Second edition, Apress,2021**
3. **Test Driven Development with python,Harry J.W Percival,2017, first edition , O'Reilly Media**
4. **Python Machine Learning Cookbook,by Prateek Joshi,2016, Packt Publishing**

Reference Books

1. "Python for Data Analysis" by Wes McKinney
2. “Deep Learning with Python" by François Chollet
3. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper
4. Python Web Scraping - Second Edition" by Katharine Jarmul and Richard Lawson
5. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
6. Manaranjan Pradhan, U Dinesh Kumar, “Machine Learning Using Python” Wiley, First Edition 2019
7. Fluent Python, 2nd Edition Released April 2022, Publisher(s): O'Reilly Media, Inc., ISBN: 9781492056355
8. “Python Cookbook" by David Beazley and Brian K. Jones

Web References

1. https://nptel.ac.in/courses/
2. https://www.udemy.com/course/
3. https://www.coursera.org/learn/

Course Code: CSA4006	**Course Title:** Advanced Database Technology **Type of Course:** Program Core - Lab Integrated	**L-T-P-C**	2	0	2	3

Version No.	**1.0**			
Course Pre-requisites	**NIL**			
Anti-requisites	**NIL**			
Course Description	**The purpose of this course is to make the students to revisit RDBMS transactions first. Then introduce them with Distributed, Parallel, and NoSQL database concepts. They include main characteristics, advantages and disadvantages of each one of them. Importance and differences among them are noted. Need to transit from RBMS to NoSQL is discussed. The striking features of distributed, parallel and NoSQL are considered and studied.** **The associated laboratory provides an opportunity to have hands on of the concepts learned during this course.**			
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Advanced DBMS** and attain **Employability Skills** through E**xperiential Learning** technique			
Course Outcomes	**On successful completion of this course the students shall be able to:** (1) Recall the transactions in RDMS **(2)** Explain advanced features of distributed, parallel, and NoSQL databases. **(3)** Illustrate the features in Distributed database **(4)** Employ Parallel database concepts in real life applications.			
Course Content:				
Module 1	**Transactions in RDBMS**	Quiz	Comprehension based Quizzes and assignments.	**08 Sessions**
Topics: Overview of Basic concepts of RDBMS – RDBMS Transaction control state diagram, ACID properties of transaction, Schedules in transactions - Serial, Non-Serial and Serializable, Serializability - Conflict and View, Conflict Serializability check by Precedence Graph, Concurrency Control – Lock Based and Time Stamp Based.				
Module 2	**NoSQL Databases**	Programming and Mini Project	Laboratory experiments and Mini Projects on NoSQL Topics using MongoDB/ Casandra.	**08 Sessions**
Topics:				

NoSQL Introduction – Scale Out, Commodity Hardware, Brief History, Features – Non-Relational, Schema Free, Simple API, and Distributed. NoSQL Architectures/Data Models - Document, Columnar, Key-Value, and Graph. Transaction in NoSQL- BASE for reliable database transactions, Achieving Horizontal Scalability with Database Sharding, CAP theorem.
Case Study: MongoDB/Casandra/ AWS/ HBase

Module 3	**Distributed Databases**	Assignment	Assignment on main topics of Distributed Databases	**08 Sessions**

Topics:
Loosely Coupled, Characteristics of Distributed Databases, Local and Global view of applications, Distributed Processing, Types – Homogeneous and Heterogeneous, Distributed Data Storage – Replication and Fragmentation, Fragmentation – Horizontal and Vertical Type, Difference between Centralized and Distributed Databases.

Topics:

Module 4	Parallel Databases	Assignment	Assignment on main topics of Parallel Databases	**06 Sessi**

Tightly Coupled, Features of parallel databases, Shared Memory, Shared Disk, Shared Nothing Systems. Advantages of each of these schemes, Advantages and Disadvantages of Parallel Databases, Differences between Parallel and Distributed Databases.

Install MONGODB

https://www.javatpoint.com/mongodb-create-database

Create any one of the following databases.
Employee, Student, University, Banking, or Online Shopping

Drop database

Create Collection: In MongoDB db.createCollection(name,option) is used to create collection.
Drop Collection

List of Laboratory Tasks:(7 X 2= 14 Sessions)

Level 1: Perform CRUD operations (Insert, Update, Delete and Query Documents) on 'Sales' Database.
Level 2: Do MongoDB text search on ' GeoSpatial ' Database.

Experiment No. 2: Try experiments on MongoDB Operators
Level 1: Perform queries involving MongoDB Query and Projection Operators using 'Sales' Database.
Level 2: Do queries involving MongoDB update operator on ' GeoSpatial ' Database.

Experiment No. 3:Explore different query modifiers.
Level 1: Perform different query modifiers on 'Sales' Database.
Level 2: Try various query modifiers on ' GeoSpatial ' Database.

Experiment No. 4: Explore Aggregation commands.
Level 1: Implement different aggregation commands on 'Sales' Database.
Level2: Perform various aggregation commands on ' GeoSpatial ' Database.

Experiment No. 5: Explore Authentication commands.
Level 1: Try authentication commands on 'Sales' Database.
Level 2: NA

Experiment No. 6:Explore Replication Commands
Level 1: Try all replication commands on 'Sales' Database.
Level2: Implement replication commands on ' GeoSpatial ' Database.

Experiment No.7:Try Sharding Commands.
Level1: Explore Sharding Commands on 'Sales' Database.
Level 2: Implement Sharding Commands on ' GeoSpatial ' Database.

Targeted Application & Tools that can be used:

MongoDB is to be installed and used.

Project work/Assignment:

Each batch of students (self-selected batch mates) will identify projects, such as, Library, Banking, and Reservation etc.,and do it. Concepts of NoSQL, like, CRUD operations, **Supporting ad hoc queries, Indexing flexibility, Assisting replication, Creating capped collections, and Retrieving data from multiple documents.**

Sample Mini Projects:

1. Content Management System

Clubbing the content assets like text and HTML into a single database helps provide a better user experience. MongoDB has an excellent toolset not only for storing and indexing but also for controlling the structure of a content management system. You can easily design a web-based CMS by using the model proposed by "Metadata and Asset Management" in MongoDB. Additionally, you can use "Storing Comments" to model user comments on blog posts.

2. Gaming Project

Data is an essential part of making video games work. Some typical examples of gaming data include player profiles, matchmaking, telemetry, and leaderboards.

The common thread between all games is that they all have a specific goal. And you have to achieve multiple objectives or pay your way out to reach the end goal. This may involve steps like watering your plants, growing vegetables, serving food in a restaurant, and so on.

Textbook(s):

1. **Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, 1st Edition, 2019(Wiley Publications).**
2. **Stefano Ceri, Giuseppe Pelagatti , Distributed Databases: Principles and Systems,, 2017(McGraw Hill Education).**

References

1. **Elmasri R and Navathe S B, "Fundamentals of Database System",7th Edition, 2017(Pearson Publication).**
2. **Pivert. *NoSQL Data Models: Trends and Challenges*, 1st edition(Wiley).**

Topics relevant to "EMPLOYABILITY SKILLS": Non-Relational, Schema Free, Simple API, and Distributed. NoSQL Architectures/Data Models - Document, Columnar, Key-Value, and Graph. Transaction in NoSQL- BASE for reliable database transactions**for developing Employability Skills** through **Experiential Learning techniques.** This is attained through assessment component mentioned in course handout.

Course Code: CSA4007	**Course Title: Object Oriented Programming using Java** **Type of Course:1] Program Core** **2] Laboratory** **Integrated**	**L-T-P-C**	**1**	**0**	**4**	**3**
Version No.	1.0					

Course Pre-requisites	**NIL**
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 Sessions, inheritance, polymorphism and composition are studied, along with constructors and method overloading. Students implement Java programs incorporating features from the Java programming language.
Course Objectives	The objective of the course is to familiarize learners with Object-Oriented Programming concepts using Java, while developing general-purpose applications with database connectivity through experiential learning and object-oriented design principles.
Course Out Comes	On successful completion of this course the students shall be able to: 1. Apply Object-Oriented Programming principles in Java to design reusable, modular Sessions using inheritance, interfaces, and packages to solve real-world problems efficiently. (Applying) 2. Apply the concepts of Multithreading, Exception handling and Collection Frameworks to develop efficient and error free codes. (Applying) 3. Develop Serverside java applications using Servlet and JSP concepts. (Applying) 4. Construct simple applications to best interact with relational database systems using JDBC and hibernate. (Applying)

Module 1	Introduction to OOPs	Assignment		Programming activity	**Th: 5Sessions Pr :15 Sessions**
	Topics: The Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Introducing Sessions – Methods and Sessions: Overloading Methods – Passing and returning Objects – Recursion – Access control – static – final – Nested and Inner Sessions. Inheritance: Basics – Using super – Method Overriding – Dynamic Method dispatch – Abstract Sessions – final with Inheritance. Packages and Interfaces : Packages –				

	Packages and Member Access – importing Packages – Interfaces – Default Interface Methods – static Methods in Interface - Private Interface methods.					
Module 2	Exception Handling, Multithreading and Collection Frameworks:	Assignment		Programming activity	**Th :4 Sessions Pr :15 Sessions**	
	Topics: Fundamentals – Types – Uncaught Exceptions – try and catch – Multiple catch – Nested try – throw – throws – finally – Built-in Exceptions – Multithreaded: Java Thread Model – Main Thread – Creating a Thread and Multiple threads – is Alive() and join() - Collection Frameworks: Collection Interfaces - Collection Sessions: ArrayList - LinkedList - HashSet - TreeSet - Priority Queue - Iterator - Map: Map Interfaces - Map Sessions: HashMap – TreeMap - Comparators.					
Module 3	Servlets and Java server Pages:	Assignment		Programming activity	**Th :3 Sessions Pr :15 Sessions**	
	Topics: Working with Servlets: Features – Servlet API – Servlet Life Cycle – Creating a Sample Servlet - Java Server Pages: Architecture of JSP pages – Life Cycle of JSP – Working with JSP Basic Tags and implicit objects – Exploring Action Tags.					
Module 4	JDBC, Hibernate and Spring:	Assignment		Programming activity	**Th :3 SEssions Pr :15 Sessions**	
	Topics: Working with JDBC: Introduction - JDBC Drivers – Features of JDBC – JDBC API – Major Sessions and Interfaces – Process with java.sql package – Working with Hibernate: Architecture – Downloading hibernate - Exploring HQL – Hibernate O/R mapping – Working with Hibernate. Introduction to Spring: Overview – Dependency Injection – Spring Libraries – Spring Tool Suite – Developing a simple Spring Application – RESTful Applications.					
1]	**List of Laboratory Tasks:** **Lab sheet -1 [5 Practical Sessions]** **Experiment No 1:** **Level1 -Programs using Control statements** Methods with Parameters, Methods with control statements					

	Level2- Demonstrations of Class, Object, Constructor, Static member, Encapsulation, Inner Class **Experiment No. 2:** **Level 1 –Simple Program for Understanding Arrays and Strings**. **Level2** - Programs to implement array of objects, passing and returning objects as arguments. **Lab sheet – 2 [2 Practical Sessions]** **Experiment No. 1:** **Level1 - Programs to demonstrate concepts of constructors and destructors** **Level2** - Write a program to create a database for a bank account contains Name, Account no, Account type, Balance, Including the following – any constructor, destructor and methods to set and get information for 10 people. **Experiment No. 2:** **Level1 – Programs to implement methods of String and String Buffer Class.** **Level2 - Programs to implement Inheritance and Polymorphism, Programs to implements Interface.** **Lab sheet – 3 [3Practical Sessions]** **Level 1 - Programs to demonstrate Exceptions Handlers.** **Level 2 - Programs to implements nested handlers, Checked and Unchecked Exception Handlers.** **Lab sheet – 4 [4 Practical Sessions]** **Level 1 -Programs to implement Thread class and Runnable Interface.** **Level 2 - Programs to implement priority, inter thread communication.** **Lab sheet –5 [1 Practical Session]** **Experiment No. 1:** **Level 1 - Programs to implement Collections (List, Set, Map).** **Level 2 - Programs to implement Comparable and Comparator Interface , Lambda Notation** **Lab sheet 6 [2 Practical Session]]** **Experiment No. 1:** **Level 1 –Programs to implement concepts of GUI.** **Level 2 – Programs to create Registration form using Swing.**
	Targeted Application & Tools that can be used: Notepad++, Eclipse IDE, NetBeans IDE

	Project work/Assignment: Mention the Type of Project /Assignment proposed for this course
2]	Programming: Implementation of given scenario using Java 1. Develop a Library management system with basic modules and users like • Database module: This has two functions – Insertion of data and extraction of data. • Report module: For the borrowed books list to display. • Availability module: To view the availability of books. • Search Module: search facility for books and members. Users in the system: • Librarian • Student User functions: • Librarian: Add, view, delete the book details and user details, issue and return books. • Student: view and requesting books, returning books. 2. Design an employee payroll management system with basic modules and its processes as Admin: • Admin can Add/Edit/delete the employees. • Admin can Add/Edit/delete the schedule the work of the employees. • Admin can Add and calculate/Edit/Delete the Salary of the employee. Employee: • Employees can view his/her schedule set by Admin. • Employees can check his/her attendance. • Employees can update his/her details. • Employees can View their salary details. 3. Design an online Quiz system with basic modules and its processes as follows Users of the System • Teacher • Student Functional Requirements Teacher: • Can create quiz after getting logged in.

	• Can enter subjects and enter question with its options and answer at the time of creating quiz. • 10 Question for each quiz required to be completed. Student: • Can search quiz according to their interest. • select the id of quiz and ready to start it. • After completing all questions, result will be displayed automatically. Can view the description about each and every question in the respective quiz
	Text Book 1. Herbert Schild,"Java: The Complete Reference", 12th Edition, McGraw Hill, 2021. 2. CDAC,"Core and Advanced Java - Black Book", 1st Edition, Dreamtech Press, 2018.
	References 1. Cay Horstmann,"Core Java -Volume 1: Fundamentals", 12th Edition, Oracle Press, 2021. 2. Bruce Eckel, **Thinking in Java. 4th ed**. 3. R. Nageswara Rao**, Core Java: An Integrated Approach, New: Includes All Versions upto Java 8** **4.** Brett McLaughlin, **Head First Object-Oriented Analysis and Design: A Brain Friendly Guide to OOA&D** **Web References** W1. NPTEL Course on "Java Programming", Prof. Debasis Samanta, https://archive.nptel.ac.in/courses/106/105/106105191/ W2. "Head First Java" by Kathe Siera and Bert Bates, 2nd edition https://www.rcsdk12.org/cms/lib/NY01001156/Centricity/Domain/4951/Head_First_Java_Second_Edition.pdf. W3. "Building java programs" https://presiuniv.knimbus.com/user#/searchresult?searchId=java%20programming&_t=1662620793642
	Topics relevant to "SKILL DEVELOPMENT": Introduction to object-oriented programming, Initializing & Accessing Array, extending interfaces, implementing interfaces - Organizing Sessions and Interfaces in Packages, life cycle of a thread, Collection Types, Sets**for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.**

<table>
<tr><td>Course Code:
PPS 3019</td><td colspan="3">Course Title: Corporate Communication

Type of Course: Practical Only Course</td><td>L- T - P- C</td><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td>Version No.</td><td colspan="8">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">• Students are expected to understand Basic English.
• Students should have desire and enthusiasm to involve, participate and learn.</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">This course is designed to enable students to understand concepts of corporate communication, improve confidence, and develop professional skills. This course will give the students a competitive advantage and increase their chances of success in the professional world by building their strong resumes and better online presence. This will benefit learners in effectively presenting their concepts and ideas in a corporate environment through various activities and learning methodologies.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course is to familiarize the learners with the concepts of “Corporate Communication” and attain SKILL DEVELOPMENT through PARTICIPATIVE LEARNING techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">On successful completion of this course, the students shall be able to:
CO1: Demonstrate effective communication while presenting oneself and others
CO2: Design resume based on industrial standards
CO3: Employ techniques to face interview and Group discussion</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Module 1</td><td colspan="3">Introduction to Corporate Communication</td><td colspan="3">Classroom activity</td><td colspan="2">6 Hours</td></tr>
<tr><td colspan="9">Topics: Setting Expectations, Ice Breaker, Cs of communication, Significance of corporate communication, Communication process, barriers in communication and solutions, Structuring messages, non-verbal communication, written communication, Self introduction.</td></tr>
</table>

Module 2	Presentation Skills	Group Presentation	8 Hours

Topics: Presentation Skills, Opening Body & Closing Body, Audibility, Speech Clarity, Fluency, Voice Modulation, Non-verbal Communication and Body Language.

Module 3	Resume Writing	Individual Assessment	8 Hours

Topics: Importance of a Resume, Types of Resumes (Chronological, Functional, and Combination), Understanding Job Descriptions, Optimizing for Applicant Tracking Systems (ATS), Understanding ATS Requirements, Formatting Tips for ATS Compliance, The Digital Edge: Online Profiles (Aligning Resumes with LinkedIn Profiles)

Module 4	Personal Interview	Individual Assessment	8 Hours

Understanding Personal Interviews, Self-Awareness and Preparation (SWOT Analysis: Knowing Your Strengths and Weaknesses), **Handling Common Questions (**Tell Me About Yourself: Structuring a Strong Response, Answering Situational and Behavioral Questions (STAR Method) **Practical Skills for Success (**Dressing for Success: Professional Appearance, Mock Interviews: Practice with Feedback, Follow-Up Etiquette: Thank You Emails and Calls)

Targeted Application & Tools that can be used:

1. TED Talks
2. You Tube Links
3. Activities

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

1) Resume
2) Self-Introduction
3) Personal Interview

Targeted Application & Tools that can be used:

1. TED Talks
2. YouTube Links

Assignments proposed for this course

1. Self-Introduction
2. Resume

YouTube Links: https://youtu.be/z_jxoczNWc (Steve Jobs Introducing the iPhone 4 in June 2010) References

1. "Talk Like TED - The 9 Public-Speaking Secrets of the World's Top Minds" By Carmine Gallo St. Martin's Press Copyright © 2014 Carmine Gallo All rights reserved. ISBN: 978-1-250-04112-8
2. "The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience" MP3 CD – Import, 22 April 2014
3. "The Definitive Book of Body Language: The Hidden Meaning Behind People's Gestures and Expressions" Hardcover – Illustrated, 25 July 2006
4. "Crucial Conversations: Tools for Talking When Stakes Are High" Paperback – Import, 1 July 2002

Web links:

1. https://www.wordstream.com/blog/ws/2014/11/19/how-to-improve-presentation-skills https://www.cbs.de/en/blog/15-effective-presentation-tips-to-improve-presentation-skills/
2. https://hbr.org/2022/05/the-art-of-asking-great-questions

Topics relevant to development of "SKILL": Art of Presentation, Team building, Art of questioning and Personal Branding for Skill Development through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.

Catalogue prepared by	Faculty of L&D
Recommended by the Board of Studies on	
Date of Approval by the Academic Council	

Course Code: CSA4098	**Course Title: Coding Training 2** **Type of Course:**	**L- T-P- C**	0	0	2	1

Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course serves the foundational building blocks for software development focusing on strong programming skills, understanding the concepts of programming, data structures, algorithms, databases, full stack development. This course ensures that MCA students not only grasp theoretical concepts but also gain hands-on experience with real-world applications, preparing them for careers in software development and emerging tech fields					
Course Objective	The objective of the course is to familiarize the learners to gain through knowledge about programming and also full stack development which helps the students to understand the process of software development for **Employability Skills** through **Experiential Learning** techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** CO 1: Infer the concepts of programming, control structures, data structures and object oriented programming [Understand]. CO 2: Practice the advanced datastructures concept, algorithms and database management system for solving real world problems. [Apply]. CO 3: Create a complete web development application by gaining knowledge of full stack development. [Apply].					
Course Content:						
Module 1	Basics of Programming	Participative Learning	Brainstorming session/Quiz	**10 Sessions**		
Topics: Control structures, data structures-Arrays, stacks, queues, linked list, functions and recursion, basic concepts of object oriented programming						
Module 2	Advanced Programming concepts and database management system	Experiential Learning	Think-pair & share and implement the	**10 Sessions**		
Topics: Advanced datastructures- trees, graphs, algorithms- searching, sorting, dynamic programming, greedy technique, back tracking, file handling and exception handling, multi						

threading and concurrency, basics of SQL, CRUD operations, views, triggers, normalization, NoSql

Module 3	Scripting and Web Development	Experiential Learning	Implementation of web development applications	**10 Sessions**

Topics: Frontend Technologies: HTML, CSS, JavaScript, React.js
Backend Development: Node.js, Express.js, Django
Web APIs and RESTful Services

TEXT BOOKS:

1. T1. Mark Allen Weiss, "*Data Structures and Algorithm Analysis in C++*", 2nd Edition, Pearson, 2004.
2. **Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, 1st Edition, 2019(Wiley Publications).**
3. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018.

Lab Experiment:

Focus on case studies and scenario-based questions derived from real-world industry challenges. These experiments aim to provide practical exposure by solving problems aligned with current industry standards and practices.

Topics relevant to "EMPLOYABILITY SKILLS": Topics of all four modules will help in developing **Employability Skills** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

Course Code: PPS3001	**Course Title: Problem Solving through Aptitude Type of Course: Practical Only Course**			**L- T-P- C**	0	0	2	1
Version No.		1.0					
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. CO2] **Identify** the principle concept needed in a question. CO3] **Solve** the quantitative and logical ability questions with the appropriate concept. CO4] **Analyze** the data given in complex problems.					
Course Content:							
Module 1	Quantitative Ability	Assignment	Bloom's Level : Application			**10 Hours**	
	Topics: Introduction to Aptitude, working of Tables, Squares, Cubes, Number Series, Wrong number series, Letter series.						
Module 2	Logical Reasoning	Assignment	Bloom's Level : Application			**20 Hours**	

	Topics: Linear & Circular Arrangement Puzzle, Coding & Decoding, Blood Relations, Directions, Ordering and Ranking, Clocks and Calendars
	Targeted Application & Tools that can be used: Application area: Placement activities and Competitive examinations. Tools: LMS

Semester 3

Course Code: CSA4005	**Course Title:** Cloud Computing **Type of Course:** Program Core – Lab Integrated	**L-T-P-C**	2	0	2	3
Version No.	**1.0**					
Course Pre-requisites	**CSA4025 - Computer Networks**					
Anti-requisites	**NIL**					
Course Description	**This course provides a hands-on comprehensive study of Cloud concepts and capabilities across the various Cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). It dives into all of the details that a student needs to know in order to plan for developing applications on the cloud and what to look for when using applications or services hosted on a cloud.**					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Cloud Computing** and attain **Skill Development** through **Experiential Learning** techniques.					
Course Outcomes	**Upon successful completion of the course the students shall be able to:** **1) Understand** the significance of Cloud computing technologies 2) **Identify** appropriate Virtualization techniques to virtualize infrastructures **3) Discuss** Cloud mechanisms to optimize the QoS parameters **4) Develop** applications using Cloud services and VM instances					
Course Content:						
Module 1	**Introduction to Cloud services**	Assignment	Theory	**No. of Sessions:7**		
Topics: Evolution of cloud computing, Computing Platforms and Technologies, Cloud Computing Architecture, IaaS, PaaS, SaaS, Types of Clouds, Cloud Computing Environments.						
Module 2	**Virtualization Techniques**	Assignment	Theory	**No. of Sessions:7**		
Topics: Basics of Virtualization - Types of Virtualizations, Taxonomy of Virtualization Techniques, Implementation Levels of Virtualization.						
Module 3	**Cloud QoS and Management**	Assignment	Theory	**No. of Sessions:8**		
Topics: Cloud Infrastructure Mechanisms, SLAs, Specialized Cloud Mechanisms, Cloud Management Mechanisms, Cloud Security Mechanisms						

Module 4	**Application development in Cloud**	Assignment	Case Study	**No. of Sessions:8**

Topics: Programming Models for Cloud Computing - Software Development in Cloud - Service creation environments to develop cloud-based applications. Development environments for service development (Demonstration using AWS Cloud); Dockers and Containers.

List of Laboratory Tasks: 30 Hours

Experiment No 1:
Level 1: Install VirtualBox/VMware Workstation with different flavors of Linux.
Level 2: Install VirtualBox Workstation with windows OS on top of windows10 or 11.

Experiment No 2:
Level 1: Review Virtualization software and the Compilers
Level 2: Install VirtualBox Workstation with windows OS on top of windows10 or 11.

Experiment No 3:
Level 1: Program to Launch a virtual machine instance on the cloud.
Level 2: Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim

Experiment No 4:
Level 1: Program to Create a virtual network and subnets and Launch VM instances within the virtual network.
Level 2: Find a procedure to transfer the files from one virtual machine to another virtual machine.

Experiment No 5:
Level 1: Evaluate and compare different cloud storage systems to understand their features, performance, and pricing.
Level 2: Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application.

Experiment No 6:
Level 1: Investigate the identity and access management (IAM) features of each cloud provider.
Level 2: Design different workflows according to requirements and apply map reduce programming mode

Experiment No 7:

Level 1: Write a Reducer to aggregate and analyze the extracted data (e.g., count occurrences).

Level 2: Write a Mapper to extract key information (e.g., IP addresses) from log entries.

Experiment No 8:

Level 1: Install Google App Engine. Create hello world app and other simple web applications using python/java.

Level 2: Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)

Targeted Application & Tools that can be used:

Targeted Applications:

Developing applications on Cloud Platforms via Virtual machines

Cloud Tools:

- CloudSim
- VMWare
- Amazon EC2
- Google Compute Engine
- Microsoft Azure

Project work/Assignment:

1. Automation of performance analysis of students through the Cloud
2. Chatbots development using Cloud resources
3. Blog creation using Cloud computing

Analysis of Case Studies: When deciding to adopt cloud computing architecture, decide if the cloud is right for your requirements (for the application identified).

Text Book(s)

1. Daniel Vaughan, "Cloud Native Development with Google Cloud". O'Reilly Media Publishers. 1st Edition 2023.
2. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "*Mastering Cloud Computing*", McGraw Hill Education, 2017edition.
3. John Rittinghouse and James Ransome, "*Cloud Computing, Implementation, Management and Security*", CRC Press, 2010 edition.

References

1. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, "*Cloud Computing Concepts, Technology & Architecture*", PHI publisher 2013 edition.

2. Anthony T Velte, Toby J Velte, Robert Elsenpeter, "*Cloud Computing: A Practical Approach*", Tata McGraw-Hill, 2010 edition.

3. David E.Y. Sarna, "*Implementing and Developing Cloud Applications*", CRC Press, 2018 edition.

4. Manvi, Sunilkumar, and Gopal K. Shyam. "*Cloud Computing: Concepts and Technologies"*. CRC Press, 2021.

Web Resources and Research Articles links:

1. IEEE Transactions on Cloud Computing- https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6245519
2. International Journal of Cloud Computing- https://www.inderscience.com/jhome.php?jcode=ijcc
3. CloudSim Resources- https://javadoc.io/doc/org.cloudsimplus/cloudsim-plus/latest/org/cloudbus/cloudsim/resources/class-use/Resource.html
4. Journal of Network and Computer Networking- https://www.journals.elsevier.com/journal-of-network-and-computer-applications

Topics relevant to "SKILL DEVELOPMENT": Taxonomy of Virtualization Techniques,**Specialized** Cloud Mechanisms, Cloud Management Mechanisms, Cloud Security Mechanisms for **Skill Development** through **Experiential Learning Techniques.** This is attained through assessment component mentioned in course handout.

`Course Code: CSA4008	**Course Title: Full Stack Development** **Type of Course: Program Core – Theory Integrated**	**L- T-P-C**	1	0	4	3
Version No.	**1.0**					
Course Pre-requisites	CSA4007 - Object Oriented Programming Using Java					
Anti-requisites	**NIL**					
Course Description	This advanced level course enables students to perform full stack development using Java, with emphasis on employability skills. The key technologies used for Full Stack development is based on either Java technology or .NET technology. In this course, the focus is on using Java, and the related technologies/tools like Java EE, Java Persistence, Hibernate, Maven, Spring Core, etc. On successful completion of this course, the student shall be able to pursue a career in full-stack 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 Java Persistence, Hibernate, Maven, Spring Coreto attain **SKILL Development** through **Experiential LEARNING TECHNIQUES**.		
Course Outcomes	**Upon successful completion of the course the students shall be able to:** **1] Practice the use of Java for full stack development [Apply]** **2] Implement web applications using Java EE. [Apply]** **3] Solve simple applications using Java Persistence and Hibernate [Apply]** **4] Apply concepts of Spring to develop a Full Stack application. [Apply]** **5] Demonstrate automation tools like Maven, Selenium for Full Stack development. [Apply]**		
Course Content:			
Module 1	**INTRODUCTION**	Understand	**[L-3, P-12 = 15]**
Review of Java; Java I/O; Advanced concepts of Java and Java New Features of Java; Collection framework, Annotation, Java generics, Lambda Expression, JDBC.			
Module 2	**Java EE Web Applications**	Apply	**[L-3, P-12 = 15]**
Introduction to Eclipse & Tomcat; Servlet API Fundamentals; Servlet Context, Session, Cookies; Request Redirection Techniques; JSP Fundamentals; Reading HTML form Data with JSP; State Management with Java; JSP Standard Tag Library - Core & Function Tags; Building MVC App with Servlets & JSP; Complete App- Integrating JDBC with MVC App			
Module 3	**Java Persistence using JPA and Hibernate**	Apply	**[L-3, P-12 = 15]**
Fundamentals of Java Persistence with Hibernate: JPA for Object/Relational Mapping, Querying database using JPQL and Criteria API (JPA). Hibernate: Architecture, HQL, Querying, Caching, Performance and Concurrency; First & Second Level Caching, Batch Fetching, Optimistic Locking & Versioning; Entity Relationships, Inheritance Mapping & Polymorphic Queries.			
Module 4	**Spring Core**	Apply	**[L-3, P-12 = 15]**
Spring Core, Spring MVC, Spring Boot REST API: Understanding Spring Framework; Spring AOP(Aspect Oriented Programming);Using Spring MVC; Building a Database Web App with Spring and Hibernate Implementing Spring Security; Developing Spring REST API; Using Spring Boot for Rapid Development			
Module 5	**Automation tools**	Apply	**[L-3, P-12 = 15]**
Introduction to Automation Tools; Apache Maven: Maven Fundamentals, Software Setup – Command lineand Eclipse, pom.xml and Directory Structure, Multi-Module Project Creation, Scopes, Dependency Management, Profiles; Functional/BDD Testing using			

Selenium, Selenium Fundamentals and IDE, Selenium WebDriver, Installation and Configuration, Locating Web Elements, Driver Commands, Web Element Command

List Of Laboratory Tasks (30 Hours)

Lab Experiments:

1. Use Serialization and Deserialization mechanism to develop a console application.
2. Build a console application by using Collection framework and Annotation.
3. Build a console application by using Collection framework and Lambda Expression
4. Develop a console application that connect with MySQLDatabase and perform database transactions.
5. Build a web application to connect with a database using Servlet that perform database manipulations.
6. Build web application to connect with a database using JSP that perform database manipulations.
7. Construct a login application in respecting the MVC model.
8. Implement a web application based on the MVC design pattern, to create an Employee Registration module using JSP, Servlet, JDBC, and MySQL database.
9. Create Student mark processing project using Hibernate with Maven.
10. Create a User Registration project using JSP, Servlet, Hibernate Framework, and MySQL database.
11. Develop a User Login Form and will validate username and password with the MySQL database using the Hibernate framework.
12. Build a complete Hibernate application with HQL CRUD operations using MAVEN ,JSP, Servlet, Hibernate Framework, JPQL and MySQL database.
13. Build CRUD RESTful API using Spring Boot 3, Spring Data JPA (Hibernate), and MySQL database.
14. Build login or sign-in and registration or signup REST API using Spring boot, Spring Security, Hibernate, and MySQL database.
15. Create Spring web application to implement SpringMVC framework using eclipse IDELanguage identifier

Text Book(s)

1. Fender, Young, “Front-end Fundamentals”,Leanpub, 2021.
2. Horstmann, “ Core Java Volume II - Advanced Features”, 12th Edition – Pearson, 2023

References:

R1. Soni, Ravi Kant. “Full Stack AngularJS for Java Developers: Build a Full-Featured Web Application fromScratch Using AngularJS with Spring RESTful.” ,Apress, 2021.

R2. Mardan, Azat. “Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB.”,Apress, 2015

Course Code: CSA4009	**Course Title: Artificial Intelligence and Machine Learning** **Type of Course: Theory-Integrated**	**L- T-P-C**	**2**	0	**2**	**3**
Version No.	1.0					
Course Pre-requisites	CSA4004 - Advanced Python Programming					
Anti-requisites	**NIL**					
Course Description	This course introduces the basic concepts of artificial intelligence. It introduces students to the basic concepts and techniques of Machine Learning (ML), a subset of Artificial Intelligence (AI), is an important set of techniques and algorithms used for solving several business and social problems. The objective of this course is to discuss machine learning model development using Python. Topics include: Working with Collections and Data Frames; Regression algorithms; Classification algorithms; Optimization techniques – Gradient Descent algorithm, Gradient Descent for simple Linear Regression; Ensemble Learning – Random Forest, Boosting techniques – AdaBoost and Gradient Boosting; Grid Search for optimal parameters; Clustering algorithms; Forecasting with Time-Series data : Auto-Regressive Integrated Moving Average Models.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Artificial Intelligence and Machine Learning and attain **Skill Development** through **experiential Learning** techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1:** To develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents. **[Understand]** **CO2:** Produce machine learning models for predictive analytics. **[Application]** **CO3:** Applyensemble learning, optimization and hyper parameter tuning techniques for machine learning algorithms. **[Application]** **CO4:** Demonstrate different types of clustering techniques. **[Application]**					
Course Content:						
Module 1	**Artificial Intelligence Foundations and Future of AI**	Assignment	Theory		**7 Sessions**	
Topics:						

Artificial Intelligence foundation, History and Applications; The Rise and fall of Expert systems, Technological driver of AI, Data: Data basics, Types of data, Big Data, Databases and other tools; Data Process, Ethics and Governance. Machine learning: What is machine learning, Standard deviation, The normal distribution, Baye's Theorem, correlation, Feature Extraction,The Machine learning process, Applying algorithms, Common types of Machine learning algorithms, Future of AI.

Module 2	**Supervised Machine Learning Algorithms**	Assignment	Programming activity	**7 Sessions**

Topics:

Introduction to the Machine Learning (ML) Framework, Descriptive analytics: Working with data frames, handling missing values, Exploration of data using visualization. Hypothesis test, Analysis of Variance

Module 3	**Classification and Regression**	Assignment	Programming activity	**8 Sessions**

Topics:

Classification overview, Binary logistic regression, Classification tree, Introduction to Gradient Descent, Advanced regression model, KNN algorithm, Ensemble methods – Random Forest, Boosting.

Module 4	**Clustering and Forecasting with Time-Series Data**	Assignment	Programming activity	**8 Sessions**

Topics:

Clustering – K-means clustering, Creating clusters,Interpreting Cluster,Hierarchical Clustering . Components of Time Series data, Moving average, Decomposing time series, Time Series Models (AR Models, ARMA Models)

List of Laboratory Tasks: 30 Hours

Lab sheet -1

Level 1-Regression Models Simple linear regression, outlier detection.

Level 2 - multiple linear regressions – model evaluation, multi-co linearity and handling multi-co linearity, outlier detection**.**

Lab sheet -2

Level 1- Decision Tree Classifiers - Decision Tree classifier using Gini Index- measuring test accuracy, displaying the tree, confusion matrix and ROC.

Level 2- Decision Tree Classifier using Entropy.

Lab sheet -3

Level 1 - Optimization Techniques Developing a Gradient Descent Algorithm for linear regression – using NumPy and using sklearn.

Level 2 - cohen_kappa_score.

Lab sheet -4

Level 1 - Hyper parameter Tuning for Ensemble models Ensemble Learning – Random Forest – Building the model, Grid Search for optimal parameters,

Level 2 - Feature Importance. Ada Boost Classifiers and Gradient Boosting Classifiers

Lab sheet -5

Level 2 - Clustering – Kmeans – cluster centers and interpreting the clusters, finding the optimal number of clusters using Elbow Curve method.

Level 2 - Agglomerative Hierarchical Clustering – Compare the clusters formed by k-means and Agglomerative Clustering

Lab sheet -6

Level 1- Models forecasting Applications

Level 2 - Models for Forecasting Time Series data

Targeted Application & Tools that can be used

Use of PowerPoint software for lecture slides and use of Google's Colab cloud service **https://www.tutorialspoint.com/google_colab/index.html** for executing and sharing of lab exercises.

Project work/Assignment:

Assignment:

1. Programming: Implementation of given scenario using Python and Colab.

Assignment: Learning courses for 4 Hours from the following link

https://learn.datacamp.com/courses?topics=Machine%20Learning

Text Book

T1. Tom Taulli, "Artificial Intelligence Basics", Apress, First Edition, 2019

T2. Manaranjan Pradhan, U Dinesh Kumar, "Machine Learning Using Python", Wiley, First Edition 2019.

References

R1. Tan P. N., Steinbach M & Kumar V. "Introduction to Data Mining", Pearson Education, 2016.

R2. Giuseppe Bonaccorso, "Machine Learning Algorithms: A reference guide to popular algorithms from data science and machine learning", Packt Publishing, 2017.

E-References

Topics relevant to development of "Skill Development":

1. Regression Models
2. Decision Tree Classifiers
3. Hyper parameter Tuning methods
4. Agglomerative Hierarchical clustering
5. Decision tree classifiers

for **Skill Development** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout.

Course Code: BBA1055	**Course Title: Managerial Economics and Financial Accounting** **Type of Course: Program Core**	**L-T- P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	• Ability to Communicate • Elementary understanding of Economics and Accounting					
Anti-requisites	**Nil**					
Course Description	The Course is conceptual and quantitative in nature, the economics concepts will help the students to gain insight about the basic aspects of economics such as Lw, Supply, Demand, Cost. The Financial Account portion will introduce the students to basic concepts of accounting.					
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Describe the Basic concepts of Managerial Economics CO2: Recognize the type of production function and cost analysis CO3: Outline the principles of Accounting CO4: Illustrate the Analysis of Financial statements					
Course objective	The objective of the course is to familiarize the learners with the concepts of Managerial Economics and attain Skill Development through Participative Learning techniques.					
Course Content:						
Module 1	**Introduction to Managerial Economics**	**Class presentation**	**Class presentation**	**12 Sessions**		
Topics: Definition, Nature and Scope of Managerial Economics, factors influencing managerial decision making process. Demand Analysis – Definition, types, Significance of Elasticity of Demand. Law of Supply, Elasticity of Supply, Equilibrium between Demand and Supply.						
Module 2	**Theory of Production and Cost Analysis**	**Class presentation**	**Class presentation**	**11 Sessions**		
Topics: Production function – Isoquants and Iso costs, MRTS, Least cost combination of inputs, Law of variable proportion, Cobb – Douglas Production function, Laws of Returns, Internal and External economies of scale. Cost Analysis – Types of Cost, Concept of revenue, Total, average and marginal revenue, determination of breakeven point (simple numerical problem, Managerial significance and limitation of BEA.						
Module 3	**Introduction to Financial Accounting**	**Numerical**	**Numerical**	**12 Sessions**		

Topics: Accounting principles, concepts and conventions, double entry book keeping, journal, ledger, Trial balance.				
Module 4	**Preparation and Analysis of Financial statements**	**Numerical**	**Numerical**	**10 Sessions**
Topics: Final Accounts, Trading Account, Profit and Loss Account, Balance sheet with simple adjustments, Financial Statement Analysis (Comparative and Common size statements) – Ratio Analysis (Liquidity Ratio, Activity Ratios, Solvency and Profitability ratios)				
Targeted Application & Tools that can be used: PPT, Videos and board & Chalk Method				
Reference **Text book** 1. C.B.Gupta, Management Theory & Practice - Sultan Chand & Sons -NewDelhi 2. L.M.Prasad, Principles & Practice of Management - Sultan Chand & Sons – New				
Reference Dr. S.Shankaran, Managerial Economics - Margram Publication -Chennai P.L Metha, Managerial Economics - Sultan Chand Publications -NewDelhi **PU library link** https://www-emerald-com-presiuniv.knimbus.com/insight/content/doi/10.1108/eb039157/full/html **NPTEL Course** https://onlinecourses.nptel.ac.in/noc22_mg43/preview				
Topics relevant to development of "SKILL DEVELOPMENT": **Break Even Analysis** for **Skill Development through Participative Learning Techniques.** This is attained through assessment component mentioned in course handout.				

Course Code: CSA4100	**Course Title:** Mini Project **Type of Course:** NTCC	**L- T-P- C**	-	-	-	5
Version No.	**1.0**					
Course Pre-requisites	**Knowledge and Skills related to all the courses studied in previous semesters.**					
Anti-requisites	**NIL**					
Course Description	Students observe science and technology in action, develop an awareness of the method of scientific experimentation, and often get an opportunity to see, study and operate sophisticated and costly equipment. They also learn about the implementation of the principles of management they have learnt in class, when they observe multidisciplinary teams of experts from engineering, science, economics, operations research, and management deal with techno-economic problems at the micro and macro levels. Finally, it enables them to develop and refine their language, communication and inter-personal skills, both by its very nature, and by the various evaluation components, such as seminar, group discussion, project report preparation, etc. The broad-based core education, strong in mathematics and science and rich in analytical tools, provides the foundation necessary for the student to understand properly the nature of real-life problems. The students have options to pursue this course as either Project Work and Dissertation at the university, or Project Work in an Industry/ Company/ Research Laboratory, or Internship Program in an Industry/Company.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Professional Practice and attain **Employability Skills** through **Experiential Learning** techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Identify real world computing problems related to local, regional, national or global needs. 2. Apply appropriate techniques or modern tools for solving the intended problem. 3. Design the experiments as per the standards and specifications. 4. Interpret the events and results for meaningful conclusions. 5. Appraise project findings and communicate effectively through scholarly publications.					

<table>
<tr><td>Course Code:
PPS 4008</td><td colspan="3">Course Title: Quantitative Skills and Logical Reasoning
Type of Course:</td><td>L- T -P- C</td><td>1 – 0 – 2 – 2</td></tr>
<tr><td>Version No.</td><td colspan="5">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="5">Students should know the basic Mathematics & aptitude along with understanding of English</td></tr>
<tr><td>Anti-requisites</td><td colspan="5">Nil</td></tr>
<tr><td>Course Description</td><td colspan="5">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.</td></tr>
<tr><td>Course Objective</td><td colspan="5">The objective of the course is to familiarize the learners with the concepts of Aptitude and attain Skill Development through Problem Solving techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">On successful completion of the course the students shall be able to:
CO1] Recall all the basic mathematical concepts they learnt in high school.
CO2] Identify the principle concept needed in a question.
CO3] Solve the quantitative and logical ability questions with the appropriate concept.
CO4] Analyze the data given in complex problems.
CO5] Rearrange the information to simplify the question</td></tr>
<tr><td>Course Content:</td><td colspan="5"></td></tr>
<tr><td>Module 1</td><td>Quantitative Ability</td><td>Assignment</td><td colspan="2">Bloom’s Level : Application</td><td>24 Hours</td></tr>
<tr><td colspan="6">Topics:
Introduction to Aptitude, Percentages, Profit & Loss, Ratio & Proportion, Averages, Time & Work, Time speed & Distance, Permutation and Combination, Probability, Data Interpretation</td></tr>
<tr><td>Module 2</td><td>Logical Reasoning</td><td>Assignment</td><td colspan="2">Bloom’s Level : Application</td><td>21 Hours</td></tr>
<tr><td colspan="6">Topics:
Linear & Circular Arrangement Puzzle, Coding & Decoding, Blood Relations, Directions, Number Series, Wrong number series, Visual Reasoning, Critical thinking, Syllogism</td></tr>
<tr><td>Text Book</td><td colspan="5"></td></tr>
</table>

1. Quantitative Aptitude by R S Aggarwal 2. Verbal & Non-Verbal Reasoning by R S Aggarwal
References 1. www.indiabix.com 2. www.youtube.com/c/TheAptitudeGuy/videos
Topics relevant to Skill development: Quantitative and reasoning aptitude for Skill Development through Problem solving Techniques. This is attained through assessment component mentioned in course handout.

Semester 4

Course Code: **CSA4101**	**Course Title:** **Major Project** **Type of Course:** **LTPC**	**L- T-P- C**	-	-	-	10
Version No.	**1.0**					
Course Pre-requisites	**Knowledge and skills gained from all courses studied in previous semesters, including those applied in the mini-project.**					
Anti-requisites	**NIL**					

Course Description	Students observe science and technology in action, develop an awareness of the method of scientific experimentation, and often get an opportunity to see, study and operate sophisticated and costly equipment. They also learn about the implementation of the principles of management they have learnt in class, when they observe multidisciplinary teams of experts from engineering, science, economics, operations research, and management deal with techno-economic problems at the micro and macro levels. Finally, it enables them to develop and refine their language, communication and inter-personal skills, both by its very nature, and by the various evaluation components, such as seminar, group discussion, project report preparation, etc. The broad-based core education, strong in mathematics and science and rich in analytical tools, provides the foundation necessary for the student to understand properly the nature of real-life problems. The students have options to pursue this course as either Project Work and Dissertation at the university, or Project Work in an Industry/ Company/ Research Laboratory, or Internship Program in an Industry/Company.
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Professional Practice and attain **Employability Skills** through **Experiential Learning** techniques.
Course Outcomes	On successful completion of this course the students shall be able to: 1. Identify real world computing problems related to local, regional, national or global needs. [**Understand]** **2.** Apply appropriate techniques or modern tools for solving the intended problem**. [Apply]** **3.** Design the experiments as per the standards and specifications. **[Apply]** 4. Interpret the events and results for meaningful conclusions. [**Analyze]** 5. Appraise project findings and communicate effectively through scholarly publications. [**Evaluate]**

Discipline Electives

Course Code: **CSA4010**	**Course Title: Internet of Things** **Type of Course: Laboratory Integrated**	**L-T-P-C**	1	0	4	3
Version No.	1.0					
Course Pre-requisites	CSA4025 - Computer Networks					
Anti-requisites	NIL					
Course Description	The Internet of Things (IoT) is an emerging paradigm combining heterogeneous devices at an unprecedented scale, thereby enabling individuals and organizations to gain greater value from networked connections among people, processes, data, and things. The Internet of Things (IoT) is a course of objects interacting with people, with information systems, and with other objects. The course will focus on creative thinking, IoT concepts &IoT technologies.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Internet of Things and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques					
Course Out Comes	On successful completion of the course the students shall be able to: Describe the fundamental concepts of Internet of Things and Architecture models to its Applications. Design and Develop the real time applications using Arduino/Raspberry Pi Controller and Sensors.					

	Describe the simple features of IoT Communication and Data protocols. Demonstrate use of IoT devices for simple application.			
Course Content:				
Module 1	INTRODUCTION TO INTERNET OF THINGS	Assignment	Simulation/Data Analysis	**[L-4,P-16=20 Sessions**
Introduction, Definition & Characteristics of IOT, Physical Design of IoT- Things in IoT, IoT Protocols, Logical design of IoT- IoT functional blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies-Wireless sensor networks, Cloud computing, Bigdata Analytics, Communication protocols, IoT Levels and Templates, **Domain Specific IoT's :** Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.				
Module 2	IOT Hardware	Assignment	Numerical from E-Resources	**[L-4,P-16=20 Sessions**
Embedded Systems – Introduction, the basics of sensors and actuators, need for ADC & DAC peripherals. Introduction to Arduino, The Arduino UNO development board – architecture and specifications, the Arduino development environment, setting up the IDE, programming the Arduino, basic examples. Introduction to RaspberryPi – the RaspberryPi architecture & Hardware overview, RaspberryPi as a gateway device.				
Module 3	IOT COMMUNICATION MODEL AND PROTOCOLS	Term paper/Assignment	Simulation/Data Analysis	**[L-3,P-12=20 Sessions**
Connectivity Protocols: 6LOWPAN,6LOWPAN Packet Format, Types of Headers in 6LOWPAN,Routing in 6LOWPAN,IEEE 802.15.4, Zigbee, Wireless HART, Z-Wave, ISA 100, NFC,RFID: Introduction, Principle of RFID, Components of an RFID system.				
Module 4	IOT COMMUNICATION MODEL AND PROTOCOLS-II and IoT Cloud	Term paper/Assignment	Simulation/Data Analysis	**[L-4,P-16=20 Sessions**
Communication/Transport Protocols: Bluetooth. Data Protocols: Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), Advanced Message Queuing Protocol (AMQP), XMPP – Extensible Messaging and Presence Protocol. Introduction to Wi-Fi Module (ESP8266), Introduction to Node MCU, Introduction to Blynk App Open Source Cloud Environment.				

List of Laboratory Tasks

1 Installation of Arduino IDE & Arduino program to implement scrolling LED, to glow even/odd LED

2 Arduino program to demonstrate usage of push button to control the LED

3 Arduino program to demonstrates traffic control system

4 Arduino program to demonstrates usage of servo motor with potentio meter.

5.Arduino program to Control an LED using Bluetooth.

6.Arduino program to implement RFID reader for security access.

7. Arduino Program to detect obstacle using IR sensor.

8.Arduino Program to detect motion using PIR sensor.

9.Installation of Raspberry pi software

10. Working basic commands on Raspberry pi & to demonstrate remote logging in raspberry pi

11.Raspberry pi program to implement blinking LED

12. Raspberry pi program to implement camera module for video

13. Raspberry pi program to obtain the temperature using DHT sensors

14.Using a Raspberry Pi with distance sensor (ultrasonic sensor HCSR04)

15. Raspberry pi program to implement Garage spot light.

16. Demonstration of Mini project with Thingspeak Cloud using ESP8266

Targeted Application & Tools that can be used:

Interfacing of ARDUINO and Raspberry pi for developing smart CITIES

Tools:

Tinker cad

Thingspeak Cloud

Text Book:

1. Internet of Things “A hands on approach” Authors: Arshdeep Bagha, Vijay Madisetti Publisher: Universities Press 2018

Reference Materials:

Reference Book(s):

1. Rajkumar Buyya, Amir Vahid Dastjerdi, “Internet of Things: Principles and Paradigms”, Morgan Kaufmann.

2. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley.

3.“Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress).

Web Based Resources and E-books:

W1. NPTEL: https://nptel.ac.in/courses/106106127

W2.
https://presiuniv.knimbus.com/user#/searchresult?searchId=eBook&curPage=0&layout=grid
&sorFieldId=none&topresult=false&content=*cloud*
https://www.arduino.cc/
https://www.raspberrypi.org/

(iii) Additional web-based resources

a) https://onlinecourses.nptel.ac.in/noc22_cs53/preview
b) https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/

(iv) Paper & Journals

A. Mutlag, M. K. Abd Ghani, N. Arunkumar, M. A. Mohammed, and O. Mohd, "Enabling technologies for fog computing in healthcare IoT systems," *Future Generation Computer Systems*, vol. 90, pp. 62–78, 2019.

N.K. Nawandar, V.R. Satpute "IoT based low cost and intelligent module for smart irrigation system" Comput. Electron. Agric., 162 (2019), pp. 979-990.

S. Biswas, L.K. Sharma, R. Ranjan, S. Saha, A. Chakraborty, J.S. Banerjee "Smart farming and water saving-based intelligent irrigation system implementation using the internet of things" Recent Trends in Computational Intelligence Enabled Research, Elsevier (2021), pp. 339-354

T. Saheb and L. Izadi, "Paradigm of IoT big data analytics in healthcare industry: a review of scientific literature and mapping of research trends," *Telematics and Informatics*, vol. 41, pp. 70–85, 2019.

Topics relevant to "SKILL DEVELOPMENT": for **Skill Development** through **Experiential Learning** techniques.

Introduction to RaspberryPi –
the RaspberryPi architecture & Hardware overview,
RaspberryPi as a gateway device.

This is attained through assessment component mentioned in course handout.

Course Code: **CSA4012**	**Course Title:** **Programming in C#** **Type of Course: Discipline Elective - Laboratory Integrated**	**L- T-P-C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	.NET is a software framework which is designed and developed by Microsoft. It is used to develop Form-based applications, Web-based applications, and Web services. There is a variety of programming languages available on the .Net platform, VB.Net, C# etc. C# is one of the most popular languages of .NET framework. It is used to build applications for Windows, Phone, Web, etc.. It provides a lot of functionalities and also supports industry standards. This course intends to provide the basic concepts of .NET framework and various components of the .NET framework architecture. This course also provides the features of C# programming language to design and implement console and desktop-based applications.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Programming in C#** and attain **Employability Skills** through E**xperiential Learning** techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Understand .NET technologies and fundamental components of .NET Framework CO2: Apply the object oriented programming concept in C# basic program coding CO3: Demonstrate the concepts of Events, Multithreading, and delegates CO4: Develop a Windows based application using ADO.NET					
Course Content:						

Module 1	**Overview of .NET**	Quiz	Demonstration of Assembly, Introduction to IDE	**No of Sessions L-5,P-1**
Topics: Overview of .NET : An overview of the .NET, Introduction to .NET framework and .NET, Architecture-.Net Framework class Libraries-CLR-Metadata-Interoperability-Assemblies, CLR-MSIL, Introduction to Visual Studio.Net, Languages supported by .NET, Different Applications of .NET				
Module 2	**Programming Concepts**	Lab Based Assignments	Creating a console application and writing programs using basic programming constructs	**No. of Sessions L-7 P-7**
Topics: Need of C#, C# Pre-processor Directives, Creating a Simple C# Console Application, C# Programming Concepts-Predefined Types- Value types and reference type, Sessions and Objects, Constructors and methods, Conditional statements, loops, arrays, Nullable and enum types, properties, Inheritance, Interfaces .				
Module 3	**Advanced Programming Concepts**	Lab Based Assignments	Creating an application using Multithreading	**No. of Sessions L-7 P -6**
Topics: Multithreaded Programming: Multithreading Fundamentals, Thread class, Thread priorities, Synchronization, Thread communication Exception handling :Handling errors and throwing exceptions Delegates and Events: Delegates and events. Anonymous delegates and lambda expression, FUNC and Action delegates.				
Module 4	Event handling, Database Connectivity	Lab based Assignments	Creating a Windows application	**No. of Sessions L-6 P -6**
Topics: Basics of Windows Programming- Event Driven Programming, Windows Forms, Fundamentals of ADO.NET: Object Model- System. Data Namespace, accessing data with ADO.NET, DataSet, typed dataset, Data Adapter, Working with Databases Using Entity Framework Core LINQ and C#. Defining and executing a Query. Implicitly typed local variables. Anonymous Types				
List of Practical Tasks: **Experiment 1:[Module 1]** Level 1: Demonstrate the .NET framework and Visual Studio IDE for writing C# code.				

Level 2: Demonstrate the .NET framework and inside of Assembly using ildasm tool.

Experiment 2: [Module 2]

Level 1: A developer wants to check whether the given input is in the Fibonacci series or not.

Level 2 : Write a C# Program to implement the find the roots by solving Quadratic Equation (-b +-√b2-4ac) / 2a.

Experiment 3: [Module 2]

Level 1 : A teacher is asked to create a mark list of her class students. The class consists of 10 students and they have 5 different subjects. Store the student's name and five subject marks also. Calculate the total of all subject marks and display them.

Level 2: Write a C# Program to implement the find the roots by solving Quadratic Equation (-b +-√b2-4ac) / 2a.

Experiment 4: [Module 2]

Level 1: Design a class to represent a bank account. Include the following members: Data Members: - Name of the depositor, Account Number, Type of Account, Balance amount in the account and methods: To assign initial values, To deposit an amount, To withdraw an amount after checking balance, To display name and the balance. Write a C# program to demonstrate the working of the various class members.

Level 2: Define a class 'Person' with data members name and age. Also include following: Default Constructor and parameterized constructor, Input method which takes values from user and assigns to data members, Output method to display all data . Create 5 objects of 'Person' class using array of objects and call all the methods of a class.

Experiment 5: [Module 2]

Level 1: Write a C# program to show single and multilevel inheritance.

Level 2: Create a class 'Emp' by extending Person class with additional data member empno, position with following features:

a. Default constructor

b. Parameterized constructor

c. Input method which takes values from user and assigns to data members and calls input method of Person

d. Output method to display all data and calls output method of Person

Define a class Manager by extending Emp with data member bonus. Provide necessary constructors and override input and output methods. Create objects of manager in main.

Experiment 6: [Module 2]

Level 1: Calculate the area of different shapes using method overloading.

Level 2: The class teacher created different groups in a class and store the data in that. In order to make common announcements and activities, the teacher merged all data into a single group. Write a code to merge two groups into one.

Experiment 7: [Module 2]

Level 1: Class Teacher stores students marks in an array. The teacher is searching for highest and lowest marks of the class and the number of students who scored those marks. Write a program to help teacher to do the same.

Level 2: Create an application for the currency converter.

Experiment 8: [Module 3]

Level 1: EC is updating its database of new voters. If the user's age is less than 18, the application should raise the exception.

Level 2: Write a multithreaded program to display odd and even numbers in different threads.

Experiment 9: [Module 3]

Level 1: Write a C# Program to call any method that agrees with its signature and return type using delegate.

Level 2: Write a program that uses delegates and event mechanisms to fire, wire, and handle an event.

Experiment 10: [Module 3]

Level1: Write a C# Program to use of an anonymous method that count from 0 to 10

Level 2: Write a multithreaded program to explain the concepts of thread communication

Experiment 11: [Module 4]

Level 1: Create a login screen and prompts for the user name and Password. If the user exists in the database , show the welcome message to the user when the button is clicked.

Level 2: The company wants to create a calculator application using C#.

Experiment 12: [Module 4]

Level 1: The University stores the CSE students' data in the database and displays the student details whenever required. Administrator allows to insert, update and modify the data. Implement this.

Level 2: The University decides to conduct online quiz for CSE students. Create a windows-based application to implement this.

Experiment 13: [Module 4]

Level 1: Write a C# Program to create a statement lambda that returns the factorial of the value it is passed.

Level 2: Write a complete application that makes extensive usage language integrated queries on objects/ sql queries)(stored in either a dictionary or a list. For example store all the students in a list and

1. Find a list of all students who have marks less than the average
2. Find all the students who have failed in physics
3. Find all the students whose names begin with a fixed character and who play badminton

Experiment 14: [Module 4]

Level 1: Write a C# Program to create an incr delegate instance that refers to a lambda expression that increases its parameter by 2.

Level 2: Develop a Windows application for registering for the various events of the cultural festival of the university.

Experiment 15:[Module 3]

Level 1: Write a used defined exception handler if the first letter of the given input is not capital and handle all other defied exception handler

Level 2: Write a code to implement multicast delegate.

Targeted Application & Tools that can be used :

Lab tasks will be implemented in Visual Studio IDE

Project work/Assignment:

1. Assignment : Inside of CLR
2. Mini Project

Text Book

1.Ian Griffiths,"Programming C# 10: Build Windows, Web, and Desktop Applications",O'Reilly Media, Inc; August2022

2. Mark J. Price,"C# 8.0 and .NET Core 3.0 – Modern Cross-Platform Development: Build applications with C#, .NET Core, Entity Framework Core, ASP.NET Core, and ML.NET using Visual Studio Code", Packt Publishing; 4th edition,October 2019

Reference Book

1. Jospeh Albahari,C# 9.0 Pocket Reference: Instant Help for C# 9.0 Programmers, O'Reilly,2019
2. Andrew Stellman, Jennifer Greene,"HEAD FIRST C#: A Learner's Guide to Real-World Programming with C# and .NET Core", O'Reilly; 4th edition, December 2020
3. "Jon Skeet Manning",C# in depth,; 4th edition, March 2019

Web References:

1.https://learn.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/tutorials/

2.https://www.tutorialspoint.com/csharp/index.htm

Course Code: CSA4013	**Course Title:** Soft Computing Techniques **Type of Course:** **Discipline Elective** **Theory Only**	**L- T- P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					

<table>
<tr><td>Course Description

Course Objective</td><td>Soft computing is an emerging approach in computing that mimics the human mind's remarkable ability to reason and learn in an environment of uncertainty and imprecision. Soft computing is based on biologically inspired methodologies such as genetics, evolution, ant behaviors, particle swarming, human nervous systems, etc. Soft computing is the only solution when we don't have any mathematical modeling of problem-solving (i.e., algorithm), needs a solution to a complex problem in real-time, and easily adapts with changing scenarios and is implemented with parallel computing. It has enormous applications in many application areas such as medical diagnosis, computer vision, handwritten character reconditions, pattern recognition, machine intelligence, weather forecasting, network optimization, VLSI design, etc.

The objective of the course IS SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING techniques</td></tr>
<tr><td>Course Outcomes</td><td>On successful completion of the course the students shall be able to:
1. Define the concept and applications of Soft Computing.
2. Discuss Fuzzy logic concepts and its applications.
3. Demonstrate Artificial Neural Networks concepts and its applications.
4. Apply Evolutionary algorithms and hybrid soft computing techniques.</td></tr>
<tr><td>Course Content:</td><td></td></tr>
</table>

Module 1	Introduction Soft Computing	Assignment	Analysis	**9 Sessions**

Topics:

Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Applications of Soft computing techniques.

Module 2	Fuzzy Logic	Assignment	Analysis, Data Collection	**12 Sessions**

Topics:

Fuzzy Logic: Introduction to Fuzzy logic. Fuzzy sets and membership functions. Operations on Fuzzy sets. Fuzzy relations, rules, propositions, implications and inferences. Defuzzification techniques. Fuzzy logic controller design. Some applications of Fuzzy logic.

Module 3	Neural Networks	Case Study	Analysis, Data Collection	**12 Sessions**

Topics:

Neural Network: Biological and Artificial Neuron, Neural Networks, Supervised and Unsupervised Learning. Single Layer Perceptron, Multilayer Perceptron, Backpropagation Learning.

Neural Networks as Associative Memories: Hopfield Networks, Bidirectional Associative Memory. Topologically Organized Neural Networks: Competitive Learning, Kohonen Maps.

Module 4	Evolutionary Computing	Assignment	Analysis, Data Collection	**12 Sessions**

Topics:

Evolutionary Computing: Concept of "Genetics" and "Evolution". Genetic Algorithm and Optimization, The Schema Theorem, GA operators: Encoding, Crossover, Selection, Mutation, etc. Introduction to ant colony optimization and particle swarm optimization. Integration of genetic algorithm with neural network and fuzzy logic.

Targeted Application & Tools that can be used:

In recent times, engineers have very well accepted soft computing tools such as Fuzzy Computing, ANN, Neuro-Computing and Evolutionary Computing, etc., for carrying out various numerical simulation studies. In the last two decades, these tools independently and in hybrid forms have been successfully applied to varieties of problems. The main objective is to introduce students to the latest soft computing tools. The training of these tools will be helpful to develop rigorous applications in the engineering domain.

Tools:

- MATLAB
- PYTHON
- C

Project work/Assignment:

Mini Project:

- Training of known/classified datasets representing some objects/pattern using various ANN learning methods including Perceptron, BPN, Adaline, Associative memory networks, Hopfield, kohenen networks.
- Classification of new input feature set/pattern based on training & learning

- Applying GA search to optimize the solutions. Implementation of the GA procedure.

Term Assignments:

- Applications of soft computing techniques in solving day today problems.
- Solving Traveling salesman problem using Genetic Algorithm and comparing different mutation operators with the same

Text Book

1. Principles of Soft computing, Shivanandam, Deepa S. N Wiley India, 3rd Edition 2019
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition, Wiley.

References

1. Kumar S., "Neural Networks - A Classroom Approach", Tata McGraw Hill, 2nd Edition 2017.
2. Eiben A. E. and Smith J. E., "Introduction to Evolutionary Computing", Second Edition, Springer, Natural Computing Series, 2nd Edition, 2015.
3. Fakhreddine O. Karray, and Clarence W. De Silva. Soft computing and intelligent systems design: theory, tools, and applications. Pearson Education, 2009.

Topics relevant to development of "Employability": ": Solving real world problems with uncertainty using Nature Inspired Algorithms

Course Code: CSA4014	**Course Title: Software Testing and Quality assurance** **Type of Course:**	**L- T-P-C**	3	0	0	3
Version No.	2.0					

Course Pre-requisites	CSA4003 - Software Engineering			
Anti-requisites				
Course Description	This Course is designed to make the students understand the strategies, methods and technologies of software testing effectively. It aims at Designing test plans and test cases, doing automatic testing; reporting on software defects; assessing the software product correctly; and distinguish the relationship between software testing and quality assurance. In addition, studentsare expected to do a group assignment on software testing tools of their choice. Topics include: Testing techniques, integration, code inspection, peer reviews, verification and validation, statistical testing methods, preventing and detecting errors, selecting and implementing project metrics, and defining test plans and strategies that map to system requirements. Testing principles, formal models of testing, all aspects of quality assurance, performance measuring and monitoring.			
Course Objective	This course is designed to develop ENTREPRENEURIAL SKILLS by using EXPERIENTIALLEARNING Techniques.			
Course Outcomes	On successful completion of the course the students shall be able to: 1. Describe the fundamentals of software testing for Quality assurance 2. Select the appropriate Testing type to test Applications/Softwares 3. Report the bugs found in Testing			
Course Content:				
Module 1	**Basics of software testing**	Knowledge		**9 Sessions**
Phases of Software Project, Quality, Quality assurance and Quality Control, Testing, Verification and Validation, LifeCycle Models. Software Testing life Cycle (STLC)				
Module 2	**Types of testing**	Comprehension		**12 Sessions**
Introduction to White Box Testing, Static Testing, structural Testing. Challenges in White Box Testing, FundamentalsBlack Box Testing, When and How to do Black Box Testing. Problems on Boundary value Analysis. Equivalence Partit ,Problems on Equivalence Partition				
Module 3	**TYPES OF TESTING, continued**	Comprehension		**12 Sessions**
Integration Testing overview, Integration Testing as a Phase of Testing, Defect Bash System Testing Overview, Functional and Non-Functional Testing, Acceptance Testing. Compatibility Testing				

, Stress and Interoperability Testing , Test case Preparation.				
Module 4	**Specialized testing techniques**	Comprehension		**12 Sessions**
Performance Testing, Regression Testing, Internationalization Testing, Ad-hoc testing Defect Life Cycle, Bug Reporting, Basics of Software Test Automation, Metrics, Metrics Types, Project Metrics.				
Targeted Application & Tools that can be used: MS office				
Assignment: Writing Test Cases and Bug Reports for simple Applications				
Text Book 1. . Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", PearsonEducation				
References 1 Aditya P. Mathur, "Foundations of Software Testing _ Fundamental Algorithms and Techniques", PearsonEducation. 2. KshirasagarNaik, PriyadarshiTripathy "Software Testing and Quality Assurance Theory and Practice", Wiley and sons. **E-Resources** https://puniversity.informaticsglobal.com:2229/login.aspx				

Course Code: CSA4015	**Course Title: DevOps and Microservices** **Type of Course: Discipline Elective Theory**		**L-T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	**NIL**					
Course Description	The course describes the DevOps fundamentals include fostering a culture of shared accountability, openness, and acceptance of failure. The course also discusses to gain a comprehensive understanding and Develop proficiency in utilizing a variety of DevOps tools. Acquire in-depth knowledge of automation best practices and strategies for efficient workflow. Gain hands-on experience through practical exercises and simulations to reinforce learning. Ability to apply DevOps principles in educational.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **DevOps with microservices** and attain **Skill Development** through **Participative Learning** techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to:** CO1: Remember Enhanced Knowledge and Proficiency in DevOps Tools. CO2: Understanding of Automation Best Practices. CO3: Apply different project management, integration, testing code deployment tools. CO4: Analyse Collaborative and adopt DevOps in Real-time projects.					
Course Content:						
Module 1	Introduction to DevOps & Microservices	Assignment/Quiz	Real-World Example of Microservices	**08 Sessions**		
Topics: Introduction, Microservices : Working of Microservices. Main Components of Microservices. Design Pattern of Microservices. Real-World Example of Microservices . Microservices v/s Monolithic Architecture. Introduction to DevOps, Need & Usage of DevOps, Applications of DevOps, Tools used to implement DevOps & Microservices. Jenkins , Jenkins Tools, CI/CD Pipeline. Scaling and Securing. Introduction To Continuous Integration, Jenkins Architecture, Managing Nodes On Jenkins, Jenkins Master Node Connection, Jenkins Integration With DevOps Tools, Understanding CI/CD Pipelines, Creating A CI/CD Pipeline.						

Module 2	Ansible	Assignment	ad-hoc Commands	**08 Sessions**
Topics: Ansible Workflow, Architecture, Installation in Linux/Windows, ad-hoc Commands, Playbooks, Tower, Roles, Variables open link, Tags, Galaxy, Commands Cheat Sheets, Modules, Shell, Templates, YAML, Inventory, Debug, Apt, Lineinfile, Copy, Command, File, Vault, Windows, Yum, AWX, Unarchive, Ansible Pip				
Module 3	Git	Case study	Git Commands	**08 Sessions**
Topics: Introduction to Git, Features of Git, Benefits, Workflow, Git vs GitHub, Installation of Git on Windows/Linux and Environment set up, All Git Commands-Working with local and remote repositories, Running first Git command, Fundamentals of Repository structure and file status life cycle, Working locally with staging, unstaging and commit.				
Module 4	Containerization Using Docker	Case study	Docker File	**08 Sessions**
Topics: Docker Life Cycle,Docker Installation, Docker Operations, Docker Concepts - Registry, Repository, Tag, Image and Containers, Create A Docker Hub Account, Docker Images and Containers, Pushing Docker ToContainer Hub, Docker File.				
Assignment:				
1. Book/Article review: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency. 2. Presentation: Group presentation, where the students will be given a topic. They will have to explain/demonstrate the working and discuss the applications for the same.				
Text Book(s): 1. Craig Berg, “DevOps For Beginners: A Complete Guide to DevOps Best Practices (Including How You Can Create World-Class Agility, Reliability, And Security In Technology Organizations With DevOps) (Code tutorials)”, Paperback – June 12, 2020. 2. Ferdinando Santacroce, “Git Essentials”, Packt Publishing, April 2015, ISBN: 9781785287909 3. John Ferguson Smart. “Jenkins: The Definitive Guide”, O'Reilly Media, Inc., July 2011, ISBN: 9781449305352				
Reference(s): **Reference Book(s):** 1. Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, Leanpub, August 5, 2020				

2. Unmesh Gundecha, Carl Cocchiaro, “Learn Selenium”, Packt Publishing, July 2019, ISBN: 9781838983048

3. Gaurav Agarwal, “Modern DevOps Practices: Implement and secure DevOps in the public cloud with cutting-edge tools, tips, tricks, and techniques”, July 2021.

4. Mikael Krief, “Learning DevOps: The complete guide to accelerate collaboration with Jenkins, Kubernetes, Terraform and Azure DevOps”, October 2019 Weblinks: 1. https://git-scm.com/book/en/v2

2. https://www.simplilearn.com/tutorials/git-tutorial/git-tutorial-for-beginner

3. https://www.javatpoint.com/selenium-tutorial

4. https://www.javatpoint.com/ansible

5. https://www.tutorialspoint.com/jenkins/jenkins_managing_plugins.htm

6. https://nptel.ac.in/courses/128106012

Topics relevant to “SKILL DEVELOMENT”: Create A Docker Hub Account, Docker Images and Containers, Pushing Docker ToContainer Hub. This is attained through assessment component mentioned in course handout.

Course Code: **CSA4016**	**Course Title: UI/UX Design** **Type of Course: Discipline Elective-Lab Integrated**	**L-T-P-C**	2	0	2	3
Version No.	1.0					
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 Balsamiq and 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 E**xperiential Learning** techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to:** **1] Explain the UX Design principles** **2] Summarize the ideal user experience** **3] Develop wireframes using digital tools** **4] Construct personas and evaluate designs**					
Course Content:						
Module 1	Introduction to UI/UX	Assignment	History of UI/UX		**10 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	Case Study			**15 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, Wireframing using Balsamiq	Case Study		**10 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	Project		**10 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 Laboratory Tasks: Experiment No. 1: Installation and Interface of Balsamiq and Figma Level 1: Ensure that both Balsamiq and Figma are up and running with user accounts. Level 2: Download and import design files from internet to fimiliarize with them. Experiment No. 2: Create wireframe of the login screen of a mobile app Level 1: Make first wireframe of one login page Level 2: Make two pages that are hyperlinked and critique the design Experiment No. 3: Final wireframe experiment. Level 1: Prepare the wireframe of all the pages of a selected website Level 2: Change the wireframe to make the design changes to the website Experiment No. 4: First Figma experiment. Level 1: Figma interface, shortcuts and tools. Level2: Create and move between frames. Experiment No. 5: Design App Screen Level 1: Create layout, layers, fill colours Level 2: Set layer opacity, lock and unlock layers				

Experiment No. 6: Logo and icon
Level 1: Boolean operations on shapes, pen tool
Level2: Make smiley face

Experiment No.7: Create an app face.
Level1: Insert image, design nav bar using logo and icons
Level 2: Duplicate frame

Experiment No.8: Create a prototype
Level1: Use designing and prototyping modes
Level 2: Create connections between frames and layers

Experiment No.9: Create prototype of food delivery app
Level1: Replicate inner pages of app
Level 2: Improve the inner page design

Experiment No.10: Create prototype of a desktop website
Level1: Replicate pages on desktop app
Level 2: Export files and share in LinkedIn

Targeted Application & Tools that can be used:

Application Area: Designing user interfaces and user experience for software applications
Professionally Used Software: *Balsamiq, Figma*

Project work/Assignment:

Assignment:
1] History of UI/UX.
2] Application of Balsamiq to create a wireframe
3] Use prototyping tools to make a prototype of a gaming application interface.

Project Assignment:
1]Improve the UI/UX of a popular mobile application.

Text Book:

1. Steven Branson, "UX / UI Design: Introduction Guide To Intuitive Design And User-Friendly Experience" 2020
2. Nick de Voil, 'User Experience Foundations', The Chartered Institute for IT, 2020. (https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=2524371&site=ehost-live)

References:

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<tr><td colspan="2">

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Ulloa, Roberto ‘Kivy – Interactive Applications and Games in Python - Second Edition, Packt Publishing, (https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1018908&site=ehost-live)
Morris, Jason, ‘Hands-On Android UI Development : Design and Develop Attractive User Interfaces for Android Applications’, Packt Publishing, 2017. (https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=1637909&site=ehost-live)
Wigdor D., Wixon D., ‘Brave NUI World : Designing Natural User Interfaces for Touch and Gesture’, Morgan Kaufmann, 2010. (https://search.ebscohost.com/login.aspx?direct=true&db=e000xww&AN=365552&site=ehost-live)

</td></tr>
<tr><td>Catalogue prepared by</td><td>Dr. Pradeep Bhaskar, Dr. R. Mahalakshmi</td></tr>
<tr><td>Recommended by the Board of Studies on</td><td>4th SOIS BoS held on 27th December 2023</td></tr>
<tr><td>Date of Approval by the Academic Council</td><td></td></tr>
</table>

Course Code: CSA4017	**Course Title: Parallel ComputingType of Course: Theory Only**		**L- P- C**	**3**	**0**	**3**
Version No.	2.0				
Course Pre-requisites	NIL				
Anti-requisites	**NIL**				
Course Description	This is an introductory course to Parallel Computing. The purpose of this Course is to understand the motivation for Parallel Computing and the concept of Parallel Computing. It also exposes the various Models of Parallel Computers and their interconnections and how computations can be performed using Parallel Algorithms and Parallel Programming Models like OpenMP and MPI.				
Course Objectives	The objective of the course is to familiarize the learners with the concepts of **ParallelComputing** and attain **Employability** through **Problem Solving** techniques				
Course Out Comes	On successful completion of this course the students shall be able to: 1. Classify Parallel Systems 2. Employ a Parallel Algorithm for the given Problem 3. Demonstrate the usage of Parallel Programming Tools				
Course Content:					
Module 1	Motivation, History & Scopeof Parallel Computing, Concurrency	Assignment	Write about parallel computing applicationareas	**9 Sessions**	
Topics: The significance of parallel computing, Motivating parallelism, scope and applications, types of computing – concurrent, parallel and distributed computing; Types of Parallel Systems: Shared Memory Systems and Distributed Memory Systems; Parallelism in uniprocessor systems – Implicit parallelism - pipelining and superscalar execution, Parallel processing mechanisms, Parallel Computer structures – pipeline computers, array processors, multiprocessor systems					
Module 2	Parallel Hardware	Assignment	Programming activityusing OpenMP	**12 Sessions**	

Flynn's Classification – SIMD , MIMD, interconnection networks, Performance evaluation criteria, The Effect of Granularity on Performance, Message-Passing Programming, Send and Receive Operations, Interconnection networks, Shared memory interconnects: Bus, Crossbar; Distributed Memory Model, Basic communication operations-One to all Broadcast and All to one Reductions, Ring, Mesh, Hypercube

Module 3	Parallel Software, I/O, Performance, Parallel Algorithm Design	Case Study	Application of Foster's design methodology to Boundary Value problem	**12 Sessions**
Introduction to Decomposition, tasks and dependency graphs; granularity, concurrency and task interaction; Processes and mapping; processes versus processors; Decomposition techniques – recursive decomposition, data decomposition, exploratory decomposition, speculative decomposition, hybrid decomposition; Characteristics of tasks and interactions; Parallel algorithm models – data parallel, task graph, work pool, master slave, producer-consumer, hybrid models				
Module 4	Parallel Programming	Assignment	Programming activity using MPI	**12 Sessions**
Modelling parallel computation: Multiprocessor Models- Random-Access Machine, The Local-Memory Machine, The Memory-Module Machine, **Parallel Programming Models**: Shared Memory Model, Shared programming model with OpenMP, Message Passing Models, Message passing interface, MPI_init, MPI_Comm_rank, MPI_finalize, Running MPI Programs, collective Communication				
Targeted Application & Tools that can be used: OpenMP programming				

Text Book

1. T. Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition. Noida, India: Pearson Education, Ltd., 2003.

Web Links:

1. Technology Enabled Learning - NPTEL offers as Course on "Introduction to Parallel Programming in OpenMP" by Yogish Sabharwal, IIT, Delhi.
2. https://swayam.gov.in/nd1_noc19_cs45/preview Students can enroll for the course that starts on 26th Aug – 20th Sep, 2019.
3. https://nptel.ac.in/courses/105105157
4. https://puniversity.informaticsglobal.com:2229/login.aspx

References

1. Michael J Quinn, "Parallel computing: Theory and Practice", 2nd edition. New Delhi, India: TataMacGraw Hill Education Private Limited, 2002.
2. Michael J Quinn, "Parallel Programming in C with MPI and OPENMP", Indian edition. Chennai, India:Tata MacGraw Hill Education (India) Private Limited, 2004.
3. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing", Indian edition, NewDelhi, India: MacGraw Hill Education (India) Private Limited, 2012
4. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, Burlington, USA,2011.
5. V.Rajaraman, C. Siva Ram Murthy, "Parallel Computers: Architecture and Programming", 2nd edition,PHI Learning Private Limited, Delhi, India, 2016.

Topics relevant to "EMPLOYABILITY SKILLS": Shared Memory Systems and Distributed Memory Systems, DataParallelism, Functional Parallelism, Pipelining,Flynn's Classification, SIMD systems, MIMD systems, for developing **Employability Skills** through **Problem Solving methodologies**. This is attained through assessment component mentioned in course handout.

Course Code: CSA4018	**Course Title: Quantum Computing** **Type of Course:**	**L- T- P- C**	3	0	0	3
Version No.	1					
Course Pre-requisites	NIL					
Anti-requisites						
Course Description	This course provides an introduction to the theory and practice of quantum computation. Topics covered include: quantum mechanics to understand quantum computation. Quantum algorithms. The Shor's factorization algorithm Grover's search algorithm Mathematical models of quantum computation, Quantum Machine Learning, and to physical systems.					
Course Objective	The objective of the course is EMPLOYBILITY of student by using PROBLEM SOLIVING techniques.					
Course Out Comes	**On successful completion of the course the students shall be able to:** • Understand the basic principles of quantum computation and quantum mechanics. • Design quantum circuits using quantum gates. • Analyze the behavior of basic quantum algorithms.					

	• Understand the difference between classical and quantum machine learning approach.			
Course Content:				
Module 1	**INTRODUCTION**	**Quiz**	**Quiz**	**10 sessions**
Topics: Introduction to quantum computing. Qubits, Bloch sphere, multiple qubits, quantum states and measurements, Postulates of quantum mechanics, Classical computation vs quantum computation.				
Module 2	**QUANTUM MODEL OF COMPUTATION**	**Quiz**	**Quiz**	**12 sessions**
Topics: The model of quantum computation, Quantum circuits: single qubit gates, multiple qubit gates, design of quantum circuits.				
Module 3	**QUANTUM ALGORITHMS**	**Assignment**	**Case Studies**	**12 sessions**
Topics: Deutsch-Jozsa algorithm and Grover's search algorithm. Shor's algorithm for factoring, Quantum Fourier transform.				
Module 4	**QUANTUM INFORMATION THEORY & QUANTUM MACHINE LEARNING**	**Assignment**	**Case Studies**	**11 sessions)**
Topics: Comparison between classical and quantum information theory, Applications of quantum information, Bell states, Quantum Machine Learning, no cloning theorem.				
Project work/Assignment:				
Assignment: • Create quantum circuit functions that can compute the XOR, AND, NAND and OR gates using the NOT gate (expressed as x in Qiskit), the CNOT gate (expressed as cx in Qiskit) and the Toffoli gate (expressed as ccx in Qiskit) . • Measure the Bloch sphere coordinates of a qubit using the Aer simulator and plot the vector on the Bloch sphere • Investigate the relationship between the number of qubits required for the desired accuracy of the phase estimation with high probability.				

Project Work:

- Create a program that builds an oracle for a given string (e.g. given 01101, will return a QuantumCircuit that inverts the phase of the state $|01101\rangle$ and leaves all other states unchanged.
- Tackle an open issue in the Qiskit Terra repo.
- Create a program that builds an oracle circuit from a problem (like the PhaseOracle class does in the previous page). Assess how the size of your circuits grow with the size of the problem.

Text Book

1. Nielsen, M., & Chuang, I. (2010). Quantum Computation and Quantum Information: 10th Anniversary Edition. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511976667
2. McMahon D. Quantum Computing Explained. Hoboken N.J: Wiley-Interscience : IEEE Computer Society; 2008.

References

1. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. (2004)
2. Pittenger A. O., An Introduction to Quantum Computing Algorithms (2000).

E book link R1:

http://community.qiskit.org/textbook

E book link R2

https://github.com/Qiskit

Web resources:

- Abraham Asfaw and Antonio Corcoles & et al. "Learn Quantum Computation Using Qiskit", 2020, http://community.qiskit.org/textbook
- IBM Qiskit Global Summer School 2021: Quantum Machine Learning, https://qiskit.org/events/summer-school/
- https://quantum-computing.ibm.com/
- https://qiskit.org/
- https://presiuniv.knimbus.com/u

Topics relevant to development of "Skill Development":

- Visualizing Quantum States
- Analyzing Quantum Gates
- Designing Quantum Circuits

Topics relevant to development of "Employability Skills"

- Designing Quantum circuits
- Visualizing Quantum Circuit outputs

- Analyzing and Comparing Quantum Algorithm Performance

Course Code: CSA4019	**Course Title: Introduction to Bioinformatics Type of Course: General CSE Basket, Theory based**		**L- T- P- C**	3	0	0	3
Version No.	2.0						
Course Pre-requisites	NIL						
Anti-requisites	NIL						
Course Description	This course is designed to provide the knowledge of the concepts related to bioinformatics. The course is aimed at understanding the DNA and Protein sequences and databases. It also deals with Pairwise comparison and calculating the scoring matrix. Further, it focuses on Sequence Alignment techniques, discovering the Motifs in the sequence. Students will also learn the overview of Structural Bioinformatics and Genome sequencing.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Introduction to Bioinformatics** and attain **Employability** through **Participative Learning** techniques.						
Course Outcomes	**C.O.1:** Understand the DNA Protein sequence and structures. (Bloom's Level: **Knowledge) C.O.2:** Explain the file formats and sequence alignments of DNA sequence. (Bloom's Level: **Comprehension)** **C.O.3:** Apply the techniques of the motifs discovery for the analysis of Protein Sequence.(Bloom's Level: **Application)**						
Course Content:							
Module 1	**Fundamentals of Bioinformatics**	Quiz	Comprehension based Quizzes and assignments;			**9 Sessions**	
Topics: **Introduction to Bioinformatics**: Introduction to molecular biology, Cell, DNA, RNA, Transcription, Translation, Folding, Gene Structure, Introduction to Bioinformatics, Components and fields of bioinformatics, Omics, basic principles of structural/functional analysis of biological molecules, Biological Data Acquisition, Types of DNA sequences,Genomic DNA ,Mitochondrial DNA,DNA Sequencing tools, Protein sequencing and structure determination methods, Finding Reverse complement of a sequence.							
Module 2	**Genome databases and Sequence Similarity**	Quizzes and assignments	Comprehension based Quizzes and assignments			**8 Sessions**	

Topics:

Types and classification of genome databases, DNA sequence retrieval system, various DNA and protein sequence file formats, Common sequence file formats; Files for multiple sequence alignment; Files for structural data, Frequent words and k-mers in Text, String Reconstruction problem, Sequence Similarity searching, Sequence Similarity searching tools, NCBI BLAST, PSI BLAST, Significance of sequence alignments, Alignment scores and gap
penalties.

Module 3	**DNA sequence analysisand applications**	Quizzes and assignments	Comprehension based Quizzesand assignments	**10 Sessions**

Sequence similarity searches and alignment tools, Finding alignment using Needleman-Wunsch and Smith- Waterman algorithm, Heuristic Methods of sequence alignment, Pair-wise and multiple sequence alignments, DNAsequence analysis, Motif in protein sequence ,Motif discovery using Gibbs sampling,Motif finding, Gene Prediction models: Hidden Markov model(HMM), Generalized Hidden Markov model(GHMM), Bayesian method.

Targeted Application & Tools that can be used:

BLAST, FastA, , ClustalW, MEGA

Project work/Assignment:

Each batch of students (self-selected batch mates – up to 4 in a batch) will be allocated case studies/assignments

Textbook(s):

1. Bioinformatics: Sequence and Genome Analysis, David W. Mount, Cold Spring Harbor Laboratory Press, 2004.
2. Introduction to Bioinformatics, Arthur Lesk, Fifth Edition, Oxford University Press, 2019

References

1. Bioinformatics Methods and Applications, S. C. Rastogi, N.Mendiratta, P.Rastogi, Fourth Edition, Prentice HallIndia.
2.Bioinformatics Algorithms- An Active Learning Approach, Phillip Compeau & Pavel Pevzner, 2nd Edition, Vol. I &II, Active Learning Publishers, 2015

E-References

1. https://puniversity.informaticsglobal.com:2229/login.aspx

Topics related to development of "Employability skills": Batch wise presentations on selected topics

1. String Reconstruction problem
2. Sequence Similarity searching
3. Alignment scores and gap penalties
4. Protein sequencing
5. Gene Prediction models: Hidden Markov model(HMM)
6. Finding similarities by performing pairwise and multiple sequence alignment,
7. Evaluating phylogenetic trees.

for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessmentcomponent mentioned in course handout.

Course Code: CSA4020	**Course Title:** DISTRIBUTED SYSTEM **Type of Course:** **General** CSE Basket, **Theory based**	**L- T- P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course is designed to provide the knowledge of the concepts related to distributed system. The course is aimed at understanding the foundations of distributed systems. It also deals with Peer to peer services and to understand about the system level and support required for distributed system. Further, it focuses on Synchronization, Process and Resource Management. Students will also learn the overview of Distributed system.					
Course Objective	The objective of the course is EMPLOYBILITY of student by using PARTICIPATIVE LEARNING techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Describe the functional characteristics and challenges in distributed system (Knowledge level) CO2: Summarize the mechanism of inter process, indirect communication techniques. (Comprehensive level) CO3: Discuss the features of peer to peer services and file systems. (Comprehensive level) CO4: Apply synchronization techniques. (Application level)					

	CO5: Explain the different process and resource management approaches. (Comprehensive level)			
Course Content:				
Module 1	**INTRODUCTION TO DISTRIBUTED SYSTEM**	Quiz	Knowledge based Quizzes and assignments;	**9 Sessions**
Topics: Introduction - Trends in Distributed Systems – Focus on resource sharing – Challenges- Examples of Distributed Systems -Case study: World Wide Web.				
Module 2	**COMMUNICATION IN DISTRIBUTED SYSTEM**	Quizzes and assignments	Comprehension based Quizzes and assignments	**9 Sessions**
Topics: System Model – Inter process Communication – the API for internet protocols – External data representation and Multicast communication. Network virtualization: Overlay networks. Indirect Communication: Group communication – Publish-subscribe systems – Message queues – Shared memory approaches.				
Module 3	**PEER TO PEER SERVICES AND FILE SYSTEM**	Quizzes and assignments	Comprehension based Quizzes and assignments	**9 Sessions**
Topics: Peer-to-peer Systems – Introduction – Peer-to-peer – Middleware – Routing overlays. Distributed File Systems –Introduction – File service architecture – Andrew File system. File System: Features-File model -File accessing models.				
Module 4	**SYNCHRONIZATION**	Quizzes and assignments	Application based Quizzes and assignments	**9 Sessions**
Introduction – Clocks, events and process states – Synchronizing physical clocks- Logical time and logical clocks – Global states – Coordination and Agreement– Distributed mutual exclusion – Elections.				
Module 5	**PROCESS AND RESOURCE MANAGEMENT**	Quizzes and assignments	Comprehension based Quizzes and assignments	**9 Sessions**

Process Management: Process Migration,Resource Management: Introduction- Load Balancing Approach – Load Sharing Approach.
Targeted Application & Tools that can be used: LINUX
Project work/Assignment:
Each batch of students (self-selected batch mates – up to 4 in a batch) will be allocated case studies/assignments
Textbook(s): 1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012. 2. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Ninth edition, Prentice Hall of India, 2007. 3. Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Second Edition, Pearson Education, 2007. 4. Liu M.L., "Distributed Computing, Principles and Applications", First Edition, Pearson Education, 2004. 5. Nancy A Lynch, "Distributed Algorithms", Second Edition, Morgan Kaufman Publishers, USA, 2003

Course Code: CSA4021	**Course Title: Search Engine Optimization** **Type of Course: Program Core & Theory Only**	**L-T-P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	**NIL**					
Anti-requisites	**NIL**					
Course Description	Objective of this course is to make students learn the basics of Search Engine and develop ability to optimize the searching based on the key words so that the business can be improved. The search engine optimization is the skill of improving a website to upsurge its visibility when people search for products or services. The more visible a website has on search engines, the more likely it is that brand captures business. The students should have prior knowledge of WWW to pursue the Course. After successful completion of the Course, the students would acquire knowledge to comprehend the Search Engine Optimization algorithms, SEO tools and Reporting methods to analyze the web sites.					
Course Objective	The objective of the course is EMPLOYBILITY of student by using PARTICIPATIVE LEARNING techniques.					

Course Out Comes	On successful completion of the course the students shall be able to: 1. Outline the basic concepts of SEO (Knowledge) 2. Discuss the content necessary for On-page & Off-Page SEO (Comprehension) 3. Illustrate Technical SEO (Application) 4. Analyse the Report of SEO to measure the performance (Analysis)			
Course Content:				
Module 1	**Introduction to SEO**			**10 Sessions**
Topics: Search Engine – works- SEO vs SEM- need – history- works- Googlebot (Google Crawler)- Types of SEO technique- Search Engine Algorithm- Google Algorithm- Key word search- Types of key words- Competition analysis- Page ranking technology				
Module 2	**On-Page and Off-Page SEO**	Assignment		**12 Sessions**
Topics: Introduction to On-Page SEO, Basics of website designing/development, HTML Basics for SEO, Meta Tag, Title Tag, Image Tag and H Tag Optimization- Link building- Optimizing SEO content- Key word search and Analysis. Introduction to Off-Page optimization- Local marketing of website as per the location- Page ranking- Building back links- Type of links – Natural Link, manually built link & Self-created link- White hat, grey hat and Black hat SEO- Social Media optimization technique.				
Module 3	**Technical SEO**			**10 Sessions**
Basics of Technical SEO- Crawling and Indexing- HTML Sitemap vs. XML Sitemap, The robots.txt File protocol, Overcoming Error codes, Technical Analysis connected with Redirection, Broken Links - Redirects, Best Practices, Analysis of Crawl Errors				
Module 4	**SEO Reporting**	Assignment		**08 Sessions**
Website position analysis in various search engine- Analyzing performance of the website using Google analytics- Goals and conversion- Tracking and report- Reports submission- Securing Ranks.				
Targeted Application & Tools that can be used: Applications: Online Business models such as e-Commerce, Digital Marketing, Health Care **Professionally used softwa**re – Google Analytics				
Project work/Assignment:				
To understand the Search Engine Optimization. Assignment: 1] Create a web site and choose a title tag for your web page in your website and Explain why you made the page changes.				

Assignment: 2] Identify a better SEO tool, analyze any website and generate the report for the website.

Text Book

T1 - “Search engine optimization all-in-one for dummies”, Clay, B ,3rd ed., John Wiley & Sons, Inc., 2015.

T2 -”Google AdWords: A beginner's guide to Google. Use Analytics, SEO, and AdWords. Become an influencer on social media”, Wally Bax , Notion Press Media Pvt Ltd., 2022.

References

R1 – “Introduction to search engine optimization: A guide for absolute beginners”, Kelsey, T, Apress. (2017).

R2 - “Step By Step Guide to SEO”, Upendra Rana, Ocean Books Pvt Ltd.R-Tech Offset Printers, 2018.

R3 - “Search Engine Optimization (SEO).Grow the Audience”, Clark, Hack Book Works, 2022.

Weblinks:

W1: https://puniversity.informaticsglobal.com/login

W2:https://essentials.ebsco.com/search?query=Search+Engine+Optimization

Topics relevant to development of “SKILL”: • We Development basic using HTML and Search engine optimization tools.

Topics relevant to development of “ENTREPRENUERSHIP”: Search Engine Optimization tools, Analysis of websites using Google Analytics.

Course Code: CSA4024	Mobile Applications and Development **Course Type : Disciple Elective – Lab Integrated**	**L- T-P-C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSA4007 - Object Oriented Programming Using Java					
Anti-requisites						
Course Description	The course deals with the 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 **Mobile Applications and Development** as mentioned above and attain **Employability Skills** through **Experiential Learning** Techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Discuss the fundamentals of mobile application development and its architecture. 2. Design mobile applications with appropriate android view. 3. Demonstrate the use of services, broadcast receiver, Notifications and content provider 4. Apply data persistence techniques, to perform CRUD operations. 5. Develop Applications using concepts of Animations and graphics					
Course Content:						
Module 1	**Introduction and Architecture of Android**	Assignment	Simulation/Data Analysis	**10 Sessions**		
Android: History and features, Architecture, Development Tools, Android Debug Bridge (ADB), and Life cycle.						

Module 2	**User Interfaces, Intent and Fragments**	Assignment	Numerical from E-Resources	**15 Sessions**
Views, Layout, Menu, Intent and Fragments.				
Module 3	**Components of Android**	Term paper/Assignment	Simulation/Data Analysis	**15 Sessions**
Activities, Services, Broadcast receivers, Content providers, User Navigation				
Module 4	**Notifications and Data Persistence**	Term paper/Assignment	Simulation/Data Analysis	**15 Sessions**
Notification, Shared Preferences, SQLite database, Android Room with a View, Firebase				
Module 5	**Advance App Development**	Term paper/Assignment	Simulation/Data Analysis	**15 Sessions**
Graphics and Animation, App Widgets, Sensors, Performance, Location, Places, Mapping, Custom Views, Canvas.				

List of Laboratory Tasks

1.a. Design an app to read user inputs using edit text and display the result of arithmetic operations using toast message.

1.b. Create an android app to calculate the current age of yourself, select your DOB using date picker.

2.a. Design an app to input your personal information. Use autocomplete text view to select your place of birth.

2.b. Design an app to select elective course using spinner view and on click of the display button, toast your ID and selected elective course.

3. Design a restaurant menu app to print the total amount of orders.

4. Develop an android app that uses intent to maintain the following scenario. Check the eligibility criteria for voting. Input the Aadhar no., Name & age in the first activity. If the age is above 18, display the voter's detail in the second activity. Else, display, “You are not eligible to vote” in the second Activity.

5. Demonstrate the use of fragment with list of buttons representing various colors, and on click of these buttons, the appropriate color is filled in the next fragment. Create an Android application to input the vitals of a person (temperature, BP). If the vitals are abnormal, give proper notification to the user.

6. Create an android app to for movie ticket booking. Save the user name of the customer using shared preferences. After completion of booking, retrieve the username from the shared preferences and print the ticket details.

7. Create an android application to manage the details of students' database using SQLite.Use necessary UI components, which perform the operations such as insertion, modification, removal and view.Presidency University needs an APP for Admission eligibility checking for students, for that you need to take the following

information from the Student: registration ID, physics, chemistry and mathematics marks (PCM), fees is allotted as below criteria.

PCM (Total marks %)	Fee concession
90 above	80 %
70 to 89	60 %
Below 69 %	no concession

On click on the button "Registration" details should be stored in the database using SQLite. Create button DISPLAY ALL (full students list) on click on the button it should display the students list per the fee concession.

8. A company need to design an app that plays soft music automatically in the background. Create an app to achieve this functionality.

9. Create an android application such that your view object in the Activity can be Animated with fade-in effect. Create an appropriate XML file named fade-in and write the application to perform the property animation.

10. Demonstrate how to send SMS and email.

11. Create an android application to transfer a file using WiFi. Create an android application "Where am I" with an Activity that uses the GPS Location provider to find the device's last known location.

Targeted Application & Tools that can be used:

Text Book

T1. Pradeep kothari "Android Application Development - Black Book", dreamtech press

T2. Barry Burd (Author), "Android Application Development" ALL – IN – ONE FOR Dummies

T3. Jeff Mcherter (Author),Scott Gowell (Author), "Professional mobile Application Development" paperback, Wrox - Wiley India Private Limited

T4. Wei-Meng Lee (Author) "Beginning Android Application Development" Wrox – Wiley India Private Limited

References

1. Bill Phillips, Chris Stewart, and Kristin Marsicano (Author) "Android Programming" 3rd edition, 2017.The Big Nerd Ranch Guide, Big Nerd Ranch LLC, 5. The Big Nerd Ranch Guide, by"

2. Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India Pvt Ltd, 2014.

3. Dawn Griffiths and David Griffiths, "Head First Android Development", 1st Edition, O'Reilly SPD Publishers, 2015.

4. J F DiMarzio, “Beginning Android Programming with Android Studio”, 4th Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580
5. Anubhav Pradhan, Anil V Deshpande, “ Composing Mobile Apps” using Android, Wiley 2014, ISBN: 978-81-265-4660-2
6. Reto Meier “Professional Android Application Development”

E-Resources: https://puniversity.informaticsglobal.com/loginOr http://182.72.188.193/

Topics relevant to the development of SKILLS: Graphics and Animation, App Widgets Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.

Network & Cloud Computing Basket

Course Code: CSA4025	**Course Title:** Computer Networks **Type of Course:** Program Core -Theory	**L-T-P-C**	3	0	0	3
Version No.	2.0					
Course Pre-requisites	NIL					
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 **Participative Learning** techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1] List the Basic Concepts of Computer Networks and Transport-Layer Services. (Remember)					

	2] Apply the Knowledge of IP Addressing and Routing Mechanism in Computer Networks. (Apply) 3] Develop the functionalities of Data Link Layer. (Apply) 4] Relate the working principles of wireless devices and security aspects of Networks. (Remember)			
Course Content				
Module 1	**Overview, Application, and Transport Layer**	Assignment	Problem Solving	**12 Sessions**
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**	Assignment	Problem Solving	**12 Sessions**
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, Intra-AS Routing in the Internet, OSPF Routing Among the ISPs: BGP, Introduction to BGP. ICMP: The Internet Control Message Protocol				
Module 3	**Data Link Layer**	Assignment	Problem Solving	**12 Sessions**
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, Ethernet, Link-Layer Switches, Virtual Local Area Networks (VLANs)

Module 4	**Wireless and Security in Computer Networks**	Assignment	Problem Solving	**09 Sessions**

Introduction, Wireless Links and Network Characteristics, Wi-Fi: 802.11 Wireless LANs, Cellular Networks: 4G and 5G.

Security in Computer Networks: Principles of Cryptography, End-Point Authentication, Securing E-Mail, Operational Security: Firewalls and Intrusion Detection Systems.

Targeted Application & Tools that can be used: Cisco Packet Tracer, Wireshark

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

1. Assume that a computer sends a frame at the transport layer to another computer and the destination port address is not running. According to what you read from chapter 2, what will happen to that process?

2. Determine the possible bit rate and the number of levels over a channel for these cases? a. B = 2.4K Hz, noiseless channel with L = 16. b. B= 2.4K Hz, SNR = 20 dB. c. B = 3.0K Hz, SNR = 40 db.

3. Using CISCO Packet Tracer Configuring Static and Default Routes
Objectives
- Configure static routes on each router to allow communication between all clients.
- Test connectivity to ensure that each device can fully communicate with all other devices.

4. Getting familiar with Wireshark software by installing it I your system, and perform following task:
1. List out the packets which are having DNS protocols
2. List of IP address present in the cache along with its MAC addresses
3. Display all the packets which are having the DNS or HTTP protocol

Text Book

1. James F. Kurose, Keith W. Ross, "*Computer Networking A Topdown Approach",* 8th Edition, Pearson, 2023.

2. Computer Networks , Tanenbaum , 5th Edition , Pearson Education Media, 2023
3. Behrouz A. Forouzan, "*Data Communications and Networking*", 5th Edition, Tata McGraw-Hill, 2017

References

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.

Web Based Resources and E-books:

W1: Computer Networks: https://gaia.cs.umass.edu/kurose_ross/index.php

W2: https://www.coursera.org/learn/computer-networking

W3: Presidency University -E Library (Knimbus)

https://presiuniv.knimbus.com/user#/searchresult?searchId=eBook&curPage=0&layout = grid&sorFieldId=none&topresult=false&content=*cloud*

Topics relevant to "SKILL DEVELOPMENT":

Application Layer, Transport Layer, Network Laryer for **Skill development** through **Participative Learning t**echniques. This is attained through the assessment component mentioned in the course handout.

<table>
<tr><td>Course Code: CSA4026</td><td colspan="4">Course Title: Wireless Ad Hoc Networks
Type of Course: Theory Only Course</td><td>L- T- P- C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="9">1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="9">CSA4025 - Computer Networks</td></tr>
<tr><td>Anti-requisites</td><td colspan="9">NIL</td></tr>
<tr><td>Course Description</td><td colspan="9">This course examines wireless cellular, ad hoc and sensor networks, covering topics such as wireless communication fundamentals, medium access control, network and transport protocols, unicast and multicast routing algorithms, mobility and its impact on routing protocols, application performance, quality of service guarantees, and security. Energy efficiency and the role of hardware and software architectures may also be presented for sensor networks.</td></tr>
<tr><td>Course Objective</td><td colspan="9">The objective of the course is to familiarize the learners with the concepts Wireless Ad Hoc Networks and attain Skill Development using PROBLEM SOLVING techniques</td></tr>
<tr><td>Course Out Comes</td><td colspan="9">On successful completion of the course the students shall be able to:
CO1. Describe the basic working of the Wireless systems. [Knowledge]
CO2. Explain the Fundamental Concepts and applications of ad hoc and wireless sensor networks [Knowledge]
CO3. Outline current and emerging trends in Ad-hoc Wireless Networks [Application]
CO4. Discuss the WSN routing issues by considering QoS measurements[Application]
CO5 Analyze Hybrid management in ad-hoc wireless networks. [Application]</td></tr>
<tr><td>Course Content:</td><td colspan="9"></td></tr>
<tr><td>Module 1</td><td colspan="2">Fundamentals of Wireless Communication</td><td>Quiz</td><td colspan="3">Assignment</td><td colspan="3">9 Sessions</td></tr>
<tr><td colspan="10">Topics:
Wireless Technology, Characteristics of the Wireless Channel, Modulation Technique, Multiple Access Techniques WIRELESS INTERNET Address Mobility.</td></tr>
</table>

Wireless Networking. Cellular Wireless Networks Channel Assignment Handoff Strategies Near–Far Problem CDMA Power Control				
Module 2	**Ad Hoc Wireless Networks**	Quiz	Assignment	**9 Sessions**
Topics: **Wireless sensor networks**: Introduction Applications of Sensor Networks Comparison with Ad Hoc Wireless Networks Issues and Challenges in Designing a Sensor Network Sensor Network Architecture Layered Architecture Clustered Architecture **Ad Hoc Wireless Networks** Introduction Cellular and Ad Hoc Wireless Networks Applications of Ad Hoc Wireless Networks Issues in Ad Hoc Wireless Networks Ad Hoc Wireless Internet				
Module 3	**MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS**	Quiz	Assignment	**9 Sessions**
Topics: Introduction, Issues in Designing a MAC Protocol for Ad Hoc, Bandwidth Efficiency, Quality of Service Support, Synchronization Distributed Nature/Lack of Central Coordination Mobility of Nodes Wireless Networks Design Goals of a MAC Protocol for Ad Hoc Wireless Networks Classifications of MAC Protocols Contention-Based Protocols Reservation Mechanisms Scheduling Mechanisms Other MAC Protocols				
Module 4	**Routing protocols for ad Hoc wireless networks**	Quiz	Assignment	**9 Sessions**
Topics: Introduction Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks Mobility, Bandwidth Constraint Resource Constraints Characteristics of an Ideal Routing Protocol for Ad Hoc Wireless Networks Classifications of Routing Protocols, Table-Driven Routing Protocols Destination Sequenced Distance-Vector Routing Protocol Wireless Routing Protocol Cluster-Head Gateway Switch Routing Protocol Source-Tree Adaptive Routing Protocol				
Module 5	**Hybrid Routing Protocols**	Quiz	Coding Assignment	**9 Sessions**
Topics: On-Demand Routing Protocols, Core Extraction Distributed Ad Hoc Routing Protocol Zone Routing Protocol, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power-Aware Routing Protocols				

Targeted Application & Tools that can be used: 1. GloMoSim Simulator, TOSSIM, OMNeT++
Project work/Assignment:
Assignment: Students will have to write the
Text Book **T1** C. Siva Ram Murthy and B. S. Manoj, Adhoc Wireless Networks – Architecture and Protocols, Pearson Publication, 2013. .
References **R1** Kazem Soharby, Daniel Minoli and Taieb Znati, Wireless Sensor Networks : Technology, Protocols and Applications, Wiley Publication, 2016,. **Web resources:** https://books.google.co.in/books?id=izNUbXbK7e4C&lpg=PR4&pg=PA8#v=onepage&q&f=false
Topics relevant to "SKILL DEVELOPMENT": Basics of personas, Creating personas. Gestalt principles of perception, Usability Testing, creating mockups and prototypes in Figma **for Skill Development** through **Problem solving techniques. This is attained through assessment component mentioned in course handout.**

Course Code: CSA4027	**Course Title: Wireless Sensor Networks**	**L- T- P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSA4025 - Computer Networks					
Anti-requisites	**NIL**					

<table>
<tr><td>Course Description</td><td colspan="4">This course examines wireless cellular, ad hoc and sensor networks, covering topics such as wireless communication fundamentals, medium access control, network and transport protocols, uni cast and multicast routing algorithms, mobility and its impact on routing protocols, application performance, quality of service guarantees, and security. Energy efficiency and the role of hardware and software architectures may also be presented for sensor networks.</td></tr>
<tr><td>Course Objective</td><td colspan="4">The objective of the course is to familiarize the learners with the concepts of Wireless Sensor Networks and attain Employability Development through Participative Learning techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="4">On successful completion of the course the students shall be able to:
Explain the basics of the Wireless systems.
Describe different protocols being used by wireless networks including ABR and MANETS.
Illustrate the Fundamental Concepts and applications of ad hoc and wireless sensor networks.
Interpret the WSN routing issues by considering related QoS measurements.</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Overview of Wireless Sensor and Adhoc Networks</td><td>Assignment</td><td>Data Interpretation</td><td>08 Sessions</td></tr>
<tr><td colspan="5">Topics:
Introduction, Sensor Network Technology background, Elements of basic Sensor Network Architecture, Survey of Sensor Networks, Network Characteristics and Challenges, Applications of Wireless Sensor Networks, Range of Applications, Category 2 WSN Applications – Home Control, Industrial Automation, Medical Applications, Category 1 WSN Applications – Sensor and Robots, Reconfigurable Sensor Networks, Highway Monitoring, Military Applications, Civil and Environmental Engineering Applications, Wildfire Instrumentation, Habitat Monitoring, Nanoscopic Sensor Applications, Introduction to Cellular and Adhoc Networks, Issues in Adhoc Networks – Routing, Multicasting, QoS, Security, Scalability.</td></tr>
<tr><td>Module 2</td><td>Wireless Transmission Technology and MAC</td><td>Assignment</td><td>Basics and Interpretation</td><td>13 Sessions</td></tr>
</table>

	Protocols for Adhoc			
Topics: Introduction, Radio Technology Primer – Propagation and Modulation, Propagation and Modulation impairments, Available Wireless Technologies, Campus Applications, MAN/WAN Applications, Medium Access Control Protocols – Fundamentals, Performance Requirements, MAC Protocols for WSNs -Schedule based Protocols and Random Access based Protocols, Sensor MAC case study, Issues in Designing MAC Protocol for Adhoc Networks - Bandwidth efficiency, QoS support, Synchronization, error-prone broadcast channel, Mobility of nodes.				
Module 3	**Routing Protocols for Adhoc and WSN**	Quiz	Questions Set	**9Sessions**
Topics: Background, Data Dissemination and gathering, Routing challenges, Network Scale and Time-Varying Characteristics, Routing Strategies, characteristics of an ideal Routing Protocol for Adhoc Networks, WSN Routing Techniques, Classifications of Routing Protocols, Table-driven and on-demand Routing Protocols, Routing Protocols with efficient flooding mechanism.				
Module 4	**Demonstration of WSN Adhoc Network using Simulators**	Quiz	Questions Set	**8 Sessions**
Topics: GloMoSim Simulator, TOSSIM, OMNeT++ and other recent available simulation tools (MATLAB wireless module, NS2, etc).				
Targeted Application & Tools that can be used: This course helps the students to understand the concepts related to Wireless Sensor and Adhoc and networks.by using simulation tools in several educational associations and research hubs. For this reason study of existing experimental tools for analyzing the behavior of WSNs becomes essential, with wireless sensor networks that include NS-2, OMNeT++, Prowler, OPNET, and TOSSIM.				
Project work/Assignment:				
Project Assignment: 1) Resource Allocation Robust to Traffic and Channel Variations in Multihop Wireless Networks. 2) Evaluation Models for the Nearest Closer Routing Protocol in Wireless Sensor Networks Assignment:				

1]Define Wireless Sensor Networks? Explain in brief about the Applications of Wireless SensorNetworks

2] Discuss the advantages and applications of sensor networks?

3] Discuss the design considerations of physical layer and transceiver?

Text Book

T1: Kazem Soharby, Daniel Minoli and Taieb Znati, Wireless Sensor Networks: Technology, Protocols and Applications, Wiley Publication, 2016, ISBN : 978-81-265-2730-4

T2: C. Siva Ram Murthy and B. S. Manoj, Adhoc Wireless Networks – Architecture and Protocols, Pearson Publication, 2013. ISBN: 978-81-317-0688-6

References

R1: Jagannathan Sarangapani, Wireless Adhoc and Sensor Networks – Protocols, Performance and Control, CRC Press 2017, e-book ISBN: 9781315221441

R2: Chai K. Toh, Ad Hoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall Publisher 2007, ISBN : 0-13-007617-4

R3: https://networksimulationtools.com/glomosim-simulator-projects/

R4 : http://vlabs.iitkgp.ac.in/ant/8/

Case study

link:https://www.academia.edu/33109763/A_Case_Study_on_Mobile_Adhoc_Network_Security_for_Hostile_Environment

E book link : http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w03.pdf

E book link :

https://referenceglobe.com/CollegeLibrary/library_books/20180301073312adhoc2-ilovepdf-compressed.pdf

Web resources: https://archive.nptel.ac.in/courses/106/105/106105160/- **IIT KGP,** Prof. SUDIP MISHRA

Web resources: https://www.digimat.in/nptel/courses/video/106105160/L22.html - **IIT KGP,** Prof. SUDIP MISHRA

Topics relevant to "EMPLOYABILITY DEVELOPMENT":

Wireless Sensor Networks Concepts of Sustainable development tools, Integrity Availability Concepts Policies, procedures, Guidelines, infrastructure-less wireless network for **Employability development** through **Participative Learning techniques**. This is attained through the assessment component mentioned in the course handout.

<table>
<tr><td>Course Code:
CSA4028</td><td colspan="3">Course Title:
Network and Information Security
Type of Course: Discipline Elective - Theory only</td><td>L- T- P- C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">On successful completion of the course, the students shall be able to
CO1: Describe the basic concept of information security
CO2: Explain the various threats and attacks
CO3: Use the different techniques for vulnerability Assessment
CO4: Apply the various Security Technology</td></tr>
<tr><td>Course Content:</td><td colspan="7"></td></tr>
<tr><td>Module 1</td><td colspan="2">Introduction to Network and Information Security</td><td>Quiz</td><td colspan="2">Introduction</td><td>10 Session</td></tr>
<tr><td colspan="8">Topics:
Attacks on Computers and Computer Security: Introduction, The need for security, Security approaches, Principles of Security, Types of security attacks, Security services, Security mechanisms, A model for network security.</td></tr>
<tr><td>Module 2</td><td colspan="2">Cryptography: Concepts and Techniques</td><td>Assignment / Case study</td><td colspan="2">Threats and Attacks</td><td>10 Session</td></tr>
<tr><td colspan="8">Topics:
Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, and possible types of attacks.</td></tr>
<tr><td>Module 3</td><td colspan="2">Symmetric and Asymmetric Key Ciphers</td><td>Problem Solving</td><td colspan="2">Block Ciphers</td><td>10 Session</td></tr>
<tr><td colspan="8">Topics:
Symmetric key Ciphers: Block Cipher principles & Algorithms (DES, AES), Stream ciphers, RC4,Location and placement of encryption function, Key distribution Asymmetric key Ciphers: Principles of public key cryptosystems, Algorithms (RSA, Diffie-Hellman), Key Distribution.</td></tr>
<tr><td>Module 4</td><td colspan="2">Security Technology</td><td>Case study</td><td colspan="2">Devices and Technology</td><td>10 Session</td></tr>
</table>

Topics:

Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction Intruders, Virus and Firewalls: Intruders, Intrusion detection, password management, Virus and related threats, Countermeasures, Firewall design principles, Types of firewalls

Project work/Assignment:

1. **Case Studies/Assignments**: The case study /assignments will be a mix of in-class and out-of-class laboratory exercises. They will usually require some kind of procedural work (we will provide instructions), as well as some reflection on the work done, such as researching processes and procedures.
2. **Book/Article review**: At the end of each module a book reference or an article topic will be given to an individual or a group of students. They need to refer the library resources and write a report on their understanding about the assigned article in appropriate format. Presidency University Library Link .

Text Book(s):

T1. Cryptography and Network Security : William Stallings, Pearson Education,411iEdition

T2. Cryptography and Network Security : Atul Kahate, Mc Graw Hill, 2" Edition

Reference(s):

Reference Book(s):

R1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, lst Edition.

R2. Cryptography and Network Security : Forouzan Mukhopadhyay, Mc Graw Hill, 2"d Edition

R3. Information Security, Principles and Practice: Mark Stamp, Wiley India.

R4. Principles of Computer Sceurity: WM.Arthur Conklin, Greg White, TMH

R5. Introduction to Network Security: Neal Krawetz, CENGAGELearning

R6. Network Security and Cryptography: Bernard Menezes, CENGAGELearning

Online Resources (e-books, notes, ppts, video lectures etc.):

W1. https://www.eccouncil.org/information-security-management/

W2. https://www.iso.org/isoiec-27001-information-security.html

W3. https://www.sans.org/reading-room/whitepapers/threats/paper/34180

W4. https://csrc.nist.gov/publications/detail/sp/800-40/version-20/archive/2005-11-16

W5. https://www.sscnasscom.com/qualification-pack/SSC/Q0901/

W6. https://www.compuquip.com/blog/prepare-for-cybersecurity-audit

W7. https://www.comparitech.com/net-admin/it-security-audit/

Online Courses:

Information Security Management System | Udemy

Certified Information Security Manager (CISM) certification | ISACA

Topics related to development of “SKILL DEVELOPMENT”: Security Policy Implementation, Block Ciphers, Information Security Project Management for Skill Development.

Course Code: CSA4029	**Course Title: Edge Computing** **Type of Course: Theory Only Course** **Discipline Elective**	**L-T-P-C**	**3**	**0**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	Distributed Systems and Algorithms					
Anti-requisites	**Nil**					
Course Description	In this course, we will study significant tools and applications that comprise today's cloud computing platform, with a special focus on using the cloud for big data applications. The course covers various topics such as the evolution of computing industry, cloud computing basics and edge computing. The course provides information on the different types of edge compute deployments, different types of edge compute services (such as CDN Edge, IOT Edge, and Multi-access Edge (MEC)). The course also educates the students on the different vendor platforms, software services, standard bodies and open source communities available for edge computing. Students will also create a research project of their choosing.					
Course Objective	The objective of the course IS SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING technique.					
Course Out Comes	On successful completion of the course the students shall be able to: CO1 Understand the principles, architectures of edge computing (Knowledge) CO2 Describe IoT Architecture and Core IoT Modules (Comprehension) CO3 Summarize edge to Cloud Protocols (Comprehension) CO4 Describe Edge computing with RaspberryPi (Comprehension)					
Course Content:						

Module 1	IoT and Edge Computing Definition and Use Cases	Term paper/Assignment/Case Study	Programming/Simulation/Data Collection/any other such associated activity	**9 Sessions**
Topics: Introduction to Edge Computing Scenario's and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog and M2M.				
Module 2	IoT Architecture and Core IoT Modules	Term paper/Assignment/**Case Study**	Programming/Simulation/Data Collection/any other such associated activity	**9 Sessions**
Topics: A connected ecosystem,IoT versus machine-to-machine versus, SCADA, The value of a network and Metcalfe's and Beckstrom's laws, IoT and edge architecture, Role of an architect, Understanding Implementations with examples-Example use case and deployment, Case study – Telemedicine palliative care, Requirements, Implementation, Use case retrospective.				
Module 3	Raspberry Pi	Term paper/Assignment/Case Study	**Programming/Simulation**/Data Collection/any other such associated activity	**10 Sessions**
Topics: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout and Pinouts, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi, Connecting Raspberry Pi via SSH, Remote access tools, Interfacing DHT Sensor with Pi, Pi as Webserver, Pi Camera, Image & Video Processing using Pi.				
Module 4	Edge to Cloud Protocols	Term paper/Assignment/Case Study	Programming/Simulation/Data Collection/any other such associated activity	**7 Sessions**
Topics: Implementation of Microcomputer RaspberryPi and device Interfacing, Edge to Cloud Protocols- Protocols,MQTT, MQTT publish-subscribe, MQTT architecture details, MQTT state transitions,MQTT packet structure, MQTT data types, MQTT communication formats, MQTT 3.1.1 working example.				

Module 5	Edge computing with Raspberry Pi	Term paper/Assignment/Case Study	**Programming/Simulation**/Data Collection/any other such associated activity	**7 Sessions**
Topics: Edge computing with RaspberryPi, Industrial and Commercial IoT and Edge, Edge computing and solutions.				
Targeted Application & Tools that can be used: ➢ **Application** : Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking. ➢ **Tools** :Eclipse ioFog : An integrated development environment built by the Eclipse Foundation, backed by IBM. Eclipse ioFog is the organization's open-source edge computing platform.				
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course				
Exploring topics such as developing scalable architectures, moving from closed systems to open systems, and ethical issues rising from data sensing, addresses both the challenges and opportunities of Edge computing presents. Students can harness federating Edge resources, middleware design issues, data management and predictive analysis, smart transportation and surveillance applications, and more. A coordinated and integrated solutions can be provided by thorough knowledge of the foundations, applications, and issues that are central to Edge computing.				
Text Book 1. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806 2. Raspberry Pi Cookbook, 3rd Edition, by Simon Monk, Publisher: O'Reilly Media, Inc., 2019, ISBN: 978149204322.				
Topics relevant to development of "Skill Development": Implementation of Microcomputer RaspberryPi and device Interfacing				

Course Code: CSA4032	Course Title: Web 3.0 Type of Course: Theory	L- T- P-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course explores the convergence of Web3.0 technologies, blockchain, and artificial intelligence (AI), providing students with a comprehensive understanding of the synergies between these transformative fields. Students will delve into the principles of decentralized systems, blockchain development, and the integration of AI models into web applications. Through hands-on labs and projects, participants will gain practical experience in building decentralized applications (DApps) that leverage blockchain and AI technologies.					
Course Outcomes	On successful completion of this course the students shall be able to: 1. Familiaritywith principles of decentralization and their significance in the context of the web.. 2. Ability to Develop and deploy smart contracts on blockchain networks, with a focus on Ethereum. 3. Ability to Utilize advanced Solidity features in smart contract development 4. Understand the process of building decentralized applications (DApps) 5. Investigate and experiment with decentralized machine learning frameworks.					
Course Content:						
Module 1	Introduction to Web 3.0 and Blockchain Basics	Assignment			**09 Sessions**	
Topics: Overview of Web 3.0 concepts-Describe the evolution from Web2.0 to Web3.0.Introduction to blockchain technology-Ethereum and smart contracts-Building blocks of a blockchain-Cryptocurrencies and decentralized ledgers Smart Contracts and Decentralized Applications (DApps):Understanding smart contracts-Developing smart contracts using Solidity-Building decentralized applications.						

Module 2	Decentralized Storage and Peer-to-Peer Networks	Assignment		**12 Sessions**
Topics: Introduction to decentralized storage (IPFS)-Peer-to-peer networking concepts- Integrating decentralized storage into a project. Semantic Web and Linked Data RDF and triple store databases: Ontologies and knowledge representation- Creating and querying linked data.				
Module 3	AI and Machine Learning in Web 3.0	Assignment		**12 Sessions**
Topics: Integrating AI with decentralized systems-Machine learning for decentralized data analysis-Implementing AI features in a DApp. Interoperability and Standards: Interoperability challenges and solutions-Cross-chain communication Implementing interoperable features.				
Module-4	Privacy and Security in Web 3.0	Technical Presentation		**12 Sessions**
Topics: Privacy-preserving technologies-Security considerations for decentralized applications-Implementing secure and private features in a DApp. Web 3.0 Protocols and Development Platforms: Overview of popular Web 3.0 protocols (e.g., Ethereum, Polkadot).Legal and Ethical Considerations:Legal aspects of blockchain and decentralized technologies-Ethical considerations in Web 3.0 development				
Project work/Assignment:				
1. Assignment 1 on (Module 1 and Module 2) **2. Assignment 2 on (Module 3 and Module 4)**				
REFERENCE MATERIALS: TEXTBOOKS 1. "Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications" by Imran Bashir, Second edition,2018, published by O'Reilly Media 2. "Blockchain Basics: A Non-Technical Introduction in 25 Steps" by Daniel Drescher,1st edition 2017, Apress publisher 3. "Blockchain Applications: A Hands-On Approach" by Arshdeep Bahga and Vijay Madisetti ,1st edition 2018,VBT publisher 4. "Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations" by Henning Diedrich, 1st Edition,Jan2019 REFERENCES 5. The Metaverse: Buying Virtual Land, NFTs, VR, Web3 & Preparing for the Next Big Thing! by Alan Turton published by Terry Winters,November 2021.				

6. The Metaverse: And How It Will Revolutionize Everything Hardcover – July 19, 2022by Matthew Ball by kindle edition

JOURNALS/MAGAZINES

- IEEE Transactions on The Integration of Block chain and AI for Web 3.0: A security Perspective
  https://ieeexplore.ieee.org/document/10068672

- IEEE Transactions on Web 3.0: The Decentralized Web Block chain networks and Protocol Innovation
  https://ieeexplore.ieee.org/document/8441990
- International Journal of Information Technology Web 3.0 In Learning Environments: A Systematic Review

  https://dergipark.org.tr/tr/doi/10.17718/tojde.849898

SWAYAM/NPTEL/MOOCs:

1. Swayam -Nptel – Block chain and its Applications – IIT Kharagpur
   https://onlinecourses.nptel.ac.in/noc22_cs44/preview

2. Coursera – Learn the Tools and Technologies Behind Web3
   https://www.coursera.org/collections/web3-tools-technologies

Data Science & Big Data Basket

Course Code: **CSA 4033**	**Course Title: Data Analytics and Visualization** **Type of Course: Discipline Elective – Lab Integrated**	**L- T-P-C**	**1**	0	4	3
Version No.	0.9					
Course Pre-requisites	CSA4004 - Advanced Python Programming					
Anti-requisites	**NIL**					
Course Description	The Course consists of two parts where first Part covers advanced analytics that covers topics necessary to give businesses greater insight into their data than they could ordinarily, and the Second Part covers data visualization concepts. Primary concepts include machine learning, data mining, predictive analytics, location analytics, big data analytics, and location intelligence. Visualization for Time series, Geolocated data, Correlations, connections, Hierarchies, networks, and interactivity.					
Course Objective	**This course is designed to improve the learners' <u>EMPLOYABILITY SKILLS</u> by using <u>EXPERIENTIAL LEARNING</u> techniques.**					
Course Outcomes	**On successful completion of this course the students shall be able to:** 1) Interpret data by performing Exploratory Data Analysis 2) Apply techniques of Machine Learning to build Generalized Predictive Models. 3) Create Data Visualization for the provided data using visualization tools 4) Appraise the Data Visualizations to provide insights from data					
Course						
Module 1	Data Analytics	Assignment	Analysis, Data Collection	**3+15**		
Topics: Characteristics and types of data, Types of Analytics, Location Analytics, Working with Geospatial Data, Feature Engineering and Selection, Dimensionality Reduction Techniques, Data Preparation.						
Module 2	Advanced Analytics	Case Study	Analysis, Data Collection, Programming	**4+15**		

Topics:

Statistical methods for Data Analytics, Advance topics in Supervised and Unsupervised Machine Learning: Cluster Analysis, Hyper-Parameter Tuning, Measuring Performance of the Models, Model Selection, Data Mining techniques

Module 3	Introduction to Data Visualization	Assignment	Analysis, Data Collection	**4+15**

Topics:

Fundamentals of Data Visualization, Human Perception, Basic plotting techniques, Interaction concepts, Visualization techniques for Time Oriented data, Visualization techniques Networks, Introduction to Data Visualization Tools

Module 4	Application - Data Visualization	Case Study	Analysis, Data Collection, Programming	**4+15**

Designing effective Visualizations, Advanced Visualization Tools, Visualizing Geospatial Data, Document Visualization, Visualization Systems, Evaluating Visualizations, Visualization Benchmarking.

List of Laboratory Tasks:

Experiment No 1: Exploratory Data analysis

Level 1: Demonstration of Tools to implement EDA

Level 2: Use the Dataset to analyze and summarize data, analyze anomalies, analyze Outliers, and Missing Value Treatment

Experiment No. 2:Dimensionality Reduction Techniques

Level 1: Implement DR Technique(s)

Experiment No. 3:Machine Learning Methods

Level 1: Implement Supervised Learning Techniques for the given dataset

Level 2: Implement Un-Supervised Learning Techniques for the given dataset and Cluster Analysis

Experiment No. 4:Measure the Performance of the Models

Level 1: Perform Model Selection

Level 2: Regularize the model

Experiment No. 5: Introduction to Data Visualization Tools

Level 1: Implement Basic plotting techniques

Experiment No. 6: Time Oriented data

Level 1: Visualization techniques for Time Oriented data

Experiment No. 7: Trees, Graphs, Networks

Level 1: Visualization techniques for Trees, Graphs, Networks

Experiment No. 8: Advanced Visualization Tools

Level 1: Design effective Visualizations for the given scenario

Level 2: Implement Visualizing of Geospatial Data and Document Visualization

Experiment No. 9: Analyze Visualization Systems

Level 1: Analyze Visualization Systems

Targeted Application & Tools that can be used:

Application Area: Google Colab

Tools:

1) R Programming
2) Python
3) Tableau
4) SAS
5) Excel
6) RapidMiner
7) IBM Cognos Analytics
8) Microsoft Power BI

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

1. **Problem Solving:**Understand and break down the given real scenario into business problem statement.

2. **Programming:** Implementation of any suitable Modeling Technique.

3. **Mini project:** Choose a real-world problem in any domain and provide the solution by applying any modeling technique along with the suitable visualization tools.

Text Book

1. Wilke, Claus O. Fundamentals of data visualization: a primer on making informative and compelling figures. O'Reilly Media, 2019.
2. Ward, Grinsten, Keim. Interactive Data Visualization: Foundations, Techniques, and Applications, A K Peters/CRC Press,2nd Edition, 2015

References

1) Mohammed J. Zaki, and Wagner Meira Jr., "Data Mining and Analysis: Fundamental Concepts and Algorithms", Cambridge University Press, 2016
2) I.H. Witten and E. Frank, Data Mining: Practical Machine learning tools and techniques Morgan Kaufmann publishers; 3rd Edition, 2011

Weblinks

https://presiuniv.knimbus.com/user#/home

Course Code: **CSA4034**	**Course Title:** Information Retrieval and Recommendation Systems **Type of Course: Theory Only Course**	**L- T-P-C**	3	0	0	3
Version No.	1					
Course Pre-requisites	CSA4002 - Advanced Data Structures and Algorithms					
Anti-requisites	NIL					
Course Description	The course studies the theory, design and implementation of Text- based information systems. The Information Retrieval core concepts of the course include statistical characteristics of text, representation of information needs and documents. Topics Include Several important retrieval models (Basic IR Models, Boolean Model, TF-IDF (Term Frequency/Inverse Document Frequency) Weighting, Vector Model, Probabilistic Model, Latent Semantic Indexing Model, Neural Network Model). Retrieval Evaluation, Retrieval Metrics, Text Classification and Clustering algorithms, Web Retrieval and Crawling. Recommender Systems: Basics of Content-based Recommender Systems, Content-based Filtering, Collaborative Filtering, Matrix factorization models and neighbourhood models.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Information Retrieval and Recommendation Systems** and attain **SKILL DEVELOPMENT** through **Participative Learning** techniques					
Course Out Comes	On successful completion of the course the students shall be able to: CO1: Define basic concepts of information Retrieval. [Remember] CO2: Evaluate the effectiveness and efficiency of different information retrieval methods. [Apply] CO3: Explain different indexing methodology requirements and the concept of web retrieval and crawling. [Understand] CO4: Classify different recommender system and its aspect. [Understand]					
Course Content:						
Module 1	**Introduction**	Assignment	Data collection	**10Sessions**		

Information Retrieval Systems, Open Source IR Systems, Inverted Indices, Retrieval and Ranking, Evaluation, Index Life Cycle, Posting Lists, Index Construction, Other Types of Indices, Query Processing, Index Compression, Dynamic Inverted Indices				
Module 2	**Retrieval and Ranking**	Assignment	Problem solving	**10 Sessions**
Probabilistic Retrieval, Language Modeling and Related Methods, Categorization and Filtering, Fusion and Meta learning				
Module 3	**Evaluation**	Term paper/Assignment	Data analysis	**10 Sessions**
Measuring Effectiveness: Traditional Effectiveness Measures, TREC, Minimizing Adjudication Effort, Nontraditional Effectiveness Measures, Measuring Efficiency: Efficiency Criteria, Queuing Theory, Query Scheduling, Caching				
Module 4	**Applications**	Term paper/Assignment	Problem solving	**12 Sessions**
Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models.				
Targeted Application & Tools that can be used: **Information Retrieval System, Collaborative Filtering System, Feedback System, Evaluation Metrics**				
Assignment:				
Group assignment, Quiz				
Text Book T1 Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, —" Information Retrieval – Implementing and Evaluating Search Engines", Third Edition, The MIT Press Books, 2018. T2 Ricci, F, Rokach, L. Shapira, B.Kantor, —"Recommender Systems Handbook", Fourth Edition, 2018.				
References R1. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, —"*Information Retrieval: Implementing and Evaluating Search Engines*", The MIT Press, 2017. R2. Jian-Yun Nie Morgan & Claypool –" *Cross-Language Information Retrieval*", Publisher series 2011. R3. Stefan M. Rüger Morgan & Claypool – "*Multimedia Information Retrieval*", Publisher series 2014. R4. B. Liu, Springer, - "*Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data*", Second Edition, 2013. R5. C. Manning, P. Raghavan, and H. Schütze, —"Introduction to Information Retrieval", Cambridge University Press, 2015. Link: https://nlp.stanford.edu/IR-book/ **Web Based Resources and E-books:**				

https://puniversity.informaticsglobal.com/login
Topics relevant to the development of SKILLS: Recommender Systems, Content-based Filtering, Collaborative Filtering, Matrix factorization models and neighborhood modelsfor Skill Development through Participative Learning Techniques. This is attained through assessment component mentioned in course handout.

<table>
<tr><td>Course Code:
CSA4035</td><td colspan="5">Course Title: Mean Stack Development

Type of Course:1]Discipline Elective
2] integrated</td><td>L-T-P-C</td><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="9">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="9">CSA4001- Web Technology</td></tr>
<tr><td>Anti-requisites</td><td colspan="9"></td></tr>
<tr><td>Course Description</td><td colspan="9">It provides students with a comprehensive understanding of full-stack development, covering both frontend and backend technologies. Mean Stack course includes MongoDB (database), Express.js (backend framework), Angular (frontend framework), and Node.js (runtime environment).The course offers hands-on experience in building real-world web applications using the Mean Stack. This practical approach allows students to apply theoretical concepts in a practical setting, enhancing their learning experience. This course incorporates modern technologies and practices such as NoSQL databases, RESTful APIs, and single-page application development. By studying Mean Stack development, students become familiar with these technologies, preparing them for the demands of the tech industry.</td></tr>
<tr><td>Course Out Comes</td><td colspan="9">On successful completion of the course the students shall be able to:
1]Experiment with Git, MongoDB Database and MySQL Database [Apply]
2]Utilize Node Modules and AngularJS[Apply]
3]Develop dynamic websites[Apply]
4]Build Web Applications using Scripts and deploy with tools[Apply]</td></tr>
<tr><td>Course Content:</td><td colspan="9">Code Dependencies, MongoDB Database, MySQL Database, Node Modules, AngularJS, CSS, Bootstrap, & Responsive Design, Write Services Once, Build Scripts, Platform Deployment.</td></tr>
<tr><td>Module 1</td><td>Title of the Module</td><td colspan="3">Term paper/Assignment/Case Study</td><td colspan="2">Programming</td><td colspan="2">12</td></tr>
<tr><td colspan="10">Topics: Code Dependencies, MongoDB Database, MySQL Database

Git Version Control, Node.js, npm, grunt, gulp, Installing a Free Open Source IDE; Connect to Ubuntu Server, Install and Confi gure MongoDB Database, MongoDB Hello World; Connect to Database and Dump MySQL Database, MySQL Workbench tool, Create Your First Database and Table.</td></tr>
</table>

Module 2	Title of the Module	Term paper/Assignment/Case Study	Programming	**12**
Topics: **Node Modules, AngularJS** npm Node Packages, Install Node.js Modules, Global Installation, Create Your Own First Node Modules- Create a GitHub Project Repository, Create a Module Project, Write Your Module Code, Install Dependencies, Ignore Files, Confi gure Package.json File, Create Markdown Home Page File, Publish Module to GitHub. Angular Seed Project, Bower Component, App Layout File, Partial Views, Styles, Controllers, AngularJS Directives, AngularJS Filters, Components, Routes, Service.				
Module 3	Title of the Module	Term paper/Assignment/Case Study	Programming	**18**
Topics: **CSS, Bootstrap, & Responsive Design** CSS Sessions Used by AngularJS , Create a New Project, ng-scope, ng-dirty, ng-invalid, and ng-pristine. Install Bootstrap, UI Bootstrap, Creating a Custom UI Bootstrap Build. CSS Bootstrap, Responsive CSS Media Queries, CSS Responsive Design Utilizing a Break Point, Bootstrap Responsive Tables, Bootstrap CSS Common Styles, Angular-Responsive Library.				
Module 4	Title of the Module	Term paper/Assignment/Case Study	Programming	**18**
Topics: **Write Services Once, Build Scripts, Platform Deployment** Express App- Installing Express, Hello World Express, Express Generator Tool. Setting Up a Service Layer. Setting Up a POST Service, MongoDB Database Integration, Start MongoDB, Create a Database. Read Results from MongoDB into our Express App. Express and Socket.IO. Browserify, Grunt, Gulp. Webpack. Node.js Deployment, Connect to Node.js Ubuntu Server, Deployment with Grunt , Deployment with Gulp. AngularJS Deployment- Web Deployment with Grunt, Web Deployment with Gulp , Web Deployment with Webpack.				
List of Laboratory Tasks: **Experiment N0 1:**				

Level 1: Install Git on local machines. Initialize a local Git repository. Perform basic Git operations such as adding files, committing changes, and viewing the commit history. Practice creating branches and merging changes. Push changes to a remote repository (e.g., GitHub, GitLab).

Experiment No. 2:

Level 1: Install Node.js and npm on local machines. Create a simple Node.js application. Use npm to manage dependencies and install packages.

Level 2: Implement basic server functionalities such as handling HTTP requests and responses. Run and test the Node.js application locally.

Experiment No. 3:

Level 1: Install Grunt and Gulp globally and locally in a Node.js project. Configure Grunt and Gulp tasks for common development tasks such as minification, concatenation, and code linting.

Level 2: Write custom tasks to automate specific project requirements. Compare and contrast the syntax and functionality of Grunt and Gulp

Experiment No. 4:

Level 1: Install MongoDB on local machines or a virtual environment. Configure MongoDB to run as a service.
Access the MongoDB shell and perform basic database operations (e.g., creating databases, collections, inserting documents).

Level 2: Connect a Node.js application to MongoDB using the official MongoDB Node.js driver. Implement a "Hello World" application that interacts with MongoDB (e.g., CRUD operations).

Experiment No. 5:

Level 1: Learn about the basics of npm commands such as npm init, npm install, and npm publish. Explore the npm registry to search for and install existing Node.js modules.

Level 2: Create a simple Node.js project and install external modules using npm.

Experiment No. 6:

Level 1: Set up a basic layout file (e.g., index.html) and configure it to load AngularJS scripts. Implement partial views, styles, controllers, and services in the project.

Level 2: Create a new AngularJS project using Angular Seed or Angular CLI.

Experiment No. 7:

Level 1: Create custom directives to extend HTML with new behaviour and functionality. Implement filters to format data displayed in views.

Level 2: Explore AngularJS routes to enable single-page application (SPA) navigation. Implement services to share data and functionality across different parts of the application.

Experiment No. 8:

Level 1: Create a simple AngularJS application with HTML templates and controllers. Demonstrate the usage of ng-scope, ng-dirty, ng-invalid, and ng-pristine CSS Sessions in various scenarios.

Level 2: Apply these Sessions dynamically to elements based on AngularJS data binding and form validation. Use developer tools to inspect and understand how AngularJS applies these Sessions to the DOM.

Experiment No. 9:

Level 1: Design responsive components such as navigation menus, cards, and tables using Bootstrap Sessions and utilities.

Level 2: Test the responsiveness of the application on various devices and screen resolutions

Experiment No. 10:

Level 1: Install Express.js framework using npm. Create a simple "Hello World" Express application. Set up routes to handle HTTP requests and responses.

Level 2: Use middleware to enhance the functionality of the Express application.

Experiment No. 11:

Level 1: Set up Mongoose, a MongoDB object modeling tool, in the Express.js application.

Level 2: Implement CRUD (Create, Read, Update, Delete) operations to interact with MongoDB data from the Express.js application.

Experiment No. 12:

Level 1: Choose a build tool (Grunt, Gulp, or Webpack) for the deployment process. Configure the build tool to automate tasks such as code minification, bundling, and deployment. Set up deployment scripts to deploy the Node.js application to a remote server.

Level 2: Test the deployment process to ensure that the application is successfully deployed and running on the server.

Targeted Application & Tools that can be used: Web Applications.
MongoDB, Express.js, Angular, Node.js, Visual Studio Code, Sublime Text, Atom, Git and GitHub, Docker

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

Create dynamic, interactive, and scalable web applications.

Text Book

1. Elrom E. Pro MEAN Stack Development. Apress; 2016 Dec 1.

References

1. Haviv AQ. MEAN Web Development. Packt Publishing Ltd; 2016 Nov 30.
2. https://www.coursera.org/specializations/mean-stack
3. https://www.mongodb.com/resources/languages/mean-stack-tutorial

Course Code: CSA4036	**Course Title: R Programming for Data Science** **Type of Course: Theory-Integrated**	**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 the core concepts of data analytics in the R environment. Initially train them with basic R, then progressively increase the difficulty as they move along in the course, capping with advanced techniques through case studies. Mastering the core concepts and techniques of data analytics in R, will help the students to apply their knowledge to a wide range of Data Analytics. R is now considered one of the most popular analytics tools in the world.					

<table>
<tr><td>Course Objective</td><td colspan="4">The course is designed to familiarize the learners with the concepts of R Programming for Data Science and attain Skill Development through Experiential Learning techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">On successful completion of this course the students shall be able to:
1) Explain basic R functions pertaining to fundamental data analysis. [Understand]
2) Interpret data using appropriate statistical methods[Apply]
3) Demonstrate the decision trees concept with the given dataset. [Apply]
4) Demonstrate the Mining concepts for both Data and Text. [Apply]</td></tr>
<tr><td>Course Content:</td><td colspan="4"></td></tr>
<tr><td>Module 1</td><td>Introduction</td><td>Quiz</td><td>Coding Assignment</td><td>8</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 2</td><td>Exploratory Data Analysis</td><td>Coding Assignment</td><td>Case Study</td><td>8ons</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 3</td><td>Regression Analysis</td><td>Coding Assignment</td><td>Project</td><td>7</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td>Module 4</td><td>Classification</td><td>Quiz</td><td>Project</td><td>7</td></tr>
<tr><td colspan="5">Topics:
Introduction, Different types of Classification, Logistic Regression, Support Vector Machines, K-Neatest Neighbors, Naïve Bayes Classifier, Decision Tree Classification, Random Forest Classification, Evaluation.</td></tr>
<tr><td colspan="5">Targeted Application & Tools that can be used:
Tools: RStudio / Google Colab</td></tr>
<tr><td colspan="5">Lab Experiments: 30 Hours</td></tr>
</table>

1. Introduction to R and RStudio
   a) Setting up R and RStudio b). Basic R syntax and data types c). Arithmetic operations in R d). Working with variables and assignments. e). Printing and displaying data
2. Working with directory in R, Loading and handling data in R,
   Data Structures in R a). Vectors: creating, indexing, and operations b). Matrices and arrays c). Lists and data frames d). Factors and character vectors e). Basic data manipulation and exploration
3. Data Visualization on with ggplot2
   a). Installing and loading ggplot2 b). Creating scatter plots, bar plots, line plots, and histograms c). Customizing plot aesthetics and themes d). Faceting and combining plots

4. Data Transformation with dplyr.
   a). Introduction to dplyr package b). Selecting, filtering, and arranging data c). Grouping and summarizing data d). Joining and merging data sets.

5 Basic Statistics with R
   a) Descriptive statistics: mean, median, variance, etc. b). Probability distributions in R

6. Introduction to Machine Learning with R
   a) Installing and loading necessary packages b. Splitting data into training and testing sets c. Building a simple machine learning model d. Model evaluation and prediction

7. Correlation and covariance
a) Find the correlation matrix. b. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data.

8) Regression model - Create a regression model for a given dataset and Analyse the result

9. Multiple regression model - Apply multiple regressions, if data have a continuous Independent variable

10. Principal Component Analysis - Perform Principal Component Analysis (PCA) using R for given dataset

11. Classification Algorithms - Implement k-Nearest Neighbors (kNN) classification using R

12. Evaluate the performance of Naive Bayes classifier using R.

13. Evaluate the performance of the Decision Tree classifier using R.

14. Evaluate the performance of Random Forest Classifier using R.

15. Mini Project - . Applying R programming skills to a real-world dataset b. Data cleaning, visualization , Model implementation, analysis, and interpretation c. Presentation of findings

Project work/Test:

Mini Project - During the course, students would need to do coding assignments to learn to train and use different models. Sample coding assignments include:
Analysis of Sales Report of a Clothes Manufacturing Outlet.
Comcast Telecom Consumer Complaints.

Web Data Analysis etc
Text Book(s): **1) Hadley Wickham and Garrett Grolemund, "R for Data Science", O'reilly, 2017.** **2) Roger D Peng, "R Programming for Data Science",2022**
Reference(s): 1) **Dr. Bharati Motwani, "Data Analytics using R", Wiley, 2019.**
Weblink(s): 1) **https://www.geeksforgeeks.org/r-programming-for-data-science/** 2) **https://r4ds.had.co.nz/**

Course Code: CSA4037	**Course Title:** Social Network Analysis **Type of Course: Theory Only Course**	**L- T-P- C**	3	0	0	3
Version No.	1					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	Networks are a fundamental tool for modeling complex social, technological, and biological systems. Coupled with the emergence of online social networks and large-scale data availability in social sciences, this course focuses on the analysis of massive networks which provide many computational, algorithmic, and modeling challenges. The course will cover research on the structure and analysis of such large networks and on models and algorithms that abstract their basic properties. We will explore how to practically analyze large-scale network data and how to reason about it through models for network structure and evolution. Topics covered in this course are how information spreads through society; robustness and fragility of networks; algorithms for the World Wide Web; prediction and recommendation in online social networks; representation learning for large networks; etc.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Information Retrieval and Recommendation Systems** and attain **SKILL DEVELOPMENT** through **Participative Learning** techniques					

Course Out Comes	On successful completion of the course the students shall be able to: CO1: Identify key metrics used to describe network structures. [Understand] CO2: Summarize different types of network structures and their characteristics. [Understand] CO3: Apply link prediction algorithms to identify clusters within social networks [Apply] CO4: Summarize different types of network structures and their characteristics. [Understand]			
Course Content:				
Module 1	**Introduction**	Assignment	Data collection	**10 Sessions**
Introduction, Applications of SNA, Preliminaries, Three levels of SNA, Historical Development, Graph Visualization Tools				
Module 2	**Network Growth Models**	Assignment		**10 Sessions**
Network Basics, Node Centrality, Assortativity, Transitivity and Reciprocity, Similarity, Degeneracy, Properties of Real-World Networks, Random Network Model, Ring Lattice Network Model, Watts-Strogratz Model, Preferential Attachment Model, Price's Model, Local-World NNetwork Growth Model, Network Model with Accelerating Growth				
Module 3	**Link Analysis and Prediction**	Term paper/Assignment	Data analysis	**13 Sessions**
Applications of Link Analysis, Signed Networks, Strong and Weak Ties, Link Analysis and Algorithms, Page Rank, Personalized Page Rank, DivRank, SImRank, PathSIm, Temporal Changes in Network, Problem Definition, Evaluating Link Prediction Methods, Heuristic Models, Probabilistic Models, Supervised Random Walk, Information-theoretic Model, Latest Trends in Link Prediction				
Module 4	**Anomaly Detection**	Term paper/Assignment	Problem solving	**12 Sessions**
Outliers vs. Network-based Anomalies, Challenges, Anomaly Detection in Static Networks and Dynamic Networks, Machine Learning Pipelines, Intuition behind Representation Learning, Benefits of Representation Learning, Criterion of GRL, GRL Pipeline, Representation of Learning Models, Applications and Case Studies				
Targeted Application & Tools that can be used:				
Assignment:				
Group assignment, Quiz				
Text Book T1 Tanmoy Chakraborty , —"Social Network Analysis", Wiley India Pvt. Ltd., 2021.				

References
R1 Mohammad GouseGalety , Chiai Al Atroshi , BuniBalabantaray, —"Social Network Analysis: Theory and Applications, Wiley India Pvt. Ltd., 2022.
Topics relevant to the development of SKILLS: Price's Model, Anomaly Detection, GRL Pipeline

Course Code: CSA4038	**Course Title: Data Mining and Warehousing** **Type of Course: Theory Only Course**	**L-T-P- C**	3	0	0	3
Version No.	1					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course provides the process involved in data mining for extracting and analysing useful information. Here, all the hidden patterns are researched from the dataset, thereby predicting future behaviour. Data mining makes the best use of artificial intelligence, statistics, machine learning systems, databases, etc. Data warehousing is a process of transforming data into information, thereby making it widely available for analysis. Data mining and data warehousing are two critical concepts in the field of data management and analysis. While they are related, they serve different purposes within an organization's data infrastructure. **Topics:** Introduction to Data Mining and Warehousing, Data Warehousing Concepts, Data Modeling, Data Warehousing Implementation, Data Mining Techniques, Advanced Topics in Data Mining					
Course Objective	• To understand data warehouse concepts, architecture, business analysis and tools • To understand data pre-processing and data visualization techniques • To study algorithms for finding hidden and interesting patterns in data • To understand and apply various classification and clustering techniques using tools					
Course Out Comes	**On successful completion of the course the students shall be able to:** • **CO1**. Explain basic data mining and warehousing. **[Knowledge]** • **CO2.** Design and Implement Data Warehouses**[Application]** • **CO3.** Analyze Data Using Mining Techniques**[Application]** • **CO4.** Apply and Utilize Data Mining Tools **[Application]**					

Course Content:				
Module 1	DATA WAREHOUSING, BUSINESS ANALYSIS AND ON-LINE ANALYTICAL PROCESSING (OLAP)	Quiz	Coding Assignment	**8 Sessions**
Topics: Basic Concepts - Data Warehousing Components – Building a Data Warehouse – Database Architectures for Parallel Processing – Parallel DBMS Vendors - Multidimensional Data Model – Data Warehouse Schemas for Decision Support, Concept Hierarchies - Characteristics of OLAP Systems – Typical OLAP Operations, OLAP and OLTP.				
Module 2	DATA MINING – INTRODUCTION	Quiz	Coding Assignment	**8 Sessions**
Topics: Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques – Issues – applications- Data Objects and attribute types, Statistical description of data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures.				
Module 3	DATA MINING - FREQUENT PATTERN ANALYSIS	Quiz	Coding Assignment	**8 Sessions**
Topics: Mining Frequent Patterns, Associations and Correlations – Mining Methods- Pattern Evaluation Method – Pattern Mining in Multilevel, Multi Dimensional Space – Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns				
Module 4	CLASSIFICATION AND CLUSTERING	Quiz	Coding Assignment	**8 Sessions**
Topics: Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines –— Lazy Learners – Model Evaluation and Selection-Techniques to improve Classification Accuracy. Clustering Techniques – Cluster analysis-Partitioning Methods - Hierarchical Methods – Density Based Methods - Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering with constraints, Outlier analysis-outlier detection methods				
Module 5	WEKA TOOL	Quiz	Coding Assignment	**8 Sessions**
Topics: Datasets – Introduction, Iris plants database, Breast cancer database, Auto imports database - Introduction to WEKA, The Explorer – Getting started, Exploring the explorer, Learning algorithms, Clustering algorithms, Association–rule learners				

Targeted Application & Tools that can be used:

2. WEKA

Project work/Assignment:

Assignment:

Students will have to use WEKA tool for analyzing dataset

Text Book

T1 Jiawei Han and Micheline Kamber, —Data Mining Concepts and Techniques‖, Third Edition, Elsevier, 2012

References

1. Alex Berson and Stephen J.Smith, —Data Warehousing, Data Mining & OLAP‖, Tata McGraw – Hill Edition, 35th Reprint 2016.
3. K.P. Soman, Shyam Diwakar and V. Ajay, —Insight into Data Mining Theory and Practice‖, Eastern Economy Edition, Prentice Hall of India, 2006.
4. 3. Ian H.Witten and Eibe Frank, —Data Mining: Practical Machine Learning Tools and Techniques‖, Elsevier, Second Edition.

Topics relevant to "SKILL DEVELOPMENT": Basics of personas, Creating personas. Gestalt principles of perception, Usability Testing, creating mockups and prototypes in Figma for **Skill Development** through **Problem solving techniques. This is attained through assessment component mentioned in course handout.**

<table>
<tr><td>Course Code:
CSA4068</td><td colspan="3">Course Title: MERN Full Stack Development
Type of Course:1]Discipline Elective
2] integrated</td><td>L-T-P-C</td><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">CSA4001 - Web Technology</td></tr>
<tr><td>Anti-requisites</td><td colspan="8"></td></tr>
<tr><td>Course Description</td><td colspan="8">It provides students with a comprehensive understanding of full-stack development, covering both frontend and backend technologies. Mern Stack course includes MongoDB (database), Express.js (backend framework), ReactJS (frontend), and Node.js (runtime environment).The course offers hands-on experience in building real-world web applications using the Mern Stack. This practical approach allows students to apply theoretical concepts in a practical setting, enhancing their learning experience. This course incorporates modern technologies and practices such as NoSQL databases, RESTful APIs, and single-page application development. By studying Mern Stack development, students become familiar with these technologies, preparing them for the demands of the tech industry.</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">On successful completion of the course the students shall be able to:
1]Experiment with Git, MongoDB Database and MySQL Database [Understand]
2]Utilize Node Modules and ReactJS[Apply]
3]Develop dynamic websites[Apply]
4]Build Web Applications using Scripts and deploy with tools[Apply]</td></tr>
<tr><td>Course Content:</td><td colspan="8">MongoDB Database, NodeJS, ReactJS, CSS, Bootstrap, & Responsive Design, NoSQL, Node Package Manager.</td></tr>
<tr><td>Module 1</td><td>Title of the Module</td><td colspan="3">Term paper/Assignment/Case Study</td><td colspan="2">Programming</td><td colspan="2">7</td></tr>
<tr><td colspan="9">Topics: Basics of Full Stack

Understanding the Basic Web Development Framework - User - Browser – Webserver - Backend Services – MVC Architecture - Understanding the different stacks –The role of Express – Node – Mongo DB – React</td></tr>
</table>

Module 2	Title of the Module	Term paper/Assignment/Case Study	Programming	**7**

Topics: **Node JS Modules**

Basics of Node JS – Installation – Working with Node packages – Using Node package manager – Creating a simple Node.js application – Using Events – Listeners –Timers - Callbacks – Handling Data I/O – Implementing HTTP services in Node.js

Module 3	Title of the Module	Term paper/Assignment/Case Study	Programming	**8**

Topics: **No SQL Database - Mongo DB**

Understanding NoSQL and MongoDB – Building MongoDB Environment – User accounts – Access control – Administering databases – Managing collections – Connecting to MongoDB from Node.js – simple applications

Module 4	Title of the Module	Term paper/Assignment/Case Study	Programming	**8**

Topics: **Front End Library - React Js**

Mern Stack – Basic React applications – React Components – React State – Express REST APIs - Modularization and Webpack - Routing with React Router – Server-side rendering

List of Laboratory Tasks: **30 Hours**

Experiment No. 1:

Install Git on local machines. Initialize a local Git repository. Perform basic Git operations such as adding files, committing changes, and viewing the commit history. Practice creating branches and merging changes. Push changes to a remote repository (e.g., GitHub, GitLab).

Experiment No. 2:

Install Node.js and npm on local machines. Create a simple Node.js application. Use npm to manage dependencies and install packages.

Experiment No. 3:

Implement basic server functionalities such as handling HTTP requests and responses. Run and test the Node.js application locally

Experiment No. 4:

Install MongoDB on local machines or a virtual environment. Configure MongoDB to run as a service.
Access the MongoDB shell and perform basic database operations (e.g., creating databases, collections, inserting documents).

Experiment No. 5:

Connect a Node.js application to MongoDB using the official MongoDB Node.js driver.

Experiment No. 6:

Implement a "Hello World" application that interacts with MongoDB (e.g., CRUD operations).

Experiment No. 7:

Learn about the basics of npm commands such as npm init, npm install, and npm publish.
Explore the npm registry to search for and install existing Node.js modules.

Experiment No. 8:

Create a simple Node.js project and install external modules using npm.

Experiment No. 9:

Level 1: Create React Application implements input box for a floating number input.
Level 2: Create a simple ReactJS Application to Pass Data from One Component to Another Component in.

Experiment No. 10:

Design responsive components such as navigation menus, cards, and tables using Bootstrap Sessions and utilities.

Experiment No. 11:

Create a ReactJs application for food delivery website where users can order food from a particular restaurant listed in the website

Experiment No. 12:

Create a web application to manage the TO-DO list of users, where users can login and manage their to-do items using MERN stack (MongoDB, ReactJS, NodeJS)

Targeted Application & Tools that can be used: Web Applications.
MongoDB, Express.js, React JS, Node.js, Visual Studio Code, Sublime Text, Atom, Git and GitHub.

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

Create dynamic, interactive, and scalable web applications.

Text Book

2. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, Apress, 2019.
3. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018.

References

4. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018.
5. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018.
6. https://www.tutorialspoint.com/the_full_stack_web_development/index.asp
7. https://www.coursera.org/specializations/full-stack-react
8. https://www.udemy.com/course/the-full-stack-web-development/

AI & ML Basket

Course Code: CSA4039	**Course Title:** Computer Vision **Type of Course: Program Core** **Theory and Lab Integrated Course**	**L- T- P- C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	Linear algebra, vector calculus, and probability, Data structures					
Anti-requisites	**NIL**					
Course Description	This course provides an introduction to computer vision, including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification, scene understanding, and deep learning with neural networks. We will develop basic methods for applications that include finding known models in images, depth recovery from stereo, camera calibration, image stabilization, automated alignment, tracking, boundary detection, and recognition. We will develop the intuitions and mathematics of the methods in class, and then learn about the difference between theory and practice in homeworks.					
Course Objective	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1: To apply mathematical modeling methods for low-, intermediate- and high- level image processing tasks. CO2: To perform software experiments on computer vision problems and compare their performance with the state of the art. CO3: To gather a basic understanding about the geometric relationships between 2D images and the 3D world.					
Course Content:						
Module 1	Digital Image Processing	Programming Assignment	Data Collection and Analysis	**12 sessions**		
Image Formation, Image Filtering, Edge Detection, Principal Component Analysis, Corner Detection SIFT, Applications: Large Scale Image Search.						

Module 2	Geometric Techniques in Computer Vision	Programming Assignment	Data Collection and Analysis	**12 sessions**
Image Transformations, Camera Projections, Camera Calibration, Depth from Stereo, Two View Structure from Motion, Object Tracking.				
Module 3	Machine Learning for Computer Vision	Programming Assignment	Data analysis	**14 sessions**
Introduction to Machine Learning, Image Classification, Object Detection, Semantic Segmentation.				

List of Laboratory Tasks:

1. Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale)
2. Implementation of Relationships between Pixels
3. Implementation of Transformations of an Image
4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization
5. Display of bit planes of an Image
6. Display of FFT (1-D & 2-D) of an image
7. Computation of Mean, Standard Deviation, Correlation coefficient of the given Image
8. Implementation of Image Smoothening Filters (Mean and Median filtering of an Image)
9. Implementation of image sharpening filters and Edge Detection using Gradient Filters
10. Image Compression by DCT, DPCM, HUFFMAN coding
11. Implementation of image restoring techniques
12. Implementation of Image Intensity slicing technique for image enhancement

Targeted Application & Tools that can be used:

Project work/Assignment:

Text Book

T1 Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.

T2 Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, 2ndEdition, Cambridge University Press, March 2004.

References

R1. R. Bishop; Pattern Recognition and Machine Learning, Springer,2006

R2. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

R3. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.

Web references:

https://onlinecourses.swayam2.ac.in/cec20_cs08/preview

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Library reference: https://presiuniv.knimbus.com/user#/home

Topics relevant to development of “Employability”: Topics relevant to “HUMAN VALUES &PROFESSIONAL ETHICS””:

Course Code: **CSA4040**	**Course Title:** **Natural Language Processing** **Type of Course:** Theory & Integrated Laboratory	**L-T-P-C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSA4009 – Artificial Intelligence and Machine Learning.					
Anti-requisites	NIL					
Course Description	This course introduces a basics of Natural Language Processing methods with specific emphasis on modern applications. The course will cover pre-processing techniques of textual data like stemming, lemmatization, tokenization etc. Different word Vectorization Techniques like Bag of Words, TF-iDF etc. followed by basics of Probability for building language models. Basics of Neural Network, LSTM Recurrent Neural Network, Applications of NLP like Machine Translation, Sentiment Analysis, etc.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Natural Language Processing** and attain **Employability** through **Experiential Learning techniques.**					
Course Out Comes	On successful completion of the course the students shall be able to: 1. CO1: Describe how to solve problems involving natural language using NLP techniques. [Knowledge] 2. CO2: Use NLP tools and packages like NLTK, Huggingface Transformers, etc. [Application] 3. CO3: Use deep learning techniques such as word embeddings and LLMs to solve NLP tasks. [Application] 4. CO4: Participate in an NLP shared task [Application]					
Course Content:						
Module 1	**Introduction to Natural Language Processing**	Assignments		**12 Sessions [L=6, P=6]**		
Topics: Introduction to Natural Language Processing, terminologies, empirical rules, why NLP is hard, why NLP is useful, NLP Processing pipeline, Corpus Cleaning techniques – word tokenization, sentence tokenization, word frequency distribution, stemming, lemmatization, dictionary, Introduction to Part of Speech Tagging, Textual Pre-Processing techniques – Stop words removal, regular expression, lower case, text standardization.						

Module 2	**Word and Text Representations**	Assignments		**18 Sessions [L=9, P=9]**
Topics: Word relationships, Word Embeddings techniques- bag of words, TF-iDF, Word2Vec and optimization. Simple N-gram models. Estimating parameters and smoothing. Negative Sampling Evaluating language models. Logistic regression – Sigmoid and Softmax. Perceptron and backpropagation. RNN, LSTM, CNN. Attention. Pre-trained language models. Multilinguality.				
Module 3	**Sequence Labeling**	Project		**16 Sessions [L=8, P=8]**
Topics: Sequence Labeling, Hidden Markov Models. Best Emission Probability, Best Forward Probability and Viterbi Decoding Algorithms. Analysis of Viterbi Algorithm. Named Entity Recognition. Constituency Parsing.				
Module 4	**Applications of NLP**	Project	Endless Runner Game	**14 Sessions [L=7, P=7]**
Topics: Application of NLP. Lexical Resource Creation. Machine Translation. Sentiment Analysis. Lexical Simplification. Text Summarization.				

List of Laboratory Tasks:

1. Reading text files
2. Text classification – models and evaluation metrics
3. Sentiment Analysis using Naïve Bayes Classifier with Bag of Words
4. Sentiment Analysis using VADER
5. Document Retrieval Using TF-IDF
6. Using NLTK PoS Tagger
7. Building a PoS Tagger with Brown Corpus Universal Tagset and Viterbi Algorithm
8. Generating a Parse Tree for a sentence
9. Named Entity Recognition in a Document
10. Machine Translation using Huggingface's Helsinki Opus MT models.

Targeted Application & Tools that can be used:

Application Areas:

1. Sentiment Analysis
2. Text Classification
3. Chatbots & Virtual Assistants
4. Text Extraction

5. Machine Translation
6. Text Summarization
7. Speech Recognition
8. Text Summarization…

Software:

1. Anaconda Navigator
2. Google Colab
3. NLP toolkit (NLTK)
4. Huggingface Transformers

Assignment:

Students can participate in a shared task, or submit a paper through ARR.

Text Book

T1. Daniel Jurafsky, and James H. Martin. Speech and Language Processing. (3rd Edition Draft, February 2024)

T2. Aditya Joshi, and Pushpak Bhattacharyya. Natural Language Processing. 1st Edition. Wiley Publishers. December 2023.

References

R1. Chris Manning and Hinrich Schutze, "Foundations of Statistical Natural Language Processing", 1st Edition, MIT Press. 1999.

R2. Pawan Goyal. "Natural Language Processing". 1st Edition, 2016.

Weblinks

W1. E-Book link or R2: https://drive.google.com/file/d/10nbwAJd-dv6htOOZVBgAvLd1WscI0RqC/view

W2. Web Resource for T1: https://web.stanford.edu/~jurafsky/slp3/ - VERY VERY IMPORTANT!!!

W3. NPTEL Courses: https://nptel.ac.in/courses/106106211 CMI), https://nptel.ac.in/courses/106105158 (IIT Kgp), https://nptel.ac.in/courses/106101007 (IITB), https://nptel.ac.in/courses/106105572 (IIT Kgp - NEW)

Topics relevant to the development of Employability:

Using Pre-trained language models, for developing **SKILL DEVELOPMENT** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout

The objective of the course is to familiarize the learners with the concepts of **Natural Language Processing** and attain **Employability** through **Experiential Learning techniques.**

Course Code: **CSA4041**	**Course Title:** Deep Learning **Type of Course:** Theory & Integrated Laboratory	**L-T-P-C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSA 3002_ Machine learning					
Anti-requisites	NIL					
Course Description	The course introduces the core intuitions behind Deep Learning, an advanced branch of Machine Learning involved in the development, implementation and application of Artificial Neural Networks that function by simulating the working principle of human brain. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. The course includes theory and lab components which emphasizes on understanding the implementation and application of deep neural networks in various prominent problem domains like speech recognition, sentiment analysis, recommendations, and computer vision etc. The course facilitates the students to interpret and appreciate the successful application and implementation of deep neural nets in various prediction and classification tasks of ML.					
Course Objective	On successful completion of the course the students shall be able to familiarize the learners with the concepts of **Deep Learning Techniques** and attain **Skill Development** through **Participative Learning** techniques.					
Course Out Comes	On successful completion of this course, the student will be able to: 1. Describe the feed-forward and deep networks. [Understand] 2. Design single and multi-layer feed-forward deep networks and tune various hyper-parameters. [Apply] 3. Implement deep neural networks to solve a problem. [Apply] 4. Analyze performance of deep networks. [Analyze]					
Course Content:						

Module 1	**Introduction to Deep Learning**	Assignments	Feed forward Networks	**7 Sessions**
Introduction: Historical context and motivation for deep learning; basic supervised classification task, optimizing logistic classifier using gradient descent, stochastic gradient descent, momentum, and adaptive sub-gradient method. Neural Networks: Feedforward neural networks, deep networks, regularizing a deep network, model exploration, and hyper parameter tuning.				
Module 2	**Convolution Neural Networks**	Assignments	Image classification implementation	**7 Sessions**
Convolution Neural Networks : Introduction to convolution neural networks: stacking, striding and pooling, applications like image, and text classification.				
Module 3	Sequence Modeling	Quiz	RNN	**8 Sessions**
Recurrent Nets: Unfolding computational graphs, recurrent neural networks (RNNs), bidirectional RNNs, encoder-decoder sequence to sequence architectures, deep recurrent networks, LSTM networks.				
Module 4	Autoencoders	Project	Real time Scenario	**8 Sessions**
Autoencoders: Undercomplete autoencoders, regularized autoencoders, sparse autoencoders, denoising autoencoders, representational power, layer, size, and depth of autoencoders, stochastic encoders and decoders.				

List of Laboratory Tasks: 30 Hours

1. Implement logistic regression classification with (a) gradient descent and (b) stochastic gradient descent method. Plot cost function over iteration.
2. Experiment with logistic regression by adding momentum term, and adaptive sub gradient method
3. Implement a feed-forward neural network for solving (a) regression and (b) 2-class classification problem. Also experiment with hyper-parameter tuning.
4. Train and test a feed-forward neural network for multi-class classification using softmax layer as output.
5. Create a 2D and 3D CNN for image classification. Experiment with different depth of network, striding and pooling values.
6. CNN-based model for sentiment analysis on a text dataset such as movie reviews or tweets.

7. Implement (a) RNN for image classification, (b) GRU network and (c) Implement LSTM networks
8. Simple Recurrent Neural Network (RNN) for predicting next word in a sentence.
9. Bidirectional RNN for Sequence Classification
10. Encoder-Decoder Architecture for Machine Translation
11. LSTM Networks for Time-Series Prediction
12. Implement an auto-encoder, denoising autoencoders and sparse autoencoders.
13. Design a stochastic encoders and decoders.

Targeted Application & Tools that can be used:

Python

Assignment:

1. Assignments are given after completion of each module which the student need to submit within the stipulated deadline.

Text Book

T1. Bunduma, N. (2017). Fundamentals of Deep Learning. O'reilly Books

T2. Heaton, J. (2015). Deep Learning and Neural Networks, Heaton Research Inc.

T3. Goodfellow, I. (2016). Deep Learning. MIT Press.

References

R1. Deng, L., & Yu, D. (2009). Deep Learning: Methods and Applications (Foundations and Trends in Signal Processing). Publishers Inc.

R2. Hall, M.L, (2011). Deep Learning. VDM Verlag

R3. David Foster, "Generative Deep Learning" O'Reilly Publishers, 2020.

R4. John D Kellehar, "Deep Learning", MIT Press, 2020.

Additional web-based resources

W1. Deep Learning (12 Weeks) | NPTEL((https://onlinecourses.nptel.ac.in/noc22_cs22/preview)

W2. Deep Learning (8 Weeks) | Coursera ((https://www.coursera.org/learn/neural-networks-deep-learning?specialization=deep-learning)

W3. https://www.deeplearning.ai/

W4. http://imlab.postech.ac.kr/dkim/class/csed514_2019s/DeepLearningBook.pdf

Topics relevant to the development of Employability:

Image and text classification

The objective of the course is to familiarize the learners with the concepts of **Deep Learning Techniques** and attain **Skill Development** through **Participative Learning** techniques.

Course Code: CSA4042	**Course Title: Reinforcement Learning** **Type of Course: 1] Program Core** **2] Laboratory integrated**	**L- T-P-C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSE3001: Artificial Intelligence and Machine Learning					
Anti-requisites	**NIL**					
Course Description	For both engineers and researchers in the field of Computer science, it is common to develop models of real-life situations and develop solutions based on those models. It is of utmost importance to come up with innovative solutions for scenarios that are highly stochastic. The objective of this course, is to introduce different reinforcement learning techniques which is a promising paradigm for stochastic decision making in the forthcoming era. Starting from the basics of stochastic processes, this course introduces several RL techniques that are as per the industry standard. With a good knowledge in RL, the students will be able to develop efficient solutions for complex and challenging real-life problems that are highly stochastic in nature.					
Course Objectives	This course isdesigned to improve the learners 'EMPLOYABILITY SKILLS' byusing EXPERIENTIAL LEARNING techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Apply dynamic programming concepts to find an optimal policy in a gaming environment[Applying] 2. Implement on-policy and off-policy Monte Carlo methods for finding an optimal policy ina reinforcement learning environment. [Applying] 3. Utilize Temporal Difference learning techniques in the Frozen Lake RL environment[Applying] 4. Solve the Multi-Armed Bandit (MAB) problem using various exploration-exploitationstrategies [Applying]					
Course Content:						

Module 1	Introduction to Reinforcement Learning	Assignment	Programming using the OpenAI Gym environment	**No. of SessionsL – 5 P – 6**
Topics : Elements of RL, Agent, environment Interface, Goals and rewards, RL platforms, Applications of RL, Markov decision process (MDP), RL environment as a MDP, Maths essentials of RL, Policy and its types,episodic and continuous tasks, return and discount factor, fundamental functions of RL – value and Q functions, model-based and model-free learning, types of RL environments, Solving MDP using Bellman Equation, Algorithms for optimal policy using Dynamic Programming -Value iteration and policy iteration, Example : Frozen Lake problem, Limitations and Scope				
Module 2	Monte-Carlo(MC) methods	Assignment	Programming using the OpenAI Gym environment	**No. of Sessions L-5 P-6**
Topics: Monte Carlo methods, prediction and control tasks, Monte Carlo prediction : algorithm, types of MC prediction, examples , incremental mean updates, Monte Carlo Control : algorithm, on-policy MC control, MC with epsilon-greedy policy, off-policy MC control. Limitations of MC method.				
Module 3	Temporal Difference(TD) Learning	Assignment /Quiz	Programming using the OpenAI Gym environment	**No. of Sessions L-7 P -6**
Topics: Temporal difference learning: TD Prediction, TD Control : On-policy TD control – SARSA, computing theoptimal policy using SARSA, Off-policy TD control – Q learning, computing optimal policy using Q learning, Examples, Difference between SARSA and Q-learning, Comparison of DP, MC and TD methods.				
Module 4	Multi-Armed Bandit(MAB) problem	Assignment	Programming using the OpenAI Gym environment	**No. of Sessions L-6 P -4**
Topics: Understanding the MAB problem, Various exploration strategies – epsilon-greedy, softmax exploration, upper confidence bound and Thompson sampling, Applications of MAB - finding the best advertisement banner for a web site, Contextual bandits, introduction to Deep Reinforcement Learning(DRL) Algorithm – Deep Q Network (DQN)				

List of Laboratory Tasks:

1 .**Software Setup : installalling Anaconda, OpenAI Gym and Universe.**

Basic simulations of some gaming environments in Gym

2. **Working with Gym environments to create agents with random policy**

2.1 Create the Frozen Lake GYM environment and explore the states, action, transition probability,reward functions and generating episodes.

2.2 Create an agent for the Cart-Pole environment using a random policy and record the game

3. **Finding the optimal policy for the agent using Dynamic Programming**

3.1 Compute the optimal policy for the Frozen Lake Environment using value iteration method

3.2 Compute the optimal policy for the Frozen Lake Environment using policy iteration method

4. **Implementing Monte Carlo prediction method using blackjack game**

4.1 Every-visit MC prediction

4.2 First-visit MC prediction

5. **Implementing on-policy MC control method using the epsilon-greedy policy for the blackjack game**

6. **Implementing Temporal Difference prediction for the Frozen lake environment for a random policy**

7. **Computing the optimal policy using on-policy TD control – SARSA**

8. **Computing the optimal policy using off-policy TD control – Q-learning**

9. **Multi-Armed Bandit problem**

9.1 Creating a MAB in Gym

9.2 Compute the best arm using various exploration strategies such as epsilon-greedy and softmaxexploration method.

10. **Application of MAB – Finding the best advertisement banner for a web site using MAB**

Targeted Application & Tools that can be used :

1. Execution of the RL algorithms will be done using the environments provided by OpenAI's Gym and Gymnasium of Farama Foundation in "Colab", available at https://colab.research.google.com/ or JupyterNotebook.
2. Laboratory tasks will be implemented using the necessary libraries available in Python

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

Students can be given group assignments to develop different gaming environments and implement the RL algorithms

Text Book 1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", MIT press, Second Edition, 2018. 2. Sudharshan Ravichandiran, "Deep Reinforcement Learning with Python", Packt Publishers, Second Edition, 2020
References 1. Laurra Graesser and Wan Loon Keng, "Foundations of Deep Reinforcement Learning", Pearson, 2022 2. https://www.udemy.com/course/artificial-intelligence-reinforcement-learning-in-python/

Course Code: CSA4043	**Course Title: Generative AI** **Type of Course: 1] Discipline Elective** **2] Laboratory integrated**		**L-T-P-C**	**2**	**0**	**2**	**3**
Version No.		1.0					
Course Pre-requisites		**CSE3001 – Artificial Intelligence and Machine Learning**					
Anti-requisites		NIL					
Course Description		This course builds the foundational insight of understanding generative AI models and to explore various architectures, algorithms and practices of Gen AI skills to accelerate strategic decision making with data and deliver cutting-edge products faster with GenAI-augmented software development and leverage Gen AI tools to optimize workflows.					
Course Objective		The objective of the course is to familiarize the learners to explore the competence in benchmarking and comprehend the potential generative AI models and techniques to revolutionize industries and create prominent Gen AI tools to attain **Employability Skills** through **Experiential Learning** techniques.					
Course Out Comes		**On successful completion of the course the students shall be able to:** CO 1: Infer the concepts of generative AI models and prompt engineering in tailoring customized outputs [Understand]. CO 2: Demonstrate attention mechanism and transformers architecture with practical Applications. [Apply]. CO 3: Practice advanced generative AI techniques using Langchain Python framework [Apply]. CO 4: Solve real-time applications using multi-modal generative AI models [Apply].					

Course Content:					
Module 1	Introduction to Generative AI	Participative Learning		Brainstorming session/Quiz	**No. of Sessions L-6 P-8**
	Topics: Introduction to Generative models: Historical perspective and evolution, Applications, Types of Generative models for different data modalities, Large Language Models (LLMs) – Introduction, evolution, Generative pre-trained transformers (GPT) and its variants, Google DeepMind's, PaLM2, LLaMa and its series of models by Meta AI, Claud and its variants by Anthropic, Prompt Engineering-basic prompting.				
Module 2	Text-based Generative models	Participative Learning		Fish bowl, Think-pair & share	**No. of Sessions L-8 P-6**
	Topics: Text-based Generative models: State-of-the Art models, RNN, LSTM, Transformer Architecture, Transformer based Generative models: BERT, GPT, Training and Fine tuning LLMs for Generative task, Open AI's Pre-trained transformers for Text Generation: ChatGPTs, Limitations of LLMs: Lack of context and Hallucination risks, Techniques to mitigate these limitations: chaining and retrieval augmentation, Workflow of an LLM application.				
Module 3	Introduction to Lang Chain	Experiential Learning		Implementation of Gen AI models using Langchain Framework	**No. of Sessions L-8 P-8**
	Topics: Introduction to Lang chain: Types, Components, Information retrieval using agents and tools in Lang chain, Retrieval Augmented Language Models (RaLM): Understanding Retrieval and vectors: Embeddings, Vector storage, Vector indexing, Vector Libraries, Vector Databases, Chatbot using memory and conversation buffer.				
Module 4	Generative models for other Data modalities	Project-based Learning		Multi-Modal Gen AI models for Realtime Applications	**No. of Sessions L-8 P-8**
	Topics: Generative Adversarial Networks (GAN): GAN Architecture, GAN variants, Neural Style transfer with GAN, Training GANs and common challenges, GAN applications in image and text generation, Variational Auto Encoders (VAEs) and its variants, Image generation models: Dall-E, MidJourney and stable diffusion: Architecture and components of stable diffusion, Text-to-image Generation, Parameter tuning, Image-to-image generation, Training custom models, In-Painting: Exchanging Sessions, Multi-modal generative models using Whisper for Audio: Speech-to-Text generation.				

	List of Laboratory Tasks:
	Experiment No.1: Setting up Python IDE(Spyder) and OpenAI API key. Introduction to OpenAI playground and prompting **Level 1**: **Document** the installation and the process for generating models in OpenAI **Level 2: Solve** various GenAI models of OpenAI from Playground using prompts
	Experiment No.2: Text classification, summarization, sentiment analysis, chatbot application, code explanation with generating single and multiple response(S). **Level 1**: **Practice** the text generation model of OpenAI and Spyder IDE to implement various applications.
	Experiment No.3: Embeddings – for words, similarity between words, text embeddings, plagiarism check of documents **Level 1: Use** generating embeddings for words, text and documents **Level 2: Apply** the embeddings API to develop applications for plagiarism check
	Experiment No.3: Image generation using Dall E. Using GPT-Vision model for text to image generation and image-to-text. **Level 1: Apply** GPT-vision model for text-to-image generation and image-to-image
	Experiment No.5: Transformer based text and email classification **Level 1: Develop** transformer-based AI models for classifying text/email
	Experiment No.6: BERT for masked token generation **Level 1: Develop** BERT based model for generating masked tokens
	Experiment No.7: Creating applications using different types of LangChains – Simple Sequential, Sequential and map reduce **Level 1: List** the various types of chains in Langchain **Level 2: Practice** different types of chains using Spyder IDE and OpenAI
	Experiment No.8: Information retrieval using agents and tools in Langchain. **Level 1: Use** agents and tools with Langchain for information retrieval
	Experiment No.9: Custom Document loading and retrieval in LangChain using ChromaDB **Level 1: Understand** ChromeDb **Level 2: Apply** chromed with Langchain to generate information retrieval model from custom document
	Experiment No.10: Create a GPT like Chatbot using the memory component and RALM in LangChain **Level 1: Show** GPT like chatbot using memory component and retrieval augmented language model
	Experiment No.11: Using action agents, human as a tool and plan and execute agents for information retrieval. **Level 1: Understand** action agents and plan and execute agents **Level 2: Use** agents and tools for information retrieval
	Experiment No.12: Implement GAN for neural style transfer

	Level 1: Demonstrate a style transfer algorithm using generative models and experiment with the transformation of images by applying different artistic styles, assessing both the technical aspects and the aesthetic outcomes
	Experiment No.13: Text to Image generation using Dall-e/stable diffusion using prompts **Level 1: List** various image generation models **Level 2: Use** an image generation model to generate image from prompts
	Experiment No.14: Image to Image generation using stable diffusion **Level 1: Apply** stable diffusion to generate image from an image using prompts
	Experiment No.15: Speech to text and multi-modal generative models using Whisper for Audio **Level 1: Identify** the generative model for text, image and audio data **Level 2: Use** Langchain to create models for generating different data modalities. Ex: Audio-to-text
	Targeted Application & Tools that can be used Open AI Generative AI models: GPT 3.5 Turbo, GPT 4.0 vision model, Dall-E 3.0, Lang Chain Framework in Python, Python IDE, Stable Diffusion, Gemini, Hugging Face,
	Mini-Project work

	Mini-Project Titles: 1. Conversational Chatbot that interacts with documents: create a conversational chatbot to enage users in meaningful dialogues, answer queries, offer recommendations, and aid tasks using provided documents as inputs. 2. Sentiment Analysis/Intent Analysis/Toxicity Analysis 3. Natural Language Translation – Instruction Tuning using FLAN (Finetuned language Net) model 4. Questions and Answering systems – Extractive & Generative 5. Text Summarization – Medicine – Med-PaLM 6. Given the Academic guidelines of the University, generate the student Handbook with FAQs and solutions. 7. Generating Cartoon based story telling 8. Simulate various driving conditions to improve safety and performance in Autonomous vehicles 9. In Financial management, generate synthetic financial data for stress testing and scenario analysis 10. Personalized recommendations/Product suggestions/tailored content based personalized design studio 11. Simulate characters for Games 12. Create conversational agents 13. Tutor in a range of preferred subjects 14. Generate codes 15. Draft documents 16. Answer questions about any knowledge base 17. Create an application which uses LangChain to connect OpenAI API to DALL-E. This image generation application turns written descriptions into lifelike pictures and artwork. 18. Embark on building a personalized language model with Falcon-7b. Utilize personalized LLM technique to explore text generation capabilities by providing task examples as inputs. 19. Use OpenAI's DALL-E and Gradio UI to develop an innovative logo builder. Th app creates unique and stunning logos from text prompts, revolutionizing the logo design process. 20. Crafting an AI powered HR Assistant: Develop a virtual assistant designed to answer queries related to Audi HR policy. Leverage Python libraries and OpenAI's GPT model for accurate and efficient query responses.
	TEXT BOOKS: **T1:** Generative AI with LangChain, Ist Edition by Ben Auffarth, Packt. Inc. ISBN: 978-1-83508-346-8, Decemeber 2023.

	T2: Generative Deep Learning, 2nd Edition by David Foster, O'Reilly Media, Inc. ISBN: 9781098134181, May 2023. **T3:** Prompt Engineering for Generative AI, by James Phoenix, Mike Taylor, O'Reilly Media, Inc., ISBN:9781098153373, July 2024.
	REFERENCES: R1. Bandi, A., Adapa, P. V. S. R., & Kuchi, Y. E. V. P. K. (2023). The power of Generative AI: a review of requirements, models, Input–Output formats, evaluation metrics, and challenges. Future Internet, 15(8), 260. https://doi.org/10.3390/fi15080260 R2. Barachini, F., & Stary, C. (2022). From digital twins to digital selves and beyond. In Springer eBooks. https://doi.org/10.1007/978-3-030-96412-2 R3. Hadi, M. U., Tashi, Q. A., Qureshi, R., Shah, A., Muneer, A., Irfan, M., Zafar, A., Shaikh, M. B., Akhtar, N., Wu, J., & Mirjalili, R4. S. (2023). Large Language Models: A Comprehensive Survey of its Applications, Challenges, Limitations, and Future Prospects. https://doi.org/10.36227/techrxiv.23589741.v4 R4. Hai-Jew, S. (n.d.). Generative AI in Teaching and Learning. IGI Global. R5. Salvaris, M., Dean, D., & Tok, W. H. (2018). Generative adversarial networks. In Apress eBooks (pp. 187–208). https://doi.org/10.1007/978-1-4842-3679-6_8
	MOOC's/Swayam Courses/Online Courses: **https://onlinecourses.swayam2.ac.in/imb24_mg116/preview** **Certification Course by Google :** **1. https://www.cloudskillsboost.google** **a. Introduction to Generative AI (Beginner)** **b. Gemini for Google Cloud (Intermediate)** **c. Generative AI for Developers (Advanced)** **2. https://www.credly.com/badges/90e3eae0-87f3-44e3-af82-658e837aad3d/public_url** **3. https://www.coursera.org/learn/generative-ai-with-llms** **4. https://www.coursera.org/specializations/prompt-engineering** **ONLINE RESOURCES:** W1. https://openai.com W2: https://python.langchain.com/v0.2/docs/introduction/ W3: https://www.udemy.com/course/master-ai-image-generation-using-stable-diffusion/?kw=Image+generation+using&src=sac&couponCode=LETSLEARNNOWPP W4: https://huggingface.co/google-t5/t5-base

	W5: https://dominguezdaniel.medium.com/exploring-image-generative-ai-models-9359705b15d3 W6: https://cloud.google.com/use-cases/retrieval-augmented-generation?hl=en# W7: https://ig.ft.com/generative-ai/ W8: https://medium.com/@samia.khalid/bert-explained-a-complete-guide-with-theory-and-tutorial-3ac9ebc8fa7c
	Topics relevant to "EMPLOYABILITY SKILLS": Topics of all four modules will help in developing **Employability Skills** through **Experiential Learning techniques**. This is attained through assessment component mentioned in course handout.

Metaverse&Blockchain Basket

Course Code: CSA4049	**Course Title: Cyber Digital Twin** **Type of Course: Theory Only Course**	**L-T- P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	-					
Anti-requisites	**NIL**					
Course Description	The objective of the course is EMPLOYBILITY of student by using PARTICIPATIVE LEARNING techniques.					
Course Objective	This course is designed to improve the learners 'Skill Development' by using modeling, optimizing, and risk management approach. The course objective is to get familiar with the Cyber digital twin-working principal, Development considerations, Data-Modelling Environment, Digital Twin Optimization, Risk Management and Applications.					
Course Out Comes	On successful completion of the course the students shall be able to: 1. Understand the basic concepts of Cyber Digital twin, and its working principle. **[KNOWLEDGE]** 2. Explain Data modeling and development consideration in digital twin model for cloud and IoT technology.**[COMPREHENSION]** 3. Observe digital twin-human behavior modeling in digital twin-optimization **[COMPREHENSION]** 4. Show Risk Assessment-Digital twin reference model-Implementation. **[APPLICATION]** 5. Apply Digital twin in various area like Manufacturing, Automotive and Healthcare.**[APPLICATION]**					
Course Content:						
Module 1	Introduction	Assign ment	Theory	**No. of Sessions:09**		
Introduction- Cyber Digital twin-definition-uses and benefits-need for digital twin-working principal Technology Digital thread-digital shadow-building blocks of digital twin-digital twin technology drivers and enablers.						

Module 2	Data Modelling Environment	Assign ment	Theory	**No. of Sessions:10**
Types of digital twin-Based on Product and Process-Based on Functionality-Based on Maturity. Development considerations-Overview of Data-Modelling Environment. Modelling-model and data management-Managing data-implementing the model- Cloud and IOT technologies.				
Module 3	Digital Twin Optimization	Assign ment	Theory	**No. of Sessions:10**
Cyber range vs digital twin-human behavior modeling in digital twin-optimization using digital twin-digital twin and cyber security-Techniques. Technologies-Industrial IOT and Digital Twin-simulation and digital twin-Machine learning and digital twin-virtual reality and digital twin-cloud technology and digital twin.				
Module 4	Risk Management and Applications	Assignment	Case Study	**No. of Sessions:10**
Digital twin and Risk Assessment-Digital twin reference model-Implementation-Development of risk assessment plan-Development of communication and control system-Development of digital twin tools-Integration-platform validation-Difficulties-Practical implications. Applications: Digital Twin in Manufacturing-Digital Twin in Automotive-Digital Twin in Healthcare-Digital Twin in Utilities-Digital Twin in Construction				
Targeted Application & Tools that can be used: **Ansys Twin Builder** is a powerful solution for building, validation and deploying simulation-based systems and digital twins: Build, validate, and deploy digital twins. Digital twin models integrate real-world data. Increase efficiency with digital twins.				
Project work/Assignment:				
Project Assignment:				
Text Book 1. Clint Bodungen, Bryan Singer, Aaron Shbeeb, Kyle Wilhoit, and Stephen Hilt," Hacking Exposed Industrial Control Systems: ICS and SCADA Security Secrets & Solutions",1st Edition, ISBN: 978-1259589713. 2. Eric D. Knapp and Raj Samani," Applied Cyber Security and the Smart Grid: Implementing Security Controls into the Modern Power Infrastructure ",1st Edition. Kevin Mitnick," The Art of Invisibility",2017.				
References				

1. Michael E. AuerKalyan Ram B. Digital," Cyber-physical System and Digital Twins - Part of the Lecture Notes in Networks and Systems book series".

2. Nassim Khaed, Bibin Pattel and Affan Siddiqui," Development and Deployment on the Cloud", Elsevier, 2020.

Weblinks:

3. https://puniversity.informaticsglobal.com/login?qurl=https://search.ebscohost.com%2flogin.aspx%3fdirect%3dtrue%26db%3dnlebk%26AN%3d1223875%26site%3dehost-live%26ebv%3dEB%26ppid%3dpp_xiii

4. https://www.udemy.com/course/digital-twin-a-comprehensive-overview/

Topics relevant to development of " EMPLOYABILITY SKILLS": Digital thread-digital shadow-building blocks of digital twin, Digital Twin in Manufacturing-Digital Twin in Automotive, Cyber range vs digital twin-human behavior modeling in digital twin-optimization

<table>
<tr><td>Course Code:
CSA4051</td><td colspan="3">Course Title: Distributed Ledger Technology
Type of Course: Discipline Elective</td><td>L-T-P-C</td><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="8">1.0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="8">Foundations of Blockchain Technology</td></tr>
<tr><td>Anti-requisites</td><td colspan="8">NIL</td></tr>
<tr><td>Course Description</td><td colspan="8">The purpose of the course is to provide the fundamental concepts of distributed ledger technologies as well as to explore various aspects of distributed ledger techniques like Ethereum, Hyper ledger and smart contract.

With a good knowledge in the fundamental concepts of block chain and distributed ledger technologies, the student can gain practical experience in implementing them, enabling the student to be an effective chaincode creator.</td></tr>
<tr><td>Course Objective</td><td colspan="8">The objective of the course IS SKILL DEVELOPMENT of student by using PARTICIPATIVE LEARNING techniques</td></tr>
<tr><td>Course Out Comes</td><td colspan="8">On successful completion of this course the students shall be able to:

1. Understand and explore the working of distributed ledger technology (Knowledge)
2. Understand the working of Smart Contracts (Knowledge)
3. Apply the learning of solidity and de-centralized apps on Ethereum (Application).</td></tr>
<tr><td>Course Content:</td><td colspan="8"></td></tr>
<tr><td>Version No.</td><td colspan="8">1.0</td></tr>
<tr><td>Module 1</td><td colspan="2">Introduction to Distributed Ledger Technologies</td><td>Assignment</td><td colspan="2">Data Collection</td><td colspan="2">No. of Sessions: 09</td></tr>
<tr><td colspan="9">Topics:
What is Distributed Ledger Technology (DLT) and How Does it work? Key Features of DLT, Distributed Nature of the Ledger, Consensus Mechanism, Open/Permissionless Distributed Ledgers : Bitcoin , Ethereum ; Permissioned Distributed Ledgers :, Ripple, Fabric</td></tr>
</table>

(Hyperledger Project) , Corda, Key Advantages of DLT, Challenges and Risks related to DLT, Applications of DLT.

Assignment: Permissionless Distributed Ledgers/ Permissioned Distributed Ledgers

Module 2	**Introduction to Hyperledger**	**Assignment**	**Writing Task**	**No. of Sessions: 09**

Topics:

What is Hyperledger? Hyper ledger frameworks, Hyperledger Fabric- Components design, principles of Hyperledger design, reference architecture, run time architecture, the journey of sample transaction, Hyperledger Composer.

Assignment: Hyperledger Fabric Design

Module 3	**Designing a Data and Transaction Model**	**Assignment**	**Programming Task**	**No. of Sessions: 10**

Topics:

Starting the chaincode development, Compiling and running chaincode, Installing and instantiating chaincode, Invoking chaincode, Creating a chaincode, The chaincode interface, setting up chaincode file, Access control – ABAC- Registering a user, Enrolling a user, Retrieving user identities and attributes in chaincode, Implementing chaincode functions, Defining chaincode assets, Coding chaincode functions Creating an asset, Testing.

Assignment: Creating Chaincode and interfacing among them.

Module 4	**Applications of DLT**	**Case Study**	**Discussion**	**No. of Sessions: 08**

Topics:

Applications: Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

Case study: Managing the Metal and Mining Industry's Supply Chain with Hyperledger Fabric

List of Laboratory Tasks:

1. Level 1: Create a Simple Blockchain in any suitable programming language.
   Level 2: Create a complex Blockchain in any suitable programming language
2. Level 1: Deposit one Ether in your MetaMask accounts.
   Level 2: Deposit 10 Ether in your MetaMask accounts
3. Level 1: Create Single account.
   Level 2: Create multiple accounts and make a transaction between these accounts
4. Level 1: Test any one property of cryptographic hashing
   Level 2: Test all the properties of cryptographic hashing
5. Level 1: Add a transaction to a blockchain
   Level 2: Add multiple transaction to a blockchain
6. Level 1: Create a new file 'WorkingWithVariables.sol' in Solidity
   Level 2: Program to write a solidity program with required variables
7. Level 1: Create a new file 'SendMoney.sol' in solidity
   Level 2: Create new transaction with signing
8. Level 1: Single Error Handling using solidity
   Level 2: Complex exception Handling using solidity
9. Level 1: Use Geth to Implement Private Ethereum Block Chain.
   Level 2: Use Geth to Implement public Ethereum Block Chain.
10. Level 1: Build Hyperledger Fabric Client Application.
    Level 2: Build Hyperledger Fabric Server/network Application.
11. Level 1: Build Hyperledger Fabric with Smart Contract.
    Level 2: Case study on Hyperledger Fabric
12. Level 1: Create Case study of Block Chain being used in illegal activities in real world.
    Level 2: Using Golang to develop Block Chain Application

Targeted Application & Tools that can be used:

Meta mask, Docker and Docker compose, Go Programming language

Project work/Assignment:

Topics:

1. Permissioned Distributed Ledgers
2. Chaincode- Creation and interface

Textbook(s):

T1. Nitin Gaur, Hands-on blockchain with Hyperledger_ Building decentralized applications with Hyperledger Fabric and Composer, Packt,2020.

References

R1. Andreas M. Antonopoulos, "Mastering Bitcoin- Programming" - The Open Blockchain, Oreilly, 2017

R2. hyperledger-fabricdocs Documentation, Release Master, 2021.

R3. D. Drescher, Blockchain Basics. Apress, 2017.

R4. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

Other Resources

- Distributed Ledger Technology (DLT) and Blockchain, Fintech
- Pu.informatics.global
- **https://sm-nitk.vlabs.ac.in/**
- Udemy: https://www.udemy.com/course/build-your-blockchain-az/
- EDUXLABS Online training :https://eduxlabs.com/courses/blockchain-technologytraining/?tab=tab-curriculum

E-Book Links:

T1. https://presidencyuniversityin-my.sharepoint.com/:b:/g/personal/sampath_ak_presidencyuniversity_in/EXc_hRKtg1dOu6GuNvv0MZMBQ_Zo0lpNJyXsJ4IANfcJdQ?e=YAvywC

R1. https://presidencyuniversityin-my.sharepoint.com/:b:/g/personal/sampath_ak_presidencyuniversity_in/EUMg4-zAc3dGgl1RWeDDJR8B4SCqMMeO0lIzun51qbDlTw?e=ObRwKr

R2. https://presidencyuniversityin-my.sharepoint.com/:b:/g/personal/sampath_ak_presidencyuniversity_in/EWrs6M9zaYpJhvf9RI2jRaUB9PIJhXmQfZC5vdg284oVlg?e=aD9RgX

Cyber Security Basket

Course Code: CSA4053	**Course Title:** **Cyber Forensics** **Type of Course:** **Program Core**	**L-T- P-C**	2	0	2	3
Version No.	1.0					
Course Pre-requisites	**Cryptography and Network Security**					
Anti-requisites	NIL					
Course Description	The purpose of this course is to introduce to the students Cyber Forensic concepts. The course is both conceptual and analytical and is understood with various open-source software's. The course develops critical thinking like correctly collect and analyze computer forensic evidence, analyze and validate Forensics Data, study the tools and tactics associated with Cyber Forensics. The course involves quizzes, assignments with various open-source software.					
Course Objective	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.					
Course Outcomes	**On successful completion of this course the students shall be able to:** **(1) understand** various digital investigation terminologies and methods (knowledge) **(2) understand** various file formats (knowledge) **(3) Recognize** the importance of digital forensic duplication and various tools for analysis to achieve adequate perspectives of digital forensic investigation in various applications (Comprehension) **(4) Apply** techniques for forensic investigation (Application)					
Course Content:						
Module 1	**DIGITAL INVESTIGATION**	Quiz	MCQ/Based on Investigation process			**No. of Sessions: 09**
Digital Evidence and Computer Crime - History and Terminology of Computer Crime Investigation - Technology and Law - The Investigative Process -Investigative Reconstruction - Modus Operandi, Motive and Technology -Digital Evidence in the Courtroom.						
Module 2	**UNDERSTANDING INFORMATION**	Quiz	MCQ/Based on file format			**No. of Sessions: 09**
Methods of storing data: number systems, character codes, record structures, file formats and file signatures - Word processing and graphic file formats - Structure and Analysis of Optical Media Disk Formats - Recognition of file formats and internal buffers - Extraction of forensic artifacts– understanding the dimensions of other latest storage devices – SSD Devices.						

Module 3	**COMPUTER BASICS FOR DIGITAL INVESTIGATORS**	Assignment	Writing task	**No. of Sessions: 09**
Computer Forensic Fundamentals - Applying Forensic Science to computers - Computer Forensic Services - Benefits of Professional Forensic Methodology -Steps taken by computer forensic specialists. Information warfare: Arsenal – Surveillance Tools – Hackers and Theft of Components – Contemporary Computer Crime-Identity Theft and Identity Fraud – Organized Crime &Terrorism. Computer forensic cases: Developing Forensic Capabilities – Searching and Seizing Computer Related Evidence –Processing Evidence and Report Preparation – Future Issues. Assignment: Computer Crime				
Module 4	**Computer Forensic Evidence and Data Recovery**	Assignment	Writing task	**No. of Sessions: 09**
Data Recovery Defined, Data Backup and Recovery, The Role of Backup in Data Recovery, The Data-Recovery Solution, Hiding and Recovering Hidden Data. Data Collection and Data seizure: why collect evidence? - Collection Options, Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody. Reconstructing the Attack. Assignment: Data Recovery				

List of Laboratory Tasks:

1. Case Studies of Opensource Forensic Tools
2. FTK Forensic Tool kit for taking mirror image

Disk Forensics-

3. Identify digital evidences
4. Acquire the evidence
5. Authenticate the evidence
6. Preserve the evidence
7. Analyze the evidence
8. Report the findings

Network Forensics:

9. Intrusion detection
10. Logging
11. Correlating intrusion detection and logging

Device Forensics

12. Mobile phone
13. Digital Music
14. Printer Forensics
15. Scanner Forensics
16. Credit Card Forensics
17. Telecommunications Forensics
18. Forensic Analysis of a Virtual Machine
19. Forensic analysis of Cloud storage and data remnants
20. RAM Dumping Tool

Targeted Application & Tools that can be used:

1. **FTK Forensic Toolkit**
2. **Encase**
3. **Kali Linux- Vinetto, galatta**
4. **Autopsy – Disk Forensics**

Project work/Assignment:

Each batch of students (self-selected batch mates) will identify projects based on the content and implement with the most suitable 2 or 3 antecedents.

Textbook(s):

1. John R. Vacca, “Computer Forensics: Computer Crime Scene Investigation”, Cengage Learning, 2nd Edition, 2019

References

1. Ravi Kumar & B Jain,2006,” Cyber Forensics - Concepts and Approaches”, icfai university press

2. ChristofPaar, Jan Pelzl," Understanding Cryptography: A Textbook for Students and Practitioners", Springer's, Second Edition, 2010,
3. Ali Jahangiri," Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts", First edition, 2009
4. Computer Forensics: Investigating Network Intrusions and Cyber Crime", Ec-Council Press, 2010.
5. C. Altheide& H. Carvey," Digital Forensics with OpenSource Tools, Syngress", 2011, ISBN: 781597495868.,https://esu.desire2learn.com

NPTEL: https://onlinecourses.swayam2.ac.in/cec21_ge10/preview
Udemy: https://www.udemy.com/topic/digital-forensics/
E-book Link(PU):
Links
http://182.72.188.195/cgi-bin/koha/opac-detail.pl?biblionumber=14073&query_desc=ti%2Cwrdl%3A%20CYBER%20FORENSIC

Course Code: CSA4055	**Course Title:** Ethical Hacking **Type of Course:** Discipline Elective in Cyber Security Basket	**L- T- P- C**	**2**	**0**	**2**	**3**
Version No.	1.0					
Course Pre-requisites	basic networking tools knowledge and Cryptography & Network Security					
Anti-requisites	NIL					
Course Description	This course introduces students to a wide range of topics related to ethical hacking. It also provides an in-depth understanding of how to effectively protect computer networks. These topics cover some of the tools and penetration testing methodologies used by ethical hackers and provide a thorough discussion of what and who an ethical hacker is and how important they are in protecting corporate and government data from cyber-attacks					
Course Objective	The objective of the course is EMPLOYBILITY of student by using EXPERIENTIAL LEARNING techniques.					
Course OutComes	On successful completion of this course the students shall be able to: 1] Illustrate the importance of ethical hacking 2] Categorize the various techniques for performing reconnaissance. 3] Demonstrate various types of system scanners and their functions 4] Demonstrate the function of sniffers on a network					
Course Content:						
Module 1	**Introduction to Hacking** (Knowledge, Application)	Assignment	Programming activity	**12 Hours**		
Topics: Introduction to Hacking-Important Terminologies - Asset - Vulnerability - Penetration Test - Vulnerability Assessments versus Penetration Test - Penetration Testing Methodologies - Categories of Penetration Test. **Assignment:** Different phase methodologies on penetration testing						
Module 2	**Linux Basics**	Assignment	Programming activity	**10 Hours**		
Topics: Major Linux Operating Systems - File Structure inside of Linux - BackTrack - Changing the Default Screen Resolution - Some Unforgettable Basics. **Assignment:** Penetration testing distribution						

Module 3	**Information Gathering Techniques**	Assignment	Programming activity	**11 Hours**
Topics: Sources of Information Gathering - Copying Websites Locally - NeoTrace - Xcode Exploit Scanner - Interacting with DNS Servers - DNS Cache Snooping - DNS Lookup with Fierce - SNMP - SMTP. **Assignment:**Domain internet groper				
Module 4	**Target Enumeration and Port Scanning Techniques**	Assignment	Programming activity	**13 Hours**
Topics: Target Enumeration and Port Scanning Techniques - Host Discovery - Scanning for Open Ports and Services - Types of Port Scanning - Vulnerability Assessment. **Assignment:** Demonstrations for port scanning				
List of Laboratory Tasks: **Experiments:** 1. Installing BackTrack 2. Netcraft 3. Keyloggers 4. Acunetix 5. Nslookup 6. SNMP 7. Port Scanning 8. NetStumbler 9. Performing an IDLE Scan with NMAP 10. Network Sniffing				
Targeted Application & Tools that can be used: Application Software and open source tools				
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course				
Any appropriate tool can be given to demonstrate i.e Sql injections.				
Text Book 1] Rafay Baloch, 2014: "Ethical Hacking and Penetration Testing Guide" Apple Academic Press Inc.				
References 2] Gary Hall, Rrin Watson, 2016: "Hacking: Computer Hacking, Security Testing,Penetration Testing, and Basic Security". 3] James Corley, Kent Backman, Michael Simpson, 2010: "Hands-On Ethical Hacking and Network Defense", 2nd Edition, Cengage Learning.				

Course Code: CSA4056	**Course Title:** Cyber threats for IOT and Cloud **Type of Course:1] Program Core** **2] Theory Only**	**L-T- P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Cyber Security, Information Security and Networks					
Anti-requisites	**NIL**					
Course Description	Objective of the course is to understand the most important cyber threats for IOT and Cloud. Cyber attackers discover new possibilities in the areas of Internet of Things and cloud services. It mainly focuses on multiple security challenges facing the IoT and cloud computing especially concerns surrounding privacy and cyber security threats of the users and the how can the cyber risks relating to them be mitigated.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Cyber threats for IOT and Cloud and attain **Skill Development** through **Participative Learning** techniques.					
Course Out Comes	On successful completion of the course the students shall be able to: • Understand the different types of cyber threats for IOT and cloud • Develop a deeper understanding and familiarity with various types of cyber-attacks, cybercrimes, vulnerabilities and remedies thereto. • Plan, implement, and monitor cyber security mechanisms to ensure the protection of information technology assets.					
Course Content:						
Module 1	**Introduction to IOT and Cloud computing**	Assignment	Programming Task	**12 Sessions**		
Topics What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, IoT Challenges, IOT Architecture and protocols, Various platforms for IoT, Real-Time examples of IoT, Overview of IoT components and IoT communication Technologies. Introduction to Cloud Computing, The Vision of Cloud Computing, Defining a Cloud, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Distributed Systems, Virtualization, Service-						

Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies.

Assignment:

Module 2	**Cyber Threats**	Assignment	Programming Task	**8 Sessions**

Topics:

What are Cyber Security Threats? Common Sources of Cyber Threats, Types of Cyber security Threats-Malware attacks, Social Engineering attacks, Supply chain attacks, Man-in-the middle Attack, Threat Detection Tools, Cyber Defense for Individuals.

Assignment:

Module 3	**Cyber Threats in Internet of Things**	Assignment	Programming/Data analysis task	**10 Sessions**

Topics:

IoT threats and vulnerabilities- IoT attack surface, Attack surface areas of the IoT, Types of IoT security threats-Botnets, Denial of service, Man-in-the-Middle, Identity and data theft, Social engineering, Advanced persistent threats, Ransomware, Remote recording, How does the IoT influence security?, Best practices to reduce risks and prevent threats. Security guidelines for IoT. Managing IoT Security Threats.

Assignment:

Module 4	**Cyber Threats in Cloud computing**	Assignment	Programming/Data analysis task	**9 Sessions**

Topics:

Cybersecurity Threats to Cloud Computing-Identity First Security, Cloud misconfiguration, Denial of Service, Insider Threats, Reduced Infrastructure Visibility, Unauthorized use of Cloud workloads, Insecure API's, Compliance and regulation issues, Mitigating cyber risks in cloud computing

Assignment:

Text Books

T1. Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives" ,Wiley India Pvt Ltd,2013

T2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)

T3. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi Mastering Cloud. Computing McGraw Hill Education

References

R1. Brooks, Charles J., Christopher Grow, Philip Craig, and Donald Short. Cybersecurity essentials. John Wiley & Sons,2018

R2. Ollie Whitehouse, "Security of Things: An Implementers' Guide to Cyber-Security for Internet of Things Devices and Beyond", NCC Group, 2014

R3. Securing The Cloud: Cloud Computing Security Techniques and Tactics by Vic (J.R.) Winkler (Syngress/Elsevier) - 978-1-59749-592-9

Weblinks:

https://www.coursera.org/learn/cloud-security-basics

https://www.imperva.com/learn/application-security/cyber-security-threats/

https://presiuniv.knimbus.com/user#/home

Topics relevant to "SKILL DEVELOPMENT":

Cyber threats in IoT and Cloud Computing for **skill development** through **Participative Learning t**echniques. This is attained through the assessment component mentioned in the course handout.

Course Code: CSA4057	**Course Title: Vulnerability Assessment and Penetration Testing** **Type of Course: Theory Only Course**	**L-T- P-C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	CSE3078					
Anti-requisites	**NIL**					
Course Description	This course explores the tools that can be used to perform information gathering. This course also covers how vulnerability can be carried out by means of tools or manual investigation, and analysis of common attacks in data, mobile applications and wireless networks					
Course Objective	The objective of the course is to familiarize the learners with the concepts of **Vulnerability Assessment and Penetration Testing** and attain **Employability** through **Problem Solving** Methodologies.					
Course Out Comes	**On successful completion of the course the students shall be able to:** • Understand the basic principles for information gathering and detecting vulnerabilities in the system. • Determine the security threats and vulnerabilities in SDN networks and web applications. • Able to use the exploits in mobile applications and wireless networks • Understand the metasploit and metrepreter are used to automate the attacks and penetration testing techniques.					
Course Content:						
Module 1	**Information Gathering, Host Discovery and Evading Techniques**	Assignment	Theory		**9 Sessions**	
Topics: Introduction - Terminologies - Categories of Penetration Testing - Phases of Penetration Test - Penetration Testing Reports - Information Gathering Techniques - Active, Passive and Sources of Information Gathering – Approaches, Host discovery - Scanning for open ports and services- Types of Port, Vulnerability Scanner Function, pros and cons - Vulnerability Assessment with NMAP - Testing, SCADA environment with NMAP						

Module 2	**Vulnerability Scanner in SDN Networks and Web application**	Quiz	Theory	**10 Sessions**
Topics: Nessus Vulnerability Scanner - Safe check – Silent dependencies - Port Range Vulnerability Data Resources, SDN Data plane, Control Plane, Application Plane. SDN security attack vectors and SDN Harderning, Authentication Bypass with Insecure Cookie Handling - XSS Vulnerability - File inclusion vulnerability - Remote file Inclusion -Patching file Inclusions - Testing a website for SSI Injection.				
Module 3	**Mobile Application Security and wireless network Vulnerability analysis**	Quiz	Theory	**11 Sessions**
Topics: Types of Mobile Application Key challenges in Mobile Application and Mobile application penetration testing methodology, Android and ios Vulnerabilities - OWASP mobile security risk - Exploiting WM - BlackBerry Vulnerabilities - Vulnerability Landscape for Symbian - Exploit Prevention -Handheld Exploitation, WLAN and its inherent insecurities Bypassing WLAN Authentication uncovering hidden SSIDs MAC Filters Bypassing open and shard authentication - Advanced WLAN Attacks Wireless eavesdropping using MITM session hijacking over wireless – WLAN Penetration Test Methodology.				
Module 4	**Exploits**	Quiz	Theory	**8 Sessions**
Topics: Architecture and Environment- Leveraging Metasploit on Penetration Tests, Understanding - Metasploit Channels, Metasploit Framework and Advanced Environment configurations – Understanding the Soft Architecture, Configuration and Locking, Advanced payloads and add on modules Global datastore, module datastore, saved environment Meterpreter.				
Targeted Application & Tools that can be used: This course helps the students to understand the threats and vulnerabilities using NMAP.				
Project work/Assignment:				
Project Assignment:				
Text Book 1. Rafay Baloch, Ethical Hacking and Penetration Testing Guide, CRC Press, 2015. ISBN : 78-1-4822-3161-8.				

2. Dr. Patrick Engebretson, The Basics of Hacking and Penetration Testing Ethical Hacking and Penetration Testing made easy , Syngress publications, Elsevier, 2013. ISBN :978-0-12-411644-3.
3. Mayor, K.K.Mookey, Jacopo Cervini, Fairuzan Roslan, Kevin Beaver, Metasploit Toolkit for Penetration Testing, Exploit Development and Vulnerability Research, Syngress publications, Elsevier, 2007. ISBN : 978-1-59749-074-0

References

1. Mastering Modern Web Penetration Testing By Prakhar Prasad,October 2016 PacktPublishing.
2. SQL Injection Attacks and Defense 1st Edition, by Justin Clarke-Salt, Syngress Publication

Web resources: https://onlinecourses.nptel.ac.in/noc19_cs68/preview - **IIT Kharagpur,** Prof. Indranil Sen Gupta

Topics relevant to development of "EMPLOYABILITY SKILLS": Exploitation, Penetration testing techniques, for development of Employability skills through the Participative Learning Techniques. This is attained through the assessment components mentioned in course handout.

<table>
<tr><td>Course Code:
CSA4059</td><td colspan="3">Course Title: Digital Watermarking and Steganography
Type of Course: 1] Program Core 2] Theory Only</td><td>L-T-P-C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Version No.</td><td colspan="7">1.1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="7">Fundamental knowledge in Operating Systems, Cryptography & Network Security and Computer Networks</td></tr>
<tr><td>Anti-requisites</td><td colspan="7">NIL</td></tr>
<tr><td>Course Description</td><td colspan="7">The purpose of this course is to enable the students to Comprehend the need for Digital Watermarking and Steganography and to develop the basic abilities of design and use Digital Watermarking and Steganography- information hiding technique. The course is both conceptual in nature and needs fair knowledge of Mathematical and computing. The course develops critical thinking and analytical skills. The course also enhances the abilities through assignments.</td></tr>
<tr><td>Course Objectives</td><td colspan="7">The objective of the course is EMPLOYBILITY of student by using PARTICIPATIVE LEARNING techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="7">On successful completion of the course the students shall be able to:
Discuss the Introduction of Digital Watermarking
Classify the various Digital Watermarking techniques.
Explain the Fundamentals of Steganography.
Summarize the Steganographic Techniques.</td></tr>
<tr><td>Course Content:</td><td colspan="7"></td></tr>
<tr><td>Module 1</td><td colspan="2">Introduction to digital watermarking</td><td>Assignment</td><td colspan="2">Programming Task</td><td>7 Sessions</td></tr>
<tr><td colspan="8">Topics
Introduction to Digital Watermarking, Digital Steganography differences, brief History, Watermarking Applications, Classification in Digital Water Marking- Classification based on Characteristics, Classification based on Applications.</td></tr>
</table>

Module 2	**Types and tools of digital watermarking**	Assignment	Programming Task	

Topics:

Digital Watermarking Fundamentals, Least Significant bit substitution, Discrete Fourier Transform, Discrete Cosine Transform, Discrete Wavelet Transform, Random Sequence Generation, Chaotic Map, Error Detection Code. Spatial domain watermarking, frequency Domain watermarking, Fragile Watermark, Robust Water Mark, Watermarking attacks and Tools, Image processing techniques, Water Mark (software Analysis).

Module 3	**Introduction to Steganography**	Assignment	Programming/Data analysis task	

Topics:

Steganography, Watermarking vs Steganography, Need for Steganography, Application of Steganography, Methods of Hiding, properties of Steganography, Performance measure of Steganography Approaches, Mathematical Notation and Terminology, Steganography Software (S-tools, StegoDos, EzStezo, JSteg,Jpeg,).

Module 4	**Techniques of Steganography**	Assignment	Programming/Data analysis task	

Substitution Systems and Bit-plane Tools- Least Significant Bit Substitution, Pseudorandom P Image Downgrading and Covert Channels, Practical Approach towards Steganography, Embe secret Message.

Textbooks

T1. Frank Y Shih. Digital Water marking and Steganography Fundamentals and Techniques, Press, second edition.

T2. Jsjit. S. Suri Shivendra Shivani, Suneeth Agarwal, Handbook on Image based Security Tec CRC Press, 2018.

References

R1. Abid Yahya, Steganography Techniques for Digital Images, Springer, 2019.

Weblinks:

W1. Digital Watermarking | ScienceDirect (informaticsglobal.com)

W2. Digital Watermarking and Steganography | ScienceDirect (informaticsglobal.com)

Course Code: CSA4060	**Course Title:** Malware Analysis **Type of Course:**Discipline Elective in Cyber Security Basket	**L-T-P- C**	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Should Have the knowledge of Cryptography and Network Security					
Anti-requisites	**NIL**					
Course Description	The purpose of the course is to explore malware analysis tools and techniques in depth. Understanding the capabilities of malware is critical to an organization's ability to derive threat intelligence, respond to information security incidents, and fortify defenses. This course builds a strong foundation for reverse-engineering malicious software using a variety of system and network monitoring utilities, a disassembler, a debugger, and other tools useful for turning malware inside-out.					
Course Objective	The objective of the course is EMPLOYBILITY of student by using PARTICIPATIVE LEARNING techniques.					
Course OutComes	On successful completion of this course the students shall be able to: 1] Understanding the nature of malware, its capabilities, and how it is combated through detection and classification. 2] Apply the methodologies and tools to perform static and dynamic analysis on unknown executables. 3] Analyze scientific and logical limitations on society's ability to combat malware.. 4] Apply techniques and concepts to unpack, extract, decrypt, or bypass new anti analysis techniques in future malware samples.					
Course Content:						
Module 1	**Introduction to MALWARE ANALYSIS**		Assignment	Programming activity	**12 Hours**	
Topics: Introduction to malware, OS security concepts, malware threats, evolution of malware, malware typesviruses, worms, rootkits, Trojans, bots, spyware, adware, logic bombs, malware analysis, static malware analysis, dynamic malware analysis. **Assignment:** Brief study on types of spyware						

Module 2	**Static Analysis**		Assignment	Programming activity	**11 Hours**
Topics: X86 Architecture- Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, The Stack, Conditionals, Branching, Rep Instructions, C Main Method and Offsets. Antivirus Scanning, Fingerprint for Malware, Portable Executable File Format, The PE File Headers and Sections, The Structure of a Virtual Machine, ReverseEngineering- x86 Architecture **Assignment:** Static analysis on malware (PeStudio & ProcMon)					
Module 3	**Dynamic Analysis**		Assignment	Programming activity	**11 Hours**
Topics: Live malware analysis, dead malware analysis, analyzing traces of malware- system-calls, api-calls, registries, network activities. Anti-dynamic analysis techniques anti-vm, runtime-evasion techniques, , Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark **Assignment:** Demonstration of wireshark					
Module 4	**Malware Functionality and Detection Techniques**		Assignment	Programming activity	**12 Hours**
Topics: Downloader, Backdoors, Credential Stealers, Persistence Mechanisms, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection. Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature Non-signature based techniques: similarity-based techniques, machine-learning methods, invariant inferences **Assignment:** Packet malware signature					
Targeted Application & Tools that can be used: eCMAP (Certified Malware Analysis Professional)					
Project work/Assignment: Mention the Type of Project /Assignment proposed for this course					
Any appropriate tool can be given to demonstrate.					
Text Book 1] Michael Sikorski and Andrew Honig, 2012: " Practical Malware Analysis", No Starch Press.					

E-Resources **W1.** https://www.geeksforgeeks.org/introduction-to-malware-analysis/ **W2.** https://ine.com/learning/courses/malware-analysis W3: https://sm-nitk.vlabs.ac.in/
References 1] Jamie Butler and Greg Hoglund, 2005: "Rootkits: Subverting the Windows Kernel", Addison-Wesley. 2] Dang, Gazet and Bachaalany, 2014: "Practical Reverse Engineering",Wiley. 3] Reverend Bill Blunden, 2012: "The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System" Second Edition,Jones& Bartlett.

Course Code: **CSA4061**	**Course Title: Business Intelligence** **Type of Course: Discipline Elective Theory Course**	**L-T-P-C**	3	0	0	3
Version No.	1					
Course Pre-requisites	**NIL**					

<table>
<tr><td>Anti-requisites</td><td colspan="3">NIL</td></tr>
<tr><td>Course Description</td><td colspan="3">This is an introductory course to data science and it covers the mathematical foundations of data science, techniques for data collection, pre-processing and visualizing data. Concepts discussed in this course will be supplemented with hands on data science tools in Data Science Lab course. This course also enables students to learn and understand the fundamentals of Business Intelligence and Describes how Data Integration is achieved using SSIS.
Topics: Introduction to Data Analysis – Getting Data – Web scrapping – Pre-processing data – Cleaning –Munging– Manipulation –Rescaling and dimensionality reduction – Visualizing data – Histograms – Line charts – Pie charts – Multiple bar graphs – Box plots and Scatter plots. Business Intelligence – Data Warehouse – ETL –SSIS</td></tr>
<tr><td>Course Objective</td><td colspan="3">The objective of the course is to familiarize the learners with the concepts of Data Analytics and Business Intelligence and attain Skill Development through Experiential Learning techniques.</td></tr>
<tr><td>Course Outcomes</td><td colspan="3">On successful completion of this course the students shall be able to:
1)Describe the fundamentals of Data Analysis and Business Intelligence Technologies; [Understanding]
2) Implement data visualization techniques to analyze Datasets; [Applying]
3)Apply ETL tools to integrate data in a warehouse; [Applying]</td></tr>
<tr><td>Course Content:</td><td colspan="3"></td></tr>
<tr><td>Module 1</td><td>Introduction to Data Analysis and Visualization</td><td>Assignment</td><td>10 Sessions</td></tr>
<tr><td colspan="4">Topics:
Introduction to Data Analysis – Python Libraries for Data analysis – Data-types of variables – Continuous and Discrete variables – Data sampling – Pandas Data Structures – Data Visualization – Matplotlib Histograms – Line charts – Pie charts – Multiple bar graphs – Box plots – Scatter plots – Sea born plots – Bokeh plots.</td></tr>
<tr><td>Module 2</td><td>Data collection</td><td>Programming Task</td><td>10 Sessions</td></tr>
<tr><td colspan="4">Topics:
Data Collection – Data Cleaning – Data munging – Web Scrapping – Rescaling and Dimensionality Reduction – Feature Selection – Feature Extraction – Principal Component Analysis.</td></tr>
</table>

Module 3	**Introduction to Business Intelligence**	Assignment	**10 Sessions**
Topics: Types of digital data – Introduction to OLTP – OLAP and Data Mining. BI Definitions & Concepts – Business Applications of BI – BI Framework – Role of Data Warehousing in BI.			
Module 4	Classification and clustering	Mini Project	**10 Sessions**
Topics: Decision tree Induction – Bayesian classification – Model evaluation and selection techniques to improve classification accuracy. Clustering Analysis – portioning method – Hierarchical methods			
Targeted Application & Tools that can be used: ApplicationsinSystemscontainingMulti-ForceMembers,Frames,Trusses,Machines,CableBridgesetc. **Professionally used softwa**re–StaadPro/ETABS/PowerBI			
Project work/Assignment:			
To understand the application of the forces on rigid bodies, the students should draw free body diagrams and calculate the magnitudes and directions of forces acting on the body. Assignment:1] Determine the resultants for the Problems using MATLAB functions Assignment:2]Determine the support reactions for the beams using MSExcel based on the given data. Mini Project: 1] Use given industrial data to analyse and submit report			
Textbooks: T1. 1. Wes Mckinney. *"Python for Data analysis",* Second Edition, O'Reilly USA, 2017. T2. 2. RN Prasad and Seema Acharya*, "Fundamentals of Business Analytics"*, First Edition, Wiley India 2016. https://presiuniv.knimbus.com/user#/home https://puniversity.informaticsglobal.com:2229/login.aspx?direct=true&db=nlebk&AN=2706929&site=ehostlive			
References: R1. Roger Peng, *"Exploratory Data Analysis"*, Lean Publications, 2015. R2. SorayaSedkaoui, MouniaKhelfaoui, *"Sharing Economy and Big Data Analytics"*, First Edition, 2020. R3. Rick Sherman , *"Business Intelligence Guidebook: From Data Integration to Analytics",2014*			

Topics relevant to "SKILL DEVELOPMENT": Data Visualization – Matplotlib Histograms – Line charts – Pie charts – Multiple bar graphs – Box plots – Scatter plots – Sea born plots – Bokeh plots **for Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.**