PRESIDENCY SCHOOL OF INFORMATION SCIENCE

Program Regulations and Curriculum

2026 – 2029

BACHELOR OF SCIENCE (B.Sc.) in

AI, Data Science and Cloud Computing

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

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

1.4 Mission of Presidency School of Information Science

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

2. Preamble to the Program Regulations and Curriculum

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

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

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

3. Short Title and Applicability

a. These Regulations shall be called the Bachelor of Science Degree Program Regulations and Curriculum 2026-2029.
b. These Regulations are subject to, and pursuant to the Academic Regulations.
c. These Regulations shall be applicable to the ongoing Bachelor of Science Degree Programs of the 2026-2029 batch, and to all other Bachelor of Science Degree Programs which may be introduced in future.
d. These Regulations shall supersede all the earlier Bachelor of Science Program Regulations and Curriculum, along with all the amendments thereto.
e. These Regulations shall come into force from the Academic Year 2026-2027.

4. Definitions

In these Regulations, unless the context otherwise requires:

a. "Academic Calendar" means the schedule of academic and miscellaneous events as approved by the Vice Chancellor;
b. "Academic Council" means the Academic Council of the University;
c. "Academic Regulations" means the Academic Regulations, of the University;
d. "Academic Term" means a Semester or Summer Term;
e. "Act" means the Presidency University Act, 2013;
f. "AICTE" means All India Council for Technical Education;
g. "Basket" means a group of courses bundled together based on the nature/type of the course;
h. "BOE" means the Board of Examinations of the University;
i. "BOG" means the Board of Governors of the University;
j. "BOM" means the Board of Management of the University;

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

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

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

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

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

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

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

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

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

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

u. "Degree Program" includes all Degree Programs;

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

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

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

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

z. "MOOC" means Massive Open Online Courses;

aa. "MOU" means the Memorandum of Understanding;

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

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

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

ee. "Program Regulations" means the Bachelor of Science Degree Program Regulations and Curriculum, 2025-2028;

ff. "Program" means the Bachelor of Science (B.Sc) Degree Program;

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

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

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

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

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

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

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

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

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

pp. "UGC" means University Grant Commission;

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

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

5. Program Description

The Bachelor of Science Program Regulations and Curriculum 2026-2029 are subject to, and, pursuant to the Academic Regulations. These Program Regulations shall be applicable to the following ongoing Bachelor of Science Degree Programs of 2026-2029 offered by the Presidency School of Information Science (PSIS):

1. Bachelor of Science abbreviated as BCU.

2. Bachelor of Science (AI, Data Science and cloud Computing) abbreviated as BCC.

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

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

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

6. Minimum and Maximum Duration

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

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

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

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

6.5 The enrolment of the student who fails to complete the mandatory requirements for the award of the concerned Degree (refer Section 19.0 of Academic

Regulations) in the prescribed maximum duration (Clauses 18.1 and 18.2 of Academic Regulations), shall stand terminated and no Degree shall be awarded.

7 Programme Educational Objectives (PEO)

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

PEO1. Pursue professional competence in Artificial Intelligence, Data Science, Cloud Computing, and allied computing domains by effectively applying analytical thinking, problem-solving abilities, and technical skills in professional practice

PEO2. Engage in continuous learning by pursuing higher education, research, professional certifications, or entrepreneurial initiatives in emerging and evolving technologies.

PEO3. Demonstrate professionalism, ethical conduct, teamwork, leadership qualities, and social responsibility while designing, developing, and deploying technology-driven solutions

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

PO1. Application of Domain Knowledge: Apply knowledge of mathematics, science, computing fundamentals, and software engineering principles to solve problems in computer science and related domains.

PO2. Problem Analysis and Solving: Identify, formulate, analyse, and solve complex computing problems using appropriate computational and analytical techniques.

PO3. Design and Development of Computing Solutions: Design, develop, and evaluate computing systems, software applications, and processes that meet specified functional and non-functional requirements.

PO4. Investigation of Computing Problems: Conduct investigations of complex computing problems using research-based knowledge, experimentation, and data analysis to draw valid conclusions.

PO5. Modern Tool Usage: Use modern computing tools, programming environments, frameworks, and ICT tools effectively for developing computing solutions.

PO6. Research Capability: Identify appropriate research methodologies, conduct research, analyze data, and report findings effectively in computing domains.

PO7. Profession and Society: Apply computing knowledge considering societal, environmental, cultural, and global contexts and contribute responsibly to society.

PO8. Ethics and Professional Responsibility: Recognize ethical, legal, and security issues and adhere to professional ethics and responsibilities in computing practice.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse and multidisciplinary teams.

PO10. Communication: Communicate effectively through oral and written forms, including technical documentation, reports, and presentations.

PO11. Project Management and Finance: Apply project management and financial principles to plan, execute, monitor, and complete computing projects successfully.

PO12. Life-long Learning: Recognize the need for and engage in independent and lifelong learning to adapt to rapid technological and societal changes.

8.2 Programme Specific Outcomes (PO)

On successful completion of the program, the graduates shall be able to:

PSO1. Apply fundamental principles of Artificial Intelligence, Data Science, mathematics, and programming to analyze data and solve real-world problems effectively.

PSO2. Design, develop, and deploy intelligent applications and data-centric solutions using appropriate AI techniques, data processing methods, and cloud computing platforms.

PSO3. Apply AI, data, and cloud technologies responsibly by following ethical practices, security considerations, and professional standards while addressing industry and societal needs.

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 B.Sc. Program is listed in the following Sub-Clauses:

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

9.2. Provided further that a candidate seeking admission to the B.Sc. (in Computer Science) Program shall have passed the 10+2 examination or its equivalent from a recognized board, with Mathematics as one of the subjects, and shall have secured a minimum of 40% marks in aggregate.

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

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

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

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

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

10 Transfer Students requirements

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

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

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

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

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

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

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

11 Change of Branch / Discipline / Specialization

A student admitted to a particular Branch of the B.Sc. Program will normally continue studying in that Branch till the completion of the program. However, the University reserves the right to provide the option for a change of Branch, or not to provide the option for a change of Branch, at the end of 1st Year of the B.Sc.

Program to eligible students in accordance with the following rules and guidelines: framed by the University from time to time.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

12.5. **Assessment Components and Weightage**

<table>
<tr><th colspan="3">Table 1: Assessment Components and Weightage for different category of Courses</th></tr>
<tr><th>Nature of Course and Structure</th><th>Evaluation Component</th><th>Weightage</th></tr>
<tr><td rowspan="2">Lecture-based Course
L component in the L-T-P Structure is predominant (more than 1)
(Examples: 3-0-0; 3-0-2; 2-1-0; 2-0-2, 2-0-4 etc.)</td><td>Continuous Assessments</td><td>50%</td></tr>
<tr><td>End Term Examination</td><td>50%</td></tr>
<tr><td rowspan="2">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.)</td><td>Continuous Assessments</td><td>75%</td></tr>
<tr><td>End Term Examination</td><td>25%</td></tr>
<tr><td>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</td><td colspan="2">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.</td></tr>
</table>

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-C) [NTCC], but with assigned Credits (as defined in Clause 5.2 of the Academic Regulations), the method of evaluation shall be based only on Continuous Assessments. The various components of Continuous Assessments, the distribution of weightage among such components, and the method of evaluation/assessment,

shall be as decided and indicated in the Course Plan/PRC. The same shall be approved by the respective DAC.

12.6. **Minimum Performance Criteria:**

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

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

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

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

12.6.2. Lab/Practice only Course and Project Based Courses

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

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

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

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

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

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

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

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

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

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

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

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

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

13.3.7. A student who has successfully completed the approved SWAYAM/NPTEL/ other approved MOOCs and wants to avail the provision of transfer of equivalent credits, must submit the original Certificate of Completion, or such similar authorized documents to the HOD concerned, with a written request for the transfer of the equivalent credits. On verification of the Certificates/Documents and approval by the HOD concerned, the Course(s) and equivalent Credits shall be 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 B.Sc. Program Structure (2026-2029) totalling 120 credits. Table 3 summarizes the type of baskets, number of courses under each basket and the associated credits that are mandatorily required for the completion of the Degree.

Summary of Mandatory Courses and Minimum Credit Contribution from various Baskets		
Sl. No.	**Baskets**	**Credit Contribution**
1.	Ability Enhancement Courses	8
2.	Skill Enhancement courses	33
3.	Core Courses	58
4.	Mandatory Courses (MAC)	0
5.	Discipline Specific Elective	18
6.	Multi- Disciplinary Elective Courses	3
	Total Credits	**120 (Minimum)**

15. Minimum Total Credit Requirements of Award of Degree

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

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

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

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

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

b. Secure a minimum CGPA of 4.50 in the concerned Program at the end of the Semester/Academic Term in which she/he completes all the requirements for the award of the Degree as specified in Sub-Clause a 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 (not Semester Wise)

Ability Enhancement Courses (AEC)						
S.No	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	ENG1902	Foundations of English Communication	3	0	0	3
2	ENG1913	Essentials of Writing Skills	3	0	0	3
3	PPS1001	Introduction to soft skills	0	0	2	1
4	PPS3001	Problem Solving through Aptitude	0	0	2	1
		Total No. of Credits				**8**

Skill Enhancement Courses (SEC)						
S.No	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSC1500	Problem Solving using C	2	0	0	2
2	CSC1501	Problem Solving using C Lab	0	0	4	2
3	CSC1502	Computational Thinking	2	0	0	2
4	CSC1503	Programming in Python	1	0	4	3
5	CSC1504	Web Design and Development	1	0	4	3
6	CSC2500	Object Oriented Programming using Java	1	0	4	3
7	CSC2502	Android Mobile Application Development	1	0	4	3
8	CSC2503	Internet of Things	1	0	4	3
9	CSC7000	Summer Internship	-	-	-	4
10	CSC7300	Project	-	-	-	8
		Total No. of Credits				**33**

Core Courses (CC)						
S.No	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	MAT1201	Linear Algebra and Calculus	2	1	0	3
2	CSC1505	Digital Computer Fundamentals	3	0	0	3
3	MAT1202	Probability and Statistical Methods	2	1	0	3
4	CSC2504	Data Structures	3	1	0	4
5	CSC2505	Data Structures Lab	0	0	2	1
6	CSC2506	Computer Networks	3	0	0	3
7	CSC1506	Computer Organization	3	0	0	3
8	CSC2507	Relational Database Management Systems	3	0	0	3

9	CSC2508	Relational Database Management Systems Lab	0	0	2	1
10	CSC2509	Discrete Mathematics	2	1	0	3
11	CSC2510	Analysis of Algorithms	3	1	0	4
12	CSC2511	Analysis of Algorithms Lab	0	0	2	1
13	CSC2512	Operating Systems	3	0	0	3
14	CSC2513	Unix Programming	0	0	2	1
15	CSC2514	Principles of Artificial Intelligence	3	0	0	3
16	CSC2501	Data Modelling Visualization	1	0	4	3
17	CSC2515	Data Mining and Data Warehousing	3	0	0	3
18	CSC2516	Essentials of Cloud Computing	3	0	0	3
19	CSC2517	Software Engineering	3	0	0	3
20	CSC2518	Machine Learning	3	0	0	3
21	CSC2523	Machine Learning Lab	0	0	2	1
22	CSC2519	Big Data Analytics	2	0	2	3
					Total No. of Credits	**58**

List of Mandatory Courses (MAC)						
S.No	**Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CHE7601	Environmental Studies	-	-	-	-
2	CIV7601	Universal Human Values	-	-	-	-

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 fulfil 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 B.Sc. 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 plan.

18.1 Summer Internship

A student may opt to undertake Internship for a duration of 6 to 8 weeks during the summer break (Between 4th and 5th semester). A student may opt Mini project work shall be considered equivalent to an internship, subject to the following conditions:

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

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

18.1.3. The number of Internships available for the concerned Academic Term. Further, the available number of internships shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student. Provided further, the student fulfils the criteria, as applicable, specified by the Industry / Company or academic / research institution providing the Internship, as stated in Sub-Clause 18.1.2 above.

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

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

18.1.6. A student may opt to do a Mini Project Work for a period of 10-12 weeks in an Industry / Company or academic / research institution or the University Department(s) as an equivalence of Summer Internship during the 5th Semester while concurrently completing the remaining registered courses for that semester.

18.2 Project Work

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

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

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

18.3 Capstone Project

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

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

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

18.3.3 The number of Capstone Project available for the concerned Academic Term. Further, the available number of Capstone Project

shall be awarded to the students by the University on the basis of merit using the CGPA secured by the student. Provided further, the student fulfils the criteria, as applicable, specified by the Industry / Company or academic / research institution providing the Capstone Project, as stated in Sub-Clause 2.6.3.2 above.

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

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

18.4 Research Project / Dissertation

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

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

18.4.2 The student may do the Research Project / Dissertation in an Industry / Company or academic / research institution of her / his choice subject to the above-mentioned condition (Sub-Clause 2.6.4.1). Provided further, that the Industry / Company or academic / research institution offering such Research Project /

Dissertation confirms to the University that the Research Project / Dissertation work will be conducted in accordance with the Program Regulations and requirements of the University.

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

Table 3.6: Discipline Specific Elective – Minimum of 15 credits is to be earned by the student in a particular track and overall, 18 credits.						
Track 1 -Full stack						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSC3500	.Net Programming Using C#	1	0	4	3
2	CSC3501	No SQL	1	0	4	3
3	CSC3502	Front-End Development using Java Script	1	0	4	3
4	CSC3503	Web Application Deployment on Cloud	1	0	4	3
5	CSC3504	Agile Structures and Frameworks	3	0	0	3
6	CSC3505	Full Stack Development using MERN Stack	2	0	2	3

Track 2 - AIML and Data Science						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSC3507	Deep Learning	2	0	2	3
2	CSC3513	Natural Language Processing	2	0	2	3
3	CSC3510	Generative AI	2	0	2	3
4	CSC3511	Computer Vision	3	0	0	3
5	CSC3508	Statistical Analysis using R Programming	2	0	2	3
6	CSC3509	UX Analytics	2	0	2	3
7	CSC3512	Social Network Analytics	2	0	2	3
8	CSC3522	Time Series Analysis and Forecasting	3	0	0	3
9	CSC2531	Business Intelligence and decision support systems	2	0	2	3
8	CSC3514	Ethical and Responsible AI	3	0	0	3
9	CSC3515	Predictive analytics	3	0	0	3

Track 3 -Cloud Computing						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	CSC3516	Virtualization and Cloud Infrastructure Management	2	0	2	3
2	CSC3517	Distributed Systems and Microservices Architecture	2	0	2	3
3	CSC3518	Cloud DevOps and CI/CD Automation	2	0	2	3
4	CSC3519	Edge Computing and Fog Computing	2	0	2	3
5	CSC3520	Cloud Security and Cryptographic Techniques	2	0	2	3
6	CSC3521	Blockchain Technologies	2	0	2	3

20. List of Multi-Disciplinary Electives to be offered by the School / Department.

Table 3.7: Multi-Disciplinary Electives Courses Baskets: Minimum Credits to be earned from this Basket is 3

Sl. No.	Course Code	Course Name	L	T	P	C
1	COM2001	Introduction to Human Resource Management	3	0	0	3
2	COM2002	Finance for non-finance	3	0	0	3
3	COM1021	Introduction to Banking	3	0	0	3
4	BBA1025	Fundamentals of Management	3	0	0	3
5	COM2007	Basics of Accounting	3	0	0	3
6	CSE3116	No Code AI	2	0	2	3
7	DSA2002	Yoga for Health	2	0	0	2
8	DSA2003	Stress Management and Well Being	2	0	0	2
9	MEC2003	Supply Chain Management	3	0	0	3
10	MEC3201	Industry 4.0	3	0	0	3
11	MGT2002	Organizational Behaviour	3	0	0	3
12	MGT2003	Competitive Intelligence	3	0	0	3
13	MGT2004	Development of Enterprises	3	0	0	3
14	MGT2011	Personal Finance	3	0	0	3
15	MGT2022	Customer Relationship Management	3	0	0	3

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

SEMESTER STRUCTURE

Semester 1								
S. NO.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE					BASKET
			L	T	P	C	CONTACT HOURS	
1	MAT1201	Linear Algebra and Calculus	2	1	0	3	3	CC
2	CSC1500	Problem Solving using C	2	0	0	2	2	SEC
3	CSC1501	Problem Solving using C Lab	0	0	4	2	4	SEC
4	CSC1505	Digital Computer Fundamentals	3	0	0	3	3	CC
5	CSC1502	Computational Thinking	2	0	0	2	2	SEC
6	CSC1504	Web Design and Development	1	0	4	3	5	SEC

7	ENG1902	Foundations of English Communication	3	0	0	3	3	AEC
8	PPS1001	Introduction to soft skills	0	0	2	1	2	AEC
		TOTAL	**13**	**1**	**10**	**19**	**24**	**-**

Semester 2								
S. NO.	**COURSE CODE**	**COURSE NAME**	**CREDIT STRUCTURE**					**BASKET**
			L	**T**	**P**	**C**	**CONTACT HOURS**	
1	CSC1503	Programming in Python	1	0	4	3	5	SEC
2	MAT1202	Probability and Statistical Methods	2	1	0	3	3	CC
3	CSC2504	Data Structures	3	1	0	4	4	CC
4	CSC2505	Data Structures Lab	0	0	2	1	2	CC
5	ENG1913	Essentials of Writing Skills	3	0	0	3	3	AEC
6	CSC2506	Computer Networks	3	0	0	3	3	CC
7	CSC1506	Computer Organization	3	0	0	3	3	CC
		TOTAL	**15**	**2**	**6**	**20**	**23**	**-**

Semester 3								
S. NO.	**COURSE CODE**	**COURSE NAME**	**CREDIT STRUCTURE**					**BASKET**
			L	**T**	**P**	**C**	**CONTACT HOURS**	
1	CSC2507	Relational Database Management Systems	3	0	0	3	3	CC
2	CSC2508	Relational Database Management Systems Lab	0	0	2	1	2	CC
3	CSC2500	Object Oriented Programming using Java	1	0	4	3	5	SEC
4	CSC2509	Discrete Mathematics	2	1	0	3	3	CC
5	CSC2510	Analysis of Algorithms	3	1	0	4	4	CC
6	CSC2511	Analysis of Algorithms Lab	0	0	2	1	2	CC
7	CSC2512	Operating Systems	3	0	0	3	4	CC
8	CSC2513	Unix Programming	0	0	2	1	2	CC
9	CSC2501	Data Modelling Visualization	1	0	4	3	5	SEC
10	CHE7601	Environmental Studies	-	-	-	-	0	MNC
		TOTAL	**13**	**2**	**14**	**22**	**30**	**-**

Semester 4								
S. NO.	**COURSE CODE**	**COURSE NAME**	**CREDIT STRUCTURE**					**BASKET**
			L	**T**	**P**	**C**	**CONTACT HOURS**	
1	CSC2514	Principles of Artificial Intelligence	3	0	0	3	3	CC
2	CSC2502	Android Mobile Application Development	1	0	4	3	5	SEC
3	CSC2515	Data Mining and Data Warehousing	3	0	0	3	3	CC
4	CSC2516	Essentials of Cloud Computing	3	0	0	3	3	CC

5	CSC2517	Software Engineering	3	0	0	3	3	CC
6	CSAXXXX	Discipline Specific Elective– I	3	0	0	3	3	DSE
7	CSAXXXX	Discipline Specific Elective– II	3	0	0	3	3	DSE
8	PPS3001	Problem Solving through Aptitude	0	0	2	1	2	AEC
9	CIV7601	Universal Human Values	-	-	-	-	0	MNC
		TOTAL	**19**	**0**	**6**	**22**	**25**	**-**

Semester 5								
S. NO.	**COURSE CODE**	**COURSE NAME**	**CREDIT STRUCTURE**					**BASKET**
			L	**T**	**P**	**C**	**CONTACT HOURS**	
1	CSC2518	Machine Learning	3	0	0	3	3	CC
2	CSC2523	Machine Learning Lab	0	0	2	1	2	CC
3	CSCXXXX	Discipline Specific Elective– III	3	0	0	3	3	DSE
4	CSCXXXX	Discipline Specific Elective– IV	3	0	0	3	3	DSE
5	CSC2519	Big Data Analytics	2	0	2	3	4	CC
6	CSC2503	Internet of Things	1	0	4	3	5	SEC
7	XXXXXXX	Multi-Disciplinary Elective – I	3	0	0	3	3	MDC
8	CSC7000	Summer Internship	-	-	-	4	0	SEC
		TOTAL	**15**	**0**	**8**	**23**	**23**	**-**

Semester 6								
S. NO.	**COURSE CODE**	**COURSE NAME**	**CREDIT STRUCTURE**					**BASKET**
			L	**T**	**P**	**C**	**Contact Hours**	
1	CSCXXXX	Discipline Specific Elective – V	3	0	0	3	3	DSE
2	CSCXXXX	Discipline Specific Elective – VI	3	0	0	3	3	DSE
3	CSC7300	Project	-	-	-	8	0	SEC
4		**TOTAL**	**6**	**0**	**0**	**14**	**6**	**-**

1. 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.

MAT1201- Linear Algebra & Calculus

Course Code: MAT1201	**Course Title:** Linear Algebra and Calculus **Type of Course:** Theory	**L-T- P-C**	**2**	**1**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	MAT2301					
Anti-requisites	NIL					
Course Description	This course explores the fundamental concepts of vectors, matrices, and their operations within the context of calculus, including vector differentiation and integration, while applying these tools to solve problems related to linear systems, transformations, and geometric interpretations in higher dimensions, often with applications in fields like physics, engineering, and computer graphics; key topics include vector algebra, matrix operations, determinants, eigenvalues, eigenvectors, gradients, divergence, curl, line integrals, surface integrals, and the fundamental theorems of vector calculus like Green's Theorem, Stokes' Theorem, and the Divergence Theorem.					
Course Objective	The course is intended to develop computational proficiency involving procedures in Matrices, Linear Algebra and Vector Calculus which are useful to all engineering disciplines. This course is to equip students with the ability to understand and manipulate vectors in multidimensional space, apply matrix operations to solve systems of linear equations, and utilize concepts like gradients, divergence, and curl to analyze physical phenomena, all while developing a strong foundation for applying these tools in various scientific and engineering fields like physics, mechanics, and computer graphics.					
Course Outcomes	On successful completion of the course the students shall be able to: **CO1** - Use matrix methods and certain techniques to solve the system of linear equations and to find eigen values, eigen vectors of a matrix to check whether it is diagonalizable. [Apply] **CO2** -Understand the abstract notions of vector space and dimensionality of it. [Understand] **CO3** -Find the matrix representation of a linear transformation given bases of the relevant vector spaces. [Apply] **CO4** - Learn different notions of vector and scalar fields with their properties. Understanding the major theorems (Green's, Stokes', Gauss') and some applications of these theorems. [Understand]					
Course Content:						
Module 1	**Systems of Linear Equations**					***8 Sessions***
Systems of Linear Equations, Matrices and Elementary Row Operations, Echelon forms, Matrix operations, invertible matrices, Determinants and their properties, Cramer's Rule, LU-decomposition, Applications of Systems of Linear Equations.						
Module 2	**Vector Space**					***9 Sessions***

Linear Combinations and Linear Independence, Vectors in n R^n, Linear Combinations, Linear Independence Vector Spaces, Definition of a Vector Space, Subspaces, Basis and Dimension, Coordinates and Change of Basis, Orthogonal bases and orthogonal projections.

Module 3	**Linear Transformations**	***15 Sessions***

Linear Transformations, Algebra of transformations, The Null Space and Range, Isomorphisms, Matrix Representation of Linear Transformations, Similarity Eigenvalues and Eigenvectors, Eigen values and Eigen vectors, Diagonalization.
Inner Product Spaces, The Dot Product on R^n and Inner Product Spaces, Orthonormal Bases, Orthogonal Complements, Application: Least Squares Approximation, Diagonalization of Symmetric Matrices, Application: Quadratic Forms.
Singular Value Decomposition: Singular values, computing singular value decomposition, and Introduction to principal component analysis.

Module 4	**Vector Calculus**	***5 Sessions***

Vector & Scalar Functions and Fields, Derivatives, Curve, Arc length, Curvature & Torsion, Gradient of Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field, Physical interpretation, solenoidal and irrotational vector fields. Problems.
Line Integrals, Path Independence of Line Integrals, Green`s Theorem in the plane, Surface Integrals, Divergence Theorem of Gauss, Stokes`s Theorem.

Targeted Application & Tools that can be used:

1. Solve systems of linear equations using various methods including Gaussian and Gauss Jordan elimination and inverse matrices.
2. Perform matrix algebra, invertibility, and the transpose and understand vector algebra in R^n.
3. Determine relationship between coefficient matrix invertibility and solutions to a system of linear equations and the inverse matrices.
4. Find eigenvalues and eigenvectors and use them in applications.
5. Find the dimension of spaces such as those associated with matrices and linear transformations.
6. Understand real vector spaces and subspaces and apply their properties.
7. Compute inner products in a real vector space and compute angle and orthogonality in inner product spaces.
8. Create orthogonal and orthonormal bases: Gram-Schmidt process and use bases and orthonormal bases to solve application problems.
9. Prove basic results in linear algebra using appropriate proof-writing techniques such as linear independence of vectors; properties of subspaces; linearity, injectivity and subjectivity of functions; and properties of eigenvectors and eigenvalues.

Assignment:

Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding the applications of Linear Algebra and Vector Calculus to engineering applications – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus of Linear Algebra and Vector Calculus is covered.

Textbook:
T1: Gilbert Strang, Linear Algebra and its applications, Wellesley-Cambridge Press,U.S.; 6th edition.
T2: B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.

References:
R1: Introduction to Linear Algebra with Application, Jim Defranza, Daniel Gagliardi, Tata McGraw-Hill

R2: Elementary Linear Algebra, Applications version, Anton and Rorres, Wiley India Edition.
R3: Advanced Engineering Mathematics, Erwin Kreysig, Wiley Publication.

E-resources/ Web links:
W1: https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_9607
W2: https://nptel.ac.in/courses/111106051/
W3: https://nptel.ac.in/courses/111106100/
W4: https://nptel.ac.in/courses/111/105/111105122/
W5: https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html

Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of Vector calculus and Linear Algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem Solving**.** This is attained through the assessment component mentioned in the course handout.

CSC1500-Problem Solving using C

Course Code: CSC1500	**Course Title:** Problem Solving using C **Type of Course:** Theory and Laboratory Integrated	L-T-P-C	2	0	0	2
Version No.	1.0					
Course Pre-requisites	Basic knowledge about the computer and its usage					
Anti-requisites	NIL					
Course Description	This Course will provide an introduction to foundational concepts of computer programming to students of BCA program. Topics covered in this Course are problem formulation and development of simple programs, Pseudo code, Flow Chart, Algorithms, data types, operators, decision making and branching, looping statements, arrays, functions, structures, Union, File handling and pointers. In the lab session students are required to solve problems based on the above concepts to illustrate the features of the structured programming					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Problem-Solving Using C and attain Skill Development through Experiential Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: **CO1:** Explain the basics of C programming and the structure of C programs. [Understand] **CO2:** Describe control statements, type casting, and loops in C. [Understand] **CO3:** Develop programs using arrays and strings to solve problems. [Apply] **CO4:** Execute programs using functions, structures, unions, pointers, and file handling. [Apply]					
Course Content:						
Module 1	**Introduction to C Programming**					**12 Sessions**
Topics: Introduction to C: Background, Computer basics, Problem solving techniques, Tokens, Input/ Output statements, Structure of C program.						
Module 2	**Control statements in C**					**20 Sessions**
Topics: Type Casting, Expression Evaluation, Conditional and unconditional statement, Looping statements						
Module 3	**Arrays and Strings**					**21 Sessions**
Topics: One dimensional Array, Array operations,2D Array, 2D Array operations, Strings and its operations, String manipulation functions.						
Module 4	**Functions, Structures and Unions, Pointers**					**10 Sessions**
Topics: Categories of functions, concept of modular programming, user defined datatypes, structures, union, pointers, file handling						
Textbook: **T1:** E. Balaguruswamy, "Programming in ANSI C", Eighth Edition - Tata McGraw Hill.						

Reference Books:

R1: Behrouz A Forouzan, Richard F Gilberg, "Computer Science: A structured programming approach using C", Third Edition Cengage Learning.
R2: Brian W. Kernighan / Dennis Ritchie, "The C Programming Language " ,Second Edition, Pearson
R3: YashavantKanetkar, "Let Us C", Eighteenth edition , BPB Publications

Web Links:

W1: https://www.coursera.org/learn/introducton- to programming-in-c (Coursera)
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAJ_1_02082022_1773 (E-Library Resource)
W2: https://onlinecourses.nptel.ac.in/noc22_cs32/preview (NPTEL)

CSC1501 Problem solving using C Lab

Course Code CSA1501	Course Title: Problem solving using C La**b** Type of Course: Laboratory Integrated Course	L-T-P-C	0	0	4	2
Version No.	1.0					
Course Pre-requisites	Basic knowledge about the computer and its usage					
Anti-requisites	NIL					
Course Description	This course introduces the fundamentals of C programming, including data types, control structures, arrays, and strings. Students will analyze problems, draw flowcharts, and implement solutions using modular programming techniques. The course also covers advanced topics such as functions, structures, unions, and pointers for efficient problem-solving.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Problem-Solving Using C and attain Skill Development through Experiential Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: **CO1:** Construct C programs using basic concepts, tokens, input/output statements, and program structure. [Apply] **CO2:** Implement C programs using control statements, type casting, expression evaluation, and loops. [Apply] **CO3:** Develop programs using one-dimensional and two-dimensional arrays, strings, and string manipulation functions. [Apply] **CO4:** Build modular C programs using functions, structures, unions, pointers, and file handling. [Apply]					
Course Content:						
Module 1	**Introduction to C Programming**					**12 Sessions**
Topics: Introduction to C: Background, Computer basics, Problem solving techniques, Tokens, Input/ Output statements, Structure of C program.						
Module 2	**Control statements in C**					**20 Sessions**
Topics: Type Casting, Expression Evaluation, Conditional and unconditional statement, Looping statements						
Module 3	**Arrays and Strings**					**21 Sessions**
Topics: One dimensional Array, Array operations,2D Array, 2D Array operations, Strings and its operations, String manipulation functions.						
Module 4	**Functions, Structures and Unions, Pointers**					**10 Sessions**
Topics: Categories of functions, concept of modular programming, user defined datatypes, structures, union, pointers, file handling						

List of Laboratory Tasks:

1. Basics of C Programming To Analyze the problem and draw the flowchart, Selecting the suitable data type
2. Develop the program, identifying errors and rectifying them
3. Programs on Branching statements, Programs on Looping
4. Analyze the problem and draw the flowchart and selecting the branching or looping construct
5. Develop the program. Identifying errors and rectifying them
6. Programs on Arrays and Strings Analyze the problem and draw the flowchart and selecting suitable data storage type.
7. Develop the program Identifying errors and rectifying them.
8. Programs on Functions, Programs on Structures & unions, programs on Pointers.
9. Developing the solution using modular programming and usage of user defined datatype.
10. Develop solutions using pointers concepts and modular programming

Textbook

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

Reference Books:

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

R2: Brian W. Kernighan / Dennis Ritchie, "The C Programming Language " ,Second Edition, Pearson

R3: YashavantKanetkar, "Let Us C", Eighteenth edition , BPB Publications

Web Links:

W1: https://www.coursera.org/learn/introducton- to programming-in-c (Coursera)
https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=DOAJ_1_02082022_1773 (E-Library Resource)

W2: https://onlinecourses.nptel.ac.in/noc22_cs32/preview (NPTEL)

CSC1505 - Digital Computer Fundamentals

Course Code: CSC1505	**Course Title:** Digital Computer Fundamentals **Type of Course:** Theory	L-T-P-C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Basic concepts of number representation, Boolean Algebra, Arithmetic and Logic Computation.					
Anti-requisites	NIL					
Course Description	The purpose of this course is to enable the students to appreciate the fundamentals of digital logic circuits and Boolean algebra focusing on both combinational and sequential logic circuits. This course is analytical in nature and needs a fundamental knowledge on logical computation with Boolean Algebra. The focus of the course will be to discuss the minimization techniques for making canonical and low-cost digital circuit implementations. In this course we emphasize analysis and design of digital electronic circuits. Additionally, this course will create a foundation for future courses including Computer Architecture, Microprocessors, Microcontrollers, and Embedded Systems etc. The course also enhances the Design, Implementation and Programming abilities through laboratory tasks. The associated laboratory provides an opportunity to verify the theoretical knowledge.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Digital Computer Fundamentals and attain the SKILL DEVELOPMENT through EXPERIENTIAL LEARNING.					
Course Outcomes	On successful completion of this course the students shall be able to: **CO1:** Explain number systems, logic gates, Boolean functions, K-Map simplification techniques, and universal gate implementations. [Understand] **CO2:** Apply Boolean algebra and K-Maps to simplify logic expressions and implement them using NAND and NOR gates. [Apply] **CO3:** Use the principles, analysis, and design of combinational logic circuits such as adders, subtractors, multiplexers, decoders, and encoders. [Apply] **CO4:** Apply sequential logic concepts to analyze and design latches, flip-flops, registers, counters, and finite state machines. [Apply]					
Course Content:						
Module 1	**Boolean function simplification**					**10 Sessions**
Topics: Review of Number systems and logic gates, Number base conversions, Overview of Boolean functions and simplifications, two, three, four variable K-Maps- Don't care conditions- Both SOP and POS- Universal Gates (NAND & NOR) Implementations.						
Module 2	**Combinational Logic circuits**					**10 Session**
Topics: Introduction to Combinational circuits, Analysis, Design procedure, Binary Adder and Subtractor, Magnitude comparator, Parity generator and checker, Multiplexers-Demultiplexers, Decoders, Encoders and Priority Encoders.						
Module 3	**Sequential and Programmable logic circuits**					**10 Session**

Topics:
Introduction to sequential circuits, Storage elements: latches and flip flops, Characteristic tables and equations, excitation table, Analysis of clocked sequential circuits, Mealy & Moore Models of finite state machines - Registers & Counters.

Targeted Application & Tools that can be used:

1. Application Area includes all modern electronic devices (cellular phones, MP3 players, laptop computers, digital cameras, high-definition televisions, Home Automation, Communication systems). The students will be able to join a profession which involves basics to high level of digital circuit design and analysis.
2. Professionally Used Software: MultiSim Simulator
3. Besides these software tools Digital IC Trainer kit and Integrated Circuits (ICs) can be used to perform circuit testing and analysis.

Textbooks:

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

Reference Books:

R1: Mano, M. Morris and Ciletti Michael D., *"Digital Design"*, 5th Edition, Pearson Education.
{[PDF] Digital Design By M. Morris Mano, Michael D Ciletti Book Free Download (studymaterialz.in)
R2: Jain, R. P., *"Modern Digital Electronics",* 4th Edition, McGraw Hill Education (India).
Roth, Charles H., Jr and Kinney Larry L., *"Fundamentals of logic Design"*, 7th Edition, Cengage Learning.

Web Links:

W1: NPTEL Course- "Digital Electronics Circuits" by Prof. GowthamSaha, Dept of ECE, IIT Kharagpur, NPTEL :: Electrical Engineering - NOC:Digital Electronic Circuits
W2: Digital Logic Design Lectures PPT Slide 1 (iare.ac.in)
W3: Digital Design Lab Tutorial Links: Multisim Tutorial for Digital Circuits - Bing video CircuitVerse - Digital Circuit Simulator online

CSC1502 - Computational Thinking

Course Code: CSC1502	**Course Title**: Computational Thinking **Type of Course**: Theory	**L- T-P-C**	2	0	0	2
Version No.	1.0					
Course Pre-requisites	Computational Thinking					
Anti-requisites	NIL					
Course Description	This course introduces the fundamental concepts of Computational Thinking and emphasizes systematic problem-solving techniques for program development. It covers decomposition, pattern recognition, abstraction, and algorithm design. Through theory and practical sessions, students develop logical thinking skills and gain experience in designing and implementing efficient solutions for real-world software applications.					
Course Objective	The objective of this course is to develop students' problem-solving and analytical skills by applying Computational Thinking principles through experiential learning techniques.					
Course Outcomes	**On successful completion of the course the students shall be able to**: **CO1:** Explain the fundamental concepts of Computational Thinking including decomposition, pattern recognition, and abstraction. **[Understand]** **CO2:** decomposition techniques to break down complex problems into manageable sub-problems. [Apply] **CO3:** Algorithm design principles to develop structured solutions for given problems. [Apply] **CO4:** Apply appropriate programming constructs to implement computational solutions. [Apply] **CO5:** Efficiency and correctness of designed algorithms. [Analyze] **CO6:** Requirements to select suitable computational strategies for effective solutions. [Analyze]					
Course Content:						
Module 1	**Introduction to Computational Thinking and Problem Solving**					**7 Sessions**
Introduction – Introduction to Computational Thinking, Characteristics and Importance. Problem Solving – Steps in Problem Solving, Understanding the Problem, Identifying Inputs and Outputs. Decomposition – Breaking Complex Problems into Smaller Sub-problems. Pattern Recognition – Identifying Similarities and Trends. Abstraction – Removing Unnecessary Details and Focusing on Important Information.						
Module 2	**Algorithm Design and Representation**					**7 Sessions**

Algorithms – Definition, Characteristics and Examples. Algorithm Design Techniques – Stepwise Refinement and Logical Thinking. Flowcharts – Symbols, Rules and Construction of Flowcharts. Pseudocode – Writing Structured Pseudocode for Problem Solving. Program Activity – Implementing Simple Algorithms using Programming Language.

Module 3	**Control Structures and Logical Thinking**	**8 Sessions**

Decision Making – Conditional Statements (if, if-else, nested if). Looping – Iterative Structures (for, while, do-while). Functions/Modular Programming – Concept of Functions and Code Reusability. Debugging – Identifying and Correcting Errors in Programs.

Module 4	**Algorithm Analysis and Real-world Applications**	**8 sessions**

Introduction to Algorithm Efficiency. Basic Concept of Time and Space Complexity. Understanding Best Case, Average Case and Worst Case Analysis. Application of Computational Thinking in Real-world Problems (Education, Business, Healthcare).

Assignment: Students should complete the theoretical exercises, case studies, and problem-solving questions related to each module and submit module-wise assignments before the deadline.

Textbook

T1 : K. Anandan, T. Pradeep Kumar and K. Shyamala: "Introduction to Computational Thinking and Problem Solving using Python", First Edition, Wiley India Pvt. Ltd., 2020.

References:

R1: Peter J. Denning and Matti Tedre: "Computational Thinking", MIT Press, 2019.

R2 :Karl Beecher: "Computational Thinking: A Beginner's Guide to Problem-Solving and Programming", BCS Learning & Development Ltd., 2017.

R3: Jeanette M. Wing: "Computational Thinking and Its Applications", Selected Articles, Carnegie Mellon University.

Web resources:

W1: For Theory: https://onlinecourses.nptel.ac.in (Computational Thinking related courses)

W2: https://www.geeksforgeeks.org/computational-thinking/

W3: https://csunplugged.org/en/topics/computational-thinking/

CSC1504-Web Design and Development

Course Code: CSC1504	**Course Title:** Web Design and Development **Type of Course:** Laboratory integrated	L-T-P-C	1	0	4	3
Version No.	1.0					
Course Pre-requisites						
Anti-requisites	NIL					
Course Description	This course is designed to build the student's knowledge on web design and development to an intermediate level. Students will learn the fundamental languages and markups for front-end web programming and back-end languages. By the end of this course, students should be able to design, program, and publish a working and atheistic website. Students will also go through the process of working in a client/server-side programming and learning skills which is necessary to successfully fulfill each role. The associated laboratory provides a platform to implement various programming languages to design web pages and enhance critical thinking and analytical skills.					
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Web Design and Development and attain Skill Development through Experiential Learning techniques.					
Course Outcomes	On successful completion of this course the students shall be able to: **CO1:** Explain the fundamentals of HTML and CSS, including elements, styles, and page formatting. [Understand] **CO2:** Develop interactive web pages using JavaScript, including variables, functions, objects, events, and dynamic HTML features. [Apply] **CO3:** Implement server-side scripts using PHP, including control statements, arrays, string handling, and form processing. [Apply] **CO4:** Construct database-driven web applications using PHP and MySQL, including state management, error handling, and CRUD operations. [Create]					
Course Content:						
Module 1	**Introduction to HTML and CSS(Application)**					**6 Sessions**
Topics: Introduction to HTML: fundamentals of HTML elements, Document body, text, hyperlink, lists, tables, color and images, frames;						

Cascading Style Sheets: Introduction, defining your own styles, properties and values in styles, style sheets, formatting blocks, and layers.		
Module 2	**Designing of simple pages (Application)**	**6 Sessions**
Topics: JavaScript: JavaScript basics, variables, string manipulation, mathematical functions, statements, operators, arrays and functions. Objects in JavaScript: Data and objects in JavaScript, regular expressions, exception handling, built-in objects, events; Dynamic HTML with JavaScript: Data validation, opening a new window, Rollover buttons, moving images, multiple pages in a single download, floating logos.		
Module 3	**Server-Side Development (Application)**	**6 Sessions**
Topics: Introduction to PHP, variables, control statements, loops, Arrays, string handling, PHP forms, Global variables in PHP, Regular expression and pattern matching. State management in web applications, cookies, Application and session state. Basic database concepts, connecting to a My SQL database, retrieving and displaying results, modifying, updating and deleting data Errors Handling: Error Handling and Validation, Exceptions, PHP Error Reporting, PHP Error and Exceptions Handling.		
List of Laboratory Tasks: Lab sheet -1 [2 Practical Sessions] Experiment No 1: Level 1 –Design a simple web page with head, body and footer, with heading tags, image tag. Level 2 - Design a page to display the product information such as name, brand, price and etc with table tag. Experiment No. 2: Level 1–Design a web site for book information, home page should contain books list, when particular book is clicked, information of the books should display in the next page. Level 2 - Design a web page to capture the user information such as name, gender, mobile number, mail id, city, state, and country using form elements. Lab sheet – 2 [2Practical Sessions] Experiment No. 1: Level 1 - Design a web page with nice formatting like background image, text colors and border for text using external CSS. Level 2 -JavaScript to perform mathematical calculations such as addition, subtraction, multiplication, and division using form elements Experiment No. 2: Level 1- Design a web page to display timer in the left side of the web page using Java Script. Level 2- Design a web page to capture the student details such as student number, name, age, marks using Java Script Object. Lab sheet – 3 [2 Practical Sessions] Experiment No. 1: Level 1 – JavaScript that calculates the Squares and Cubes of numbers from 0 to 10. Level 2 –Display the results in an HTML table format. Experiment No. 2: Level 1 -JavaScript code that displays text “PRESIDENCY-UNIVERSITY” with increasing font size in the interval of 200ms in a color. Level 2 –When font reaches to 100pt it displays “School of Engineering” in a color. Then font size decreases to 10pt. Lab sheet – 4 [2 Practical Sessions] Experiment No. 1: Level 1 - PHP program print the grade of student using marks		

Level 2 -PHP program to print the date in ten different formats
Experiment No. 2:
Level 1 - PHP program to keep track of the number of visitors visiting the web page and to display this count of visitors, with proper headings.
Level 2 -PHP program to display a digital clock which display the current time of the server.
Lab sheet -5 [2 Practical Sessions]
Experiment No. 1:
Level 1 - PHP program to sort the student's records which are stored in the database using the SELECTION sort.
Level 2 –Design an XML document to store information about a student in a college. The information must include USN, Name, Course name, Year of joining, and email id. Create a style sheet and use it to display document.

Textbooks:

T1: HTML and CSS: The Comprehensive Guide, Jürgen Wolf, SAP Press; New edition (30 June 2023)
T2: JAVASCRIPT THE DEFINITIVE GUIDE 7/ED, David Flanagan, Shroff/O'Reilly; Seventh edition (15 June 2020)
T3: PHP & MySQL: Server-side Web Development, Jon Duckett, Wiley; 1st edition (April 12, 2022)

References:

R1: Deitel, Deitel, Goldberg,"Internet& World Wide Web How to Program", Fifth Edition, Pearson Education, 2021.
R2: HTML &CSSQuickStart Guide, David DuRocher, ClydeBankMedia,2021
JavaScript from Beginner to Professional, Laurence Svekis, Packt Publishing Limited (22 January 2021)

ENG1902-Foundations of English Communication

Course Code: ENG1902	**Course Title:** Foundations Of English Communication **Type of Course:** Theory	**L- T-P- C**	**3**	**0**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	**+ 2 Level English Language Proficiency**					
Anti-requisites	**NIL**					
Course Description	This foundational course is designed to develop core English communication skills in learners with beginner proficiency. centred around the LSRW approach—Listening, Speaking, Reading, and Writing—the course introduces students to practical and interactive methods for enhancing their confidence and fluency in English. Through real-life contexts, engaging activities, and multimedia resources, students will build essential skills needed for academic, professional, and everyday communication. The course also fosters collaboration, self-expression, and digital literacy through creative tasks and group exercises.					
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Identify the basics of English communication and gain confidence in using the language in both academic and social contexts. [Understand] **CO2:** Recognize active listening skills by engaging with different English accents, tones, and formats to better understand meaning and context. [Understand] **CO3:** Demonstrate speaking fluency, correct pronunciation, and clear expression through conversations, role plays, and public speaking. [Apply] **CO4:** Classify vocabulary and reading comprehension skills by reading and analysing various texts such as stories, poems, and digital content. [Understand] **CO5:** Develop effective writing skills for both academic and creative purposes through activities like writing paragraphs, and short stories. [Apply]					
Module 1	**Introduction to English Communication**					**06 Sessions**
Topics: • Importance of English in academics and career • Basics of communication (verbal/non-verbal) • Elements of effective communication • Barriers to communication **Activity:** Verbal and Nonverbal communication- charades.						
Module 2	**Active Listening**					**9 Sessions**

Topics:

- Listening to conversations,
- Listening for gist and details
- Listening and Note-taking

Audio Sources: BBC Learning English, TEDx (simplified), Daily conversations

Activity:

- Listening quiz

Module 3	**Better Speaking**	**12Sessions**

Topics:

- Everyday conversations: shopping, college, travel
- Role plays and dialogues
- Describing people/places

Activity:

- Speech on "My Role Model"
- Extempore (guided)

Module 4	**Reading for Understanding**	**12 Sessions**

Topics:

- Reading simple paragraphs, short stories, and poetry
- Identifying main ideas and supporting details
- Skimming and scanning
- Reading digital content (tweets, podcasts, blogs)

Texts:

- *The Eyes Are Not Here* (Ruskin Bond)
- *Leisure* (W.H. Davies)

Module 5	**Effective Writing**	**12 Sessions**

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

Activity:

- Picture-based story writing

Textbooks:

T1: Gairns, Ruth, and Stuart Redman. *Oxford English for Academic Communication*. Oxford UP, 2021.

T2: Flowerdew, John, and Lindsay Miller. *The Routledge Handbook of English for Academic Purposes*. 2nd ed., Routledge, 2022.

Reference Books:

R1: Richards, Jack C. *Key Issues in Language Teaching*. 2nd ed., Cambridge UP, 2022.

R2: Nation, I. S. P., and Averil Coxhead. *Teaching Vocabulary: A Vocabulary Research Manual*. Routledge, 2022.

R3: Hyland, Ken. *Second Language Writing*. 3rd ed., Cambridge UP, 2021.

R4: Paltridge, Brian, and Sue Starfield. *Getting Published in Academic Journals: Navigating the Publication Process*. 2nd ed., University of Michigan Press, 2020.

Web Resources:

W1: BBC Learning English – https://www.bbc.co.uk/learningenglish.

W2: TEDx Talks – https://www.ted.com/talks.

W3: Grammarly Blog – https://www.grammarly.com/blog/.

W4: FutureLearn – Understanding English Language and Culture – https://www.futurelearn.com/courses/explore-english-language-culture

W5: Cambridge English Learning Resources – https://www.cambridgeenglish.org/learning-english/

PPS1001-Introduction to soft skills

Course Code: PPS1001	**Course Name:** Introduction to Soft Skills **Type of Course:** Lab Course	L- T-P- C	0-0-2-1
Version No.	1		
Course Pre-requisites	1. Students are expected to understand basic English. 2. Students should have desire and enthusiasm to involve, participate and learn.		
Anti-requisites	NIL		
Course Description	This course is designed to enable students to understand the importance of soft skills and improve confidence, communication and professional skills to give the students a competitive advantage and increase chances of success in the professional world. The course will benefit learners in presenting themselves effectively through various activities and learning methodologies.		
Course Objective	The objective of the course is skill development of student by using participative & experiential learning techniques		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Prepare professional social media profiles. [Understand] **CO2:** Recognize the significance of Soft Skills. [Understand] **CO3:** List the techniques of unlearning poor habits and forming healthy habits. [Understand] **CO4:** Demonstrate appropriate team behavior & people management. [Apply]		
Course Content:			
Module 1	**Introduction to Soft Skills**		**6 Sessions**
Topics: Setting Expectations, Ice Breaker, Significance of soft skills.			
Module 2	**Professional Brand Building**		**6 Sessions**
Topics: Significance of a profile. Creating an online profile. Networking - 100 connections, LinkedIn as a live resume, Create a dashboard.			
Module 3	**Habit Formation**		**6 Sessions**
Topics: Professional and personal ethics for success, Identity based habits, Domino effect, Habit Loop, Unlearning, standing up for what is right, New skills acquisition - 10,000 hours' rule for expertise.			
Module 4	**Team Synergy & People Management, Adaptability, Effective communication**		**12 Sessions**

Topics:
Importance of team, Get to know team needs (Maslow's Theory of needs), Trust and collaboration, Virtual Team building.
Change management: VUCA, adapting to changes, growth and fixed mindset, Continuous Learning
Different styles of communication, Difference between hearing and listening, Effective communication for success.
Self-introduction framework.
Self-awareness, Empathy, Self-management, social awareness, and Relationship management

Textbooks:
T1: The 7 Habits of Highly Effective People, first published in 1989, is a business and self-help book written by Stephen R. Covey – (Module – Habit Formation)
T2: The Power of Habit: Why We Do What We Do in Life and Business is a book by Charles Duhigg (Module – Habit Formation)

E-Resources:
W1: How to Write a Blog on LinkedIn
W2: 7 steps for successful career planning (naukri.com)
Ted Talk:
W3: An introvert's guide to networking | Rick Turoczy | TEDxPortland - YouTube (Module: Professional Brand building)
W4: How to turn a group of strangers into a team | Amy Edmondson - YouTube (Module: Team skills and People Management)
W5: How Adaptability Will Help You Deal With Change | Jennifer Jones | TEDxNantwich - YouTube (Module: Adaptability)

CSC1503-Programming in Python

Course Code: **CSC1503**	**Course Title:** Programming In Python **Type of Course:** Laboratory Integrated Course	**L-T-P- C**	1	0	4	3
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	NIL					
Course Description	This course provides the opportunity for the students of Computer Science engineering to develop Python scripts using its powerful programming features like lists, sets, tuples, dictionaries and sets. Students will also be introduced to object-oriented programming concepts and packages for data visualization.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Problem-Solving Using Python and attain **Skill Development** through E**xperiential Learning** techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: **CO1**: Explain basic problem-solving methods and fundamental Python programming concepts. [Understand] **CO2:** Demonstrate the use of functions, strings, and lists to develop simple Python programs. [Apply] **CO3:** Implement Python data structures along with file handling and exception handling in programs. [Apply] **CO4:** Examine object-oriented programs and data visualization outputs to understand program structure and data patterns. (Analyze)					
Course Content:						
Module 1	**Problem Solving Techniques and Basics of Python Programming**					**15 Sessions**
Basics of problem solving techniques, Basics of Python programming, operators and expressions, decision statements, loop control statements.						
Module 2	**Function, String and List**					**20 Sessions**
Functions, strings, lists, list processing: searching and sorting, nested list, list comprehension						
Module 3	**Data Structures, File and Exception handling**					**20 Sessions**
Tuples and dictionaries, sets, file handling, exception handling.						

Module 4	Object-Oriented Programming and Data Visualization	20 Sessions

Object oriented programming concepts, modules and packages for data visualization.

List of Laboratory Tasks:

Each Lab sheets experiments are prepared by level 0 and level 1 module wise.

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

Targeted Application & Tools that can be used:

1. Any IDE –PyCharm
2. VS Code
3. Python IDE
4. Spyder
5. jupyter note book
6. Google Colab

Assignment:

1. Write a python program to input 5 subject marks and calculate total marks, percentage and grade based on following criteria

i)percentage less than 50 (Grade C)
ii)percentage equal to 50 and less than 80 (Grade B)
iii)percentage equal to 80 and more than 80 (Grade A)

2. Write a python program to fetch only Email ID from text file which include following fields -:
   i)Name
   ii)Mobile Number
   iii)Roll Number
   iv)Email ID

3. Write a python script to answer the following questions:

i) What is the average molecular weight of an aminoacids?

ii) What is the total molecular weight and number of aminoacids of the P53 peptide GSRAHSSHLKSKKGQSTSRHK?

iii) What is the total molecular weight and number of aminoacids of the peptide YTSLIHSLIEESQNQQEKNEQELLELDKWASLWNWF?

Textbooks:

T1: Ashok NamdevKamthane and Amit Ashok Kamthane, "Problem Solving and Python Programming", Tata

McGraw Hill Edition, 2018.

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

T3: ReemaThareja, "Python Programming Using Problem Solving Approach", Oxford University Press, 2017.

References

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

E-Resources:

W1: http://pythontutor.com/http://pythontutor.com/

W2. https://www.udemy.com/topic/python/

W3. https://in.coursera.org/courses?query=python

W4: https://puniversity.informaticsglobal.com/login

MAT1202- Probability and Statistics

Course Code: MAT1202	**Course Title:** Probability and Statistics **Type of Course:** Theory	L-T- P-C	**2**	**1**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	Knowledge of Central Tendency and Measure of Dispersion					
Anti Pre-requisites	**NIL**					
Course Description	The course introduces the concepts of probability theory and statistical analysis, covering how to collect, organize, interpret, and draw inferences from data using mathematical models to understand randomness and uncertainty, with applications across various fields like science, engineering, economics, and social sciences.					
Course Objective	The objective of the course is to equip students with the foundational knowledge of probability theory and statistical methods, enabling them to collect, analyze, and interpret data, and make informed decisions based on the likelihood of events occurring in various situations, often applied across different fields like science, engineering, and business.					
Course Outcomes	On successful completion of the course the students shall be able to: **CO1 -** Compute conditional probabilities directly and using Bayes' theorem and check for independence of events. [Apply] **CO2 –** Apply discrete & continuous random variables; in particular, to understand the Bernoulli, binomial, geometric, Poisson distributions, uniform, normal, and exponential distributions. [Apply] **CO3 -** Identifying different types of data relationships (linear, polynomial, exponential, logarithmic). [Understand] **CO4 -** Use specific significance tests, including z-test, t-test (one- and two-sample), and chi-squared test [Apply]					
Course Content:						
Module 1	**Basic Probability**					**4 Sessions**
Probability of an Event, multiplication rule, permutations, combinations, Addition Law, Multiplication Law, Conditional Probability, Bayes's Theorem and Problems.						
Module 2	**Random Variables and Bivariate Distributions**					**18 Sessions**
Random Variables (discrete and continuous), Probability Mass/Density Functions, Mathematical Expectations, discrete probability distributions - Binomial distribution, Poisson distribution, geometric distribution, Continuous uniform distribution - exponential distribution, normal distribution, gamma distribution. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule. Joint Probability distribution for two discrete random variables, expectation and covariance.						
Module 3	**Statistical Methods**					**11 Sessions**

Descriptive Statistics - Moments, skewness and Kurtosis, Correlation - Karl Pearson's coefficient of correlation and rank correlation (with & Without repetition, Multiple Correlation - Problems. Regression analysis - lines of regression, Multiple regression - Problems.

Curve Fitting (Straight Line ($y = a + bx$), Parabola ($y = a + bx + cx^2$), Exponential Curves ($y = ae^{bx}$, $y = ab^x$ and $y = ax^b$)

Module 4	**Sampling Theory**	**12 Sessions**

Random sampling, sampling distributions, Standard Error, Type I & Type II errors, Testing of Hypothesis, Test of significance - Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations, Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Targeted Application & Tools that can be used:

The contents of this course has direct applications in most of the core engineering courses for problem formulations, Problem Solution and system Design.

Tools Used: R software (Open Source)

Assignment:

Select any one simple differential equation pertaining to the respective branch of engineering, identify the dependent and independent variable – Obtain the solution and compare the solution sets by varying the values of the dependent variable.

Textbooks:

R1: Ronald .E. Walpole, Raymond. H. Myers, Sharon. L Myers, and Keying E. Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Delhi-9th edition, 2012.

R2: B. S. Grewal (2017), Higher Engineering Mathematics by, 44th Edition, Khanna Publishers.

References:

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

R2: Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley and sons, Inc.10th Edition.

R3: Douglas C. Montgomery & George Runger, Applied Statistics and Probability for Engineers, , Wiley Publications

E-resources/ Web links:

W1: https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_10427

W2: https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_100198

W3: https://nptel.ac.in/courses/109104124

W4: https://nptel.ac.in/courses/111106051

W5: https://nptel.ac.in/courses/111102137

W6: https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html

W7: https://www.scu.edu.au/study-at-scu/units/math1005/2022/

Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of Vector calculus and Linear Algebra with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem Solving**.** This is attained through the assessment component mentioned in the course handout.

CSC2504 Data Structures

Course Code: CSC2504	**Course Title:** Data Structures **Type of Course:** Theory	**L- T-P-C**	3	1	0	4
Version No.	1.0					
Course Pre-requisites	Problem Solving Using C					
Anti-requisites	NIL					
Course Description	This course introduces the fundamental concepts of data structures and to emphasize the importance of choosing an appropriate data structure and technique for program development. This course has theory and lab component which emphasizes on understanding the implementation and applications of data structures using Java programming language. With a good knowledge in the fundamental concepts of data structures and practical experience in implementing them, the student can be an effective designer, developer for new software applications.					
Course Objective	The objective of the course is SKILL DEVELOPMENT of student by using EXPERIENTIAL LEARNING techniques					
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Understand the fundamentals of data structures, linear data structures, and the concepts of arrays, stacks, and queues. [Understand] **CO2:** Apply stack and queue operations using array implementations to solve basic computational problems. [Apply] **CO3:** Use linked list concepts and recursion techniques to develop programs for linear data management. [Apply] **CO4:** Implement non-linear data structures such as trees and graphs, including traversals and representations, to solve problem scenarios. [Apply] **CO5:** Examine the searching and sorting algorithms and evaluate their performance using time and space complexity in best, average, and worst cases. [Analyze]					
Course Content:						
Module 1	**Introduction to Data Structure and Linear Data Structure – Stacks and Queues**					**11 Sessions**
Introduction – Introduction to Data Structures, Types and concept of Arrays. **Stack -** Concepts and representation, Stack operations, stack implementation using array and Applications of Stack. **Queues -** Representation of queue, Queue Operations, Queue implementation using array, Types of Queue and Applications of Queue.						
Module 2	**Linear Data Structure- Linked List**					**11 Sessions**

Topics: **Linked List** - Singly Linked List, Operation on linear list using singly linked storage structures, Circular List, Applications of Linked list. **Recursion** - Recursive Definition and Processes, Programming examples.		
Module 3	**Non-linear Data Structures - Trees and Graph**	**11 Sessions**
Topics: **Trees** - Introduction to Trees, Binary tree: Terminology and Properties, Use of Doubly Linked List, Binary tree traversals: Pre-Order traversal, In-Order traversal, Post-Order traversal. **Graph** - Basic Concept of Graph Theory and its Properties, Representation of Graphs.		
Module 4	**Searching & Sorting Performance Analysis**	**12 sessions**
Topic: Sorting & Searching - Sequential and Binary Search, Sorting – Selection and Insertion sort. **Performance Analysis** - Time and space analysis of algorithms – Average, best and worst case analysis.		
Assignment: Students should complete the lab programs associated with each module by end of each practical session and module wise assignments before the deadline.		
Textbooks: **T1:** NarasimhaKarumanchi: *"Data Structures and Algorithms Made Easy in Java",* 5th Edition, CareerMonk Publications, 2017.		
References: **R1** : Mark Allen Weiss: *"Data Structures and Algorithm Analysis in Java",* 4th Edition, Pearson Educational Limited, 2014. **R2:** Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser: *"Data Structures and Algorithms in Java"*, 6th Edition, John Wiley & Sons, Inc., ISBN: 978-1-118-77133-4, 2014. **R3:** Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, 2017: *"Introduction to Algorithms",* 3rd Edition, PHI Learning Private Limited. **Web Resources**: **W1:** For theory: https://onlinecourses.nptel.ac.in/noc20_cs85/preview **W2:** https://www.geeksforgeeks.org/data-structures/		

CSC2505-Data Structures Lab

Course Code: CSC2505	**Course Title:** Data Structures Lab **Type of Course:** Lab	**L- T-P- C**	**0-0-2-1**
Version No.	1.0		
Course Pre-requisites	Problem Solving Using C		
Anti-requisites	NIL		
Course Description	This course introduces the fundamental concepts of data structures and to emphasize the importance of choosing an appropriate data structure and technique for program development. This course has theory and lab component which emphasizes on understanding the implementation and applications of data structures using Java programming language. With a good knowledge in the fundamental concepts of data structures and practical experience in implementing them, the student can be an effective designer, developer for new software applications.		
Course Objective	The objective of the course is SKILL DEVELOPMENT of student by using EXPERIENTIAL LEARNING techniques		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Implement linear data structures including arrays, stacks, and queues to solve computational problems [Apply]. **CO2:** Develop programs using linked lists and recursion to manipulate dynamic data [Apply]. **CO3:** Apply non-linear data structures such as trees and graphs, including traversals and basic operations. [Apply]. **CO4:** Analyze the performance of searching and sorting algorithms in terms of time and space complexity [Analyze].		
Course Content:			
Module 1	**Introduction to Data Structure and Linear Data Structure – Stacks and Queues**		**8 Sessions**
Introduction – Introduction to Data Structures, Types and concept of Arrays. **Stack -** Concepts and representation, Stack operations, stack implementation using array and Applications of Stack. **Queues -** Representation of queue, Queue Operations, Queue implementation using array, Types of Queue and Applications of Queue.			
Module 2	**Linear Data Structure- Linked List**		**8 Sessions**

Topics: **Linked List** - Singly Linked List, Operation on linear list using singly linked storage structures, Circular List, Applications of Linked list.

Recursion - Recursive Definition and Processes, Programming examples.

Module 3	Non-linear Data Structures - Trees and Graph	8 Sessions

Topics: **Trees** - Introduction to Trees, Binary tree: Terminology and Properties, Use of Doubly Linked List, Binary tree traversals: Pre-Order traversal, In-Order traversal, post-order traversal. **Graph** - Basic Concept of Graph Theory and its Properties, Representation of Graphs.

Module 4	Searching & Sorting Performance Analysis	6 Sessions

Topic: Sorting & Searching - Sequential and Binary Search, Sorting – Selection and Insertion sort.

Performance Analysis - Time and space analysis of algorithms – Average, best and worst case analysis.

List of Laboratory Tasks:

Lab sheet -1
Level 1: Program to Create, display, insert, and delete for elements in an array.
Level 2: Program to merge two sorted arrays into a single sorted array.
Lab sheet -2
Level 1: Program to demonstrate the working of stack using array.
Level 2: Program for Towers of Hanoi problem.
Lab sheet -3
Level 1: Program to convert infix arithmetic expression to post fix expression.
Level 2: Program to simulate the working of an ordinary queue using an array.
Lab sheet -4
Level 1: Program to simulate the working of Circular Queue using an array.
Level 2: Program to Insert and delete a node in a Singly Linked List
Lab sheet -5
Level 1: Program to find the GCD of two numbers using recursion.
Level 2: Program to find the Factorial of a Number using recursion
Lab sheet -6
Level 1: Program to calculate the sum of the first N natural numbers using recursion.
Level 2: Program to create and display a general Tree without traversal operations.
Lab sheet -7
Level 1: program to perform basic Operations on binary tree
a) Create a binary tree
b) Insertion
c) Deletion
Level 2: Program to perform In-order traversal operation.
Lab sheet -8
Level 1: Program to perform Pre-order traversal operation.
Level 2: Program to perform post-order traversal operation.
Lab sheet -9
Level 1: program to search an element using linear search.
Lab sheet -10
Level 1: program to search an element using Binary search.

Lab sheet -11
Level 2: Program to Sort the elements using Bubble sort technique.
Lab sheet -12
Level 1: Program to sort the elements using Insertion Sort.
Lab sheet -13
Level 1: Program to sort the elements using Selection Sort.

Targeted Application & Tools that can be used
Use of PowerPoint software for lecture slides and use of Ubuntu for lab programs to execute. Tool is Codetantra tool.

Project work/Assignment:

Assignment: Students should complete the lab programs by end of each practical session and module wise assignments before the deadline.

Text books:

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

References:

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

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

R3: Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, 2017: *"Introduction to Algorithms",* 3rd Edition, PHI Learning Private Limited.

Web Resources:

W1: For theory: https://onlinecourses.nptel.ac.in/noc20_cs85/preview

W2: https://puniversity.informaticsglobal.com/login

ENG1913- Essentials of Writing Skills

Course Code: **ENG1913**	**Course Title:** Essentials of Writing Skills **Type of Course**: Theory	**L-T- P- C**	3	0	0	3
Version No.	1					
Course Prerequisites	Basic understanding of English language.					
Anti-requisites	NIL					
Course Description	This foundational course is designed to equip BCA students with essential writing skills necessary for academic, professional, and everyday communication. The course begins with the absolute basics and gradually progresses toward structured writing, including report writing. Emphasis is placed on developing clarity, coherence, and correctness in writing, which are crucial in academic and workplace settings.					
Course Objective	To develop foundational writing skills by focusing on clarity, coherence, and correctness in written communication. The course aims to build competence from basic sentence construction to structured forms such as report writing, preparing students for effective academic, professional, and everyday communication.					
Course Outcomes	By the end of the course, students will be able to: **CO1:** Explain the principles of effective written communication. [Understand] **CO2:** Correctly use punctuation marks. {Apply] **CO3:** Produce grammatically correct and coherent sentences. [Apply] **CO4:** Prepare structured paragraphs and short compositions. [Apply] **CO5:** Prepare technical reports with attention to format, clarity, and purpose. [Apply]					
Course Content:						
Module I	**Introduction to Writing**				**9 Sessions**	
• The Nature and Purpose of Writing • Writing as a Process • Characteristics of Effective Writing • Forms of Writing • Audience and Purpose						
Module II	**Guided Composition**				**9 Sessions**	
• Understanding Guided Composition • Using Prompts and Cues • Organizing Content • Linking Paragraphs • Common Composition Types						
Module III	**Types of Writing**				**9**	

		Sessions
• Overview of Writing Types • Narrative Writing • Descriptive Writing • Expository Writing • Persuasive Writing		
Module IV	**Technical Writing**	**9 Sessions**
• Principles of Technical Writing • Language and Tone in Technical Writing • Report Writing • Writing Meeting Minutes and Summaries • Common Errors in Technical Writing		
Module V	**Revising and Editing**	**9 Sessions**
• The Difference Between Revising and Editing • Revising for Content, Clarity, and Structure • Editing for Grammar, Punctuation, and Style • Peer Review and Self-Editing Techniques • Tools and Strategies for Effective Proofreading		
Targeted Application & Tools that can be used: Microsoft Word, Google Docs, ChatGPT.		
Reference Books: **R1:** Langan, John**.** *College Writing Skills with Readings*. McGraw-Hill Education, 2019. **R2:** Seely, John. *The Oxford Guide to Effective Writing and Speaking*. Oxford University Press, 2013. **R3:** Strunk, William, and E. B. White. *The Elements of Style*. Pearson, 2000. **R4:** Sharma, R. C., and Krishna Mohan. *Business Correspondence and Report Writing*. Tata McGraw-Hill, 2016 **R5:** Bailey, Stephen. *Academic Writing: A Handbook for International Students*. Routledge, 2018. **Web Sources:** **W1:** https://owl.purdue.edu **W2:** https://www.bbc.co.uk/learningenglish **W3:** https://www.coursera.org **W4:** http://www.phrasebank.manchester.ac.uk		
Topics Relevant to "employability": Writing skills, compositions, types of writing, technical writing, team collaboration.		

CSC2506- Computer Networks

Course Code: **CSC2506**	**Course Title:** Computer Networks **Type of Course:** Theory	**L-T-P-C**	**3**	**0**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	Computer Organization					
Anti-requisites	NIL					
Course Description	This course gives a thorough introduction to all the layers of computer networks 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 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 Outcomes	On successful completion of the course the students shall be able to: **CO1:** Explain the basic concepts of computer networks, network topologies, and OSI and TCP/IP models. [Understand] **CO2:** Describe the working of application, transport, network, and data link layer protocols.[Understand] **CO3:** Utilize networking concepts to solve problems related to IP addressing, routing, and data link layer protocols. [Apply] **CO4:** Select wireless networking and security techniques to build and secure simple network applications. [Apply]					

Course Content

Module 1	**Overview, Application, and Transport Layer**	**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**	**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**	**08 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**	**08 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.		
TargetedApplication & Tools that can be used: 1. Cisco Packet Tracer 2. Wireshark		
Case Study/Assignment: Assignment proposed for this course in CO1-CO4 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? 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. 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.

Getting familiar with Wireshark software by installing it I your system, and perform following task:

List out the packets which are having DNS protocols

List of IP address present in the cache along with its MAC addresses

Display all the packets which are having the DNS or HTTP protocol

Problem Solving:

Choose an appropriate devices and implement various network concepts.

Textbooks:

T1: James F. Kurose, Keith W. Ross, "*Computer Networking ATopdown Approach",* 8th Edition, Pearson, 2023.

T2: Computer Networks ,Tanenbaum , 5th Edition , Pearson Education Media, 2023

T3: Behrouz A. Forouzan, "*Data Communications and Networking*", 5th Edition, Tata McGraw-Hill, 2017

Reference Books:
R1: CompTIA Network+ Certification All in one Exam Guide , Mike Meyers , 7th Edition , McGraw Hill, 2023
R2: Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007.

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*

CSC1506-Computer Organization

Course Code: CSC1506	**Course Title:** Computer Organization **Type of Course:** Theory	L-T-P- C	3	0	0	3
Version No.	1.0					
Course Pre-requisites	Nil					
Anti-requisites	NIL					
Course Description	Computer Organization is an introductory course that focuses on the fundamental principles and concepts behind the design and implementation of modern computer systems. The course explores the structure and functionality of computers at the hardware level, providing students with a solid foundation in understanding how computers work. Throughout the course, students will delve into various topics related to computer organization, including processor architecture, memory systems, input/output (I/O) devices, and system buses. They will gain an understanding of the interplay between hardware and software and how they interact to execute programs and perform computations efficiently.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Computer Organization and attain Skill Development through Participative Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: **CO1:** Explain the fundamentals of computer systems, their evolution, performance considerations, and instruction execution. [Understand] **CO2:** Describe computer arithmetic concepts, processor organization, and memory hierarchy. [Understand] **CO3:** Use fixed-point and floating-point arithmetic techniques to solve numerical problems. [Apply] **CO4:** Interpret datapath, pipelining, and hazard handling concepts to analyze processor performance. [Apply] **CO5:** Apply memory organization, I/O organization, and parallel processing concepts to analyze modern computing systems. **[Apply]**					
Course Content:						
Module 1	**Computer Organization & Instructions**					**10 Sessions**
Basics of a computer system: Evolution, Ideas, Technology, Performance, Power wall, Uniprocessors to Multiprocessors. Addressing and addressing modes. Instructions: Operations and Operands, Representing instructions, Logical operations, control operations.						
Module 2	**Arithmetic Instructions**					**8 Sessions**
Fixed point Addition, Subtraction, Multiplication and Division. Floating Point arithmetic, High performance arithmetic, Subword parallelism						
Module 3	**The Processor**					**8 Sessions**
Introduction, Logic Design Conventions, Building a Datapath — A Simple Implementation scheme — An Overview of Pipelining — Pipelined Datapath and Control. Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions.						
Module 4	**Memory and I/O Organization**					**10 Sessions**
Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, Serial Bus Architectures, Mass storage, Input and Output Devices.						
Module 5	**Advanced Computer Architecture**					**9 Sessions**

Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors, Introduction to Graphics Processing Units, Clusters and Warehouse scale computers — Introduction to Multiprocessor network topologies.
List of Laboratory Tasks: Each Lab sheets experiments are prepared by level 0 and level 1 module wise.
Targeted Application & Tools that can be used: NA
Assignment:
Assignments are given after completion of each module which the students need to submit within the stipulated deadline.
Textbooks: **T1:** Carl Hamacher, ZvonkoVranesic and SafwatZaky, "Computer Organization", Fifth Edition, Tata McGraw Hill, 2021. **T2:** Godse, A. P., &Godse, D. A. (2021). Computer Organization and Architecture. Technical Publications.
Reference Books: **R1:** David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Elsevier, 2019. **R2:** William Stallings, "Computer Organization and Architecture – Designing for Performance", Sixth Edition, Pearson Education, 2003. **R3:** John P. Hayes, "Computer Architecture and Organization", Third Edition, Tata McGraw Hill.

CSC2507-Relational Database Management Systems

Course Code: CSC2507	**Course Name:** Relational Database Management Systems **Type of Course:** Theory Course	**L- T-P-C**	**3-0-0-3**
Version No.	1		
Course Pre-requisites	Computer Organization		
Anti-requisites	Nil		
Course Description	This course introduces the core principles and techniques required in the design and implementation of database systems. It covers concepts of relational database systems (RDBMS). More emphasis is set on how to design, develop, organize, maintain and retrieve the information efficiently. It helps the students to learn and practice data modeling and database designs.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Relational Database Managment Systems and attain Skill Development through Participative Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1** Understand databases, ER/relational models, and DBMS benefits. [Understand] **CO2:** Use relational algebra and SQL for data retrieval and manipulation. [Apply] **CO3:** Choose normalization techniques and schema design principles to design efficient and reliable database schemas. [Apply] **CO4:** Develop schemas & FDs to identify anomalies and performance problems. [Apply]		
Course Content:			
Module 1	**Introduction to Database Modelling and Relational Algebra**		**15 Sessions**
Topics: Introduction to Database: Schema, Instance, 3-shema architecture, physical and logical data independence, Data isolation problem in traditional file system, advantages of database over traditional file systems. Entity Relationship (ER) Model, ER Model to Relational Model, Examples on ER model. Relational Algebra with selection, projection, rename, set operations, Cartesian product, joins (inner and outer joins), and division operator. Examples on Relational Algebra Operations.			
Module 2	**Fundamentals of SQL and Query Optimization**		**15 Sessions**
Database Querying: DDL, DML, Constraints, Operators- BETWEEN, IN, LIKE, where clause, order by command, Set Operators, Aggregate Functions, having, group by clauses, Views, Procedures, Cursors and Triggers. Query Optimization: Purpose, transformation of relational expressions, estimating cost and statistics of expression, choosing evaluation plans, linear and bushy plans, dynamic programming algorithms.			
Module 3	**Designing and Refining Database Schema**		**15 Sessions**
Topics: Schema Design: Problems in schema design, redundancy and anomalies. Schema refinement: Functional Dependencies, Normalization and forms - First, Second, Third, Dependency Preservation – Boyce/Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Fundamentals of Transaction:			

Introduction to Transaction Processing, Transaction and System concepts, Desirable properties (ACID) of Transactions.
Text Book **T1.** Elmasri R and Navathe S B, "Fundamentals of Database System", Pearson Publication, 7th Edition, 2018. **T2.** RamaKrishna & Gehrke, "Database Management Systems" 3rd Edition, 2018, McGraw-Hill Education.
References **R1.** W. Lemahieu, S. vanden Broucke and B. Baesens, "Principles of Database Management: Practical Guide to Storing, Managing and Analyzing Big and Small Data", Cambridge University Press, 2018. **R2**. Avi Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill ,7th Edition, 2019.
E-Resources NA

CSC2508-Relational Database Management Systems Lab

Course Code: CSC2508	**Course Name:** Relational Database Management Systems Lab Type of Course: Lab	**L- T-P-C**	**0-0-2-1**
Version No.	1		
Course Pre-requisites	CSA2103 – Relational Database Management Systems (Basics of Database)		
Anti-requisites	NIL		
Course Description	This course is designed to implement various databases using MySQL DATABASE in information technology applications. All the exercises will focus on the fundamentals for creating, populating, sophisticated, interactive way of querying, and simultaneous execution of the transactions of database.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Relational Database Managment Systems and attain Skill Development through Experiential Learning techniques.		
Course Outcomes	On successful completion of the course the students shall be able to: **CO1:** Apply ER models, relational algebra, and SQL queries to create and use a database. [Apply] **CO2:** Select database schemas to find redundancy and normalization problems. [Analyze] **CO3:** Construct queries and transactions to improve database performance and reliability. [Analyze]		
Course Content:			
Module 1	**Introduction to Database Modelling and Relational Algebra**		**15 Sessions**
Topics: Introduction to Database: Schema, Instance, 3-shema architecture, physical and logical data independence, Data isolation problem in traditional file system, advantages of database over traditional file systems. Entity Relationship (ER) Model, ER Model to Relational Model, Examples on ER model. Relational Algebra with selection, projection, rename, set operations, Cartesian product, joins (inner and outer joins), and division operator. Examples on Relational Algebra Operations.			
Module 2	**Fundamentals of SQL and Query Optimization**		**15 Sessions**
Topics: Database Querying: DDL, DML, Constraints, Operators- BETWEEN, IN, LIKE, where clause, order by command, Set Operators, Aggregate Functions, having, group by clauses, Views, Procedures, Cursors and Triggers. Query Optimization: Purpose, transformation of relational expressions, estimating cost and statistics of expression, choosing evaluation plans, linear and bushy plans, dynamic programming algorithms.			
Module 3	**Designing and Refining Database Schema**		**15 Sessions**
Topics: Schema Design: Problems in schema design, redundancy and anomalies. Schema refinement: Functional Dependencies, Normalization and forms - First, Second, Third, Dependency Preservation – Boyce/Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. Fundamentals of Transaction: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties (ACID) of Transactions.			

List of Laboratory Tasks

Labsheet-1 [3 Practical Sessions]

Experiment No 1:

To study and implement the different language of Structured Query Language.

Level 1: Perform operations using Data Definition Language and Data Manipulation Language commands including different variants of SELECT on Student DB.

Level 2: Identify the given requirements; valid attributes and data types and Perform DDL and DML operations on a given scenario. [Banking Databases]

Experiment No. 2:

1. To study and implement the concept of integrity constraints in SQL.

Level 1: Create tables on Banking database using PRIMARY KEY, NOT NULL, UNIQUE, FOREIGN KEY and demonstrate the working of relational, logical, pattern matching, BETWEEN, IS NULL, IN and NOT IN Special Operators on Student Database.

Level 2: Enforce different types of data and referential integrity constraints. Then try queries with special operators based on the student database. [Banking Database].

Labsheet-2 [4 Practical Sessions]

Experiment No. 3:

2. Implement complex queries in SQL.

Level 1: Implement the conjugate of GROUP BY, ORDER BY and aggregate functions on Banking Database. Level 2: Implement MySQL DB queries on library database using appropriate clauses and aggregate functions. Also order the data either in ascending and descending order using corresponding clause. [Library databases].

Experiment No. 4:

3. To study and implement different types of Set and Join Operations

Level 1: Demonstrate different types of Set Operations (UNION, UNION ALL, INTERSECT, MINUS) and Join Operations (INNER JOINs, OUTER JOINS, CROSS JOIN, NATURAL JOIN) on two or more tables of Airline Database.

Level 2: Use Set and Join operations to retrieve the data from two or more relations(tables) as per the given scenario. [Airline Database]

Labsheet-3 [3 Practical Sessions]

Experiment No. 5:

5. To study and implement Views, and Procedures in MySQL DB.

Level 1: Implement MySQL Views, and Procedures in ORACLE DB on Employee database.

Level 2: Analyze the requirement and construct views, and Procedures on Mini Project Domain. [Banking Database]

Labsheet-4 [2 Practical Sessions]

Experiment No. 6:

6. To study and implement Functions, and Triggers in MySQL DB.

Level 1: Implement Oracle Functions and Triggers in Oracle on Employee database.

Level 2: Analyze the requirement and construct Functions and Triggers. [Supply chain Database]

Labsheet-5 [2 Practical Sessions]

Experiment No. 7:

To implement the concept of forms and reports.

Level 1: Implement the concept of forms and reports.

Level 2: Analyze the schema relationship.

Labsheet-6 [3 Practical Sessions]

Experiment No. 8:

Design a mini project based on the databases such as Inventory Management System, University Management System, Hospital Management System, etc.

Level 1: Implement the real time database.

Level 2: Analyze the working of database in real time.

Text Book

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

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

References

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

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

E-Resources

NA

CSC2500- Object Oriented Programming using Java

Course Code: CSC2500	**Course Name:** Object Oriented Programming using Java **Type of Course:** Lab Course	**L- T-P-C**	**1-0-4-3**
Version No.	1		
Course Pre-requisites	CSA2500		
Anti-requisites	Nil		
Course Description	The main objective is to learn the basic concept and techniques which form the object-oriented programming paradigm. Object-oriented programming is a new way of thinking about problem using models organized around real world concept. It investigates the software engineering principles of encapsulation, information hiding and code reuse, and discusses how these concepts are used to build abstract data types. The object oriented programming features of classes, inheritance, polymorphism and composition are studied, along with constructors and method overloading. Students implement Java programs incorporating features from the Java programming language.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Object Oriented Programming Using Java and attain Skill Development through Experiential Learningtechniques.		
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1:** Understand object-oriented programming concepts and execute basic Java programs. [Understand] **CO2:** Explain class-related concepts and built-in methods of the String and String Buffer classes. [Understand] **CO3:** Implement constructors, polymorphism, inheritance, interfaces, and packages through Java programs. [Apply] **CO4:** Create and manage threads and design GUI forms using Applet and Swing components. [Create]		
Course Content:			
Module 1	**Introduction to OOP : Class and Object**		**20 Sessions**
Topics: Classes, Methods, Objects, Description of data hiding and data encapsulation, Constructors, Use of static Keyword in Java, Use of this Keyword in Java, Concept of Access Modifiers (Public, Private, Protected, Default).			
Module 2	**Arrays, Strings , Extending Class**		**15 Sessions**
Topics: Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array,Array of Objects, Strings: Operation on String, Mutable & Immutable String, Creating Strings using String Buffer or StringBuilder. String Constant Pool, String Internal representation, String Application. Tokenizing a String. Inheritance and Polymorphism: Use and benefits of inheritance in OOP, Types of Inheritance, Method overriding, super keyword, Final, Polymorphism in inheritance, Abstract, Exception Handling.			

Module 3	Interface, Package and Exception Handling	15 Sessions
Topics: Introduction to threads, life cycle of a thread, Creating Threads, Extending the Thread Class, Implementing the Runnable interface, priority of a thread, synchronization, Inter communication of Threads. JAVA File I/O - Byte Stream - InputStream - OutputStream - FileInputStream - FileOutputStream - The Character Streams - Reader - Writer - FileReader - FileWriter		
Module 4	**Collection & GUI Programming**	**25 Sessions**
Topics: The Collection Framework : Collections of Objects , Collection Types, Sets , Sequence, Map, Understanding Hashing, Use of ArrayList& Vector Graphics Programming: Introduction, the abstract window toolkit (AWT), Layout managers, Frames, Panels, Drawing geometric figures, Keyboard Event and Mouse Event. Creating User Interface: Introduction, describe various user interface Components: button, label, text field, text area, choice, list, check box.		
Text Book T1. Herbert Schildt, Java, The Complete Reference, Eleventh Edition, McGraw-Hill Education, 2019. • E Balagurusamy, Programming with Java, 7th Edition, McGraw-Hill Education, 2020.		
List of Laboratory Tasks **Lab Sheet - 1** **Experiment No 1:** **Level1** -Programs using Control statementsà 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. **Level 2** - Programs to implement array of objects, passing and returning objects as arguments. **Lab sheet – 2** **Experiment No. 1:** **Level 1** - Programs to demonstrate concepts of constructors and destructors **Level 2** - 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:** **Level 1** – Programs to implement methods of String and String Buffer Class. **Level 2** - Programs to implement Inheritance and Polymorphism, Programs to implements Interface. **Lab sheet – 3** **Level 1** - Programs to demonstrate Exceptions Handlers. **Level 2** - Programs to implements nested handlers, Checked and Unchecked Exception Handlers. **Lab sheet – 4** **Level 1** - Programs to implement Thread class and Runnable Interface. **Level 2** - Programs to implement priority, inter thread communication. **Level 3** - Programs to implement file handling mechanism. **Lab sheet –5** **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** **Experiment No. 1:** **Level 1** – Programs to implement concepts of GUI. **Level 2** – Programs to create Registration form using Swing.
References **T1.** R. Nageswara Rao, Core Java: An Integrated Approach, New: Includes All Versions upto Java 8 2016. **T2.** Brett McLaughlin, Head First Object-Oriented Analysis and Design: A Brain Friendly Guide to OOA&D, Dreamtech Press , 2016.
E-Resources **W1.** "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.

CSC2509- Discrete Mathematics

Course Code: CSC2509	**Course Title: Discrete Mathematics Type of Course:1] School Core**	**L-T-P- C**	**2**	**1**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	Linear Algebra					
Anti-requisites	**NIL**					
Course Description	The course explores the study of mathematical structures that are fundamentally discrete (not continuous), focusing on concepts like set theory, logic, graph theory, combinatorics, and number theory, with applications primarily in computer science fields like algorithms, software development, and cryptography; it covers topics such as propositional logic, proof techniques, relations, functions, counting principles, and basic graph algorithms, providing a foundation for analyzing discrete problems and structures within computer science.					
Course Objective	The main objective of the course is that students should learn a particular set of mathematical facts and how to apply them. It teaches students how to think logically and mathematically through five important themes: mathematical reasoning, combinatorial analysis, discrete structures, algorithmic thinking, and applications and modeling. A successful discrete mathematics course should carefully blend and balance all five themes.					
Course Outcomes	On successful completion of the course the students shall be able to: **CO1** - Explain logical sentences through predicates, quantifiers and logical connectives. **CO2** - Deploy the counting techniques to tackle combinatorial problems **CO3** - Comprehend the basic principles of set theory and different types of relations. **CO4** - Apply different types of structures of trees for developing programming skills					
Course Content:						
Module 1	**Fundamentals of Logic**					**(10 Classes)**
Basic Connectives and Truth Tables, Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy.						
Module 2	**Principle of Counting**					**(15 Classes)**
The Well Ordering Principle – Mathematical Induction The Basics of Counting, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Generating Permutations and Combinations Advanced Principle Counting: The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements – Nothing is in its Right Place, Rook Polynomials.						
Module 3	**Relations and Functions**					**(10 Classes)**
Cartesian Products and Relations, Functions, One-to-One, Onto Functions. The Pigeon-hole Principle, Function Composition and Inverse Functions.						

Relations, Properties of Relations, Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders, Lattice, Hasse Diagrams, Equivalence Relations and Partitions.		
Module 4	**Recurrence Relations and Generating Functions**	**(10 Classes)**
Homogeneous and inhomogeneous recurrences and their solutions - solving recurrences using generating functions - Repertoire method - Perturbation method - Convolutions - simple manipulations and tricks.		
Module 5	**Graph Theory & Algorithms on Networks**	**(15 Classes)**
Definitions and basic results - Representation of a graph by a matrix and adjacency list - Trees - Cycles - Properties - Paths and connectedness - Sub graphs - Graph Isomorphism - Operations on graphs - Vertex and edge cuts - Vertex and edge connectivity, Euler and Hamilton Paths, Shortest-Paths. Tree - Definitions, Properties, and Examples, Routed Trees, Binary search tree, Decision tree, spanning tree: BFS, DFS. Algorithms on Networks - Shortest path algorithm- Dijikstra's algorithm, Minimal spanning tree- Kruskal algorithm and Prim's algorithm.		
Targeted Application & Tools that can be used: Discrete mathematics provides the mathematical foundations for many computer science courses including data structures, algorithms, database theory, automata theory, formal languages, compiler theory, computer security, and operating systems.		
Assignment:		
Assignment 1: Logic Equivalences and Predicate calculus. **Assignment 2: Equivalence Relations and Lattices** **Assignment 3: Recurrence Relations**		
Text Book T1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw-Hill,s 8th Edition,2019. T2. Harary – Graph Theory, Addison-Wesley Publishing Company.		
References: R1. Arthur Gill, "Applied Algebra for Computer Science", Prentice Hall. R2. K.D. Joshi, "Discrete Mathematics", Wiley Eastern Ltd. R3. Ralph. P. Grimaldi., "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia. **E-resources/ Web links:** W1. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_54588 W2. https://presiuniv.knimbus.com/user#/viewDetail?searchResultType=ECATALOGUE_BASED&unique_id=EBSCO95_30102024_375 W3. https://www.math.hkust.edu.hk/~maqian/ma006_0607F.html W4. https://www.scu.edu.au/study-at-scu/units/math1005/2022/		
Topics relevant to SKILL DEVELOPMENT: The course focuses on the concepts of calculus and differential equation with reference to specific engineering problems. The course is of both conceptual and analytical type in nature through Problem solving**.** This is attained through the assessment component mentioned in course handout.		

CSC2510-Analysis of Algorithms

Course Code: CSC2510	**Course Name: Analysis of Algorithms** **Type of Course: Theory**	**L- T-P-C**	**3-1-0-4**
Version No.	1		
Course Pre-requisites	Data Structures and Algorithms		
Anti-requisites	NIL		
Course Description	This Course introduces techniques for the design and analysis of efficient algorithms and methods of applications. Deals with analyzing time and space complexity of algorithms, and to evaluate trade-offs between different algorithms.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Analysisof Algorithms and attain Skill Development through Problem Solving Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Explain problem types, asymptotic notations, and the time complexity analysis of recursive and non-recursive algorithms. **(Understand)** **CO2 :**Describe the working principles of brute force, divide-and-conquer, dynamic programming, greedy, and backtracking techniques. **(Understand)** **CO3 :**Select algorithm design techniques to solve problems such as sorting, searching, knapsack, shortest path, and minimum spanning tree. **(Apply)** **CO4 :**Identify appropriate algorithms to solve optimization and combinatorial problems like travelling salesman, n-queens, Hamiltonian path, and graph coloring. **(Apply)**		
Course Content:			
Module 1	**Introduction**		**10 Sessions**
Topics: Important Problem types, Asymptotic Notations and its properties, Mathematical analysis for Recursive and Non-recursive algorithms.			
Module 2	**Algorithm design techniques-Brute force**		**10 Sessions**
Topics: Selection Sort, sequential search, Uniqueness of Array, Exhaustive search Travelling Salesman, Knapsack Problem.			
Module 3	**Divide-and-conquer**		**10 Sessions**
Topics: Master Theorem, Merge sort, Quick sort, Binary search.			
Module 4	**Dynamic programming and greedy technique**		**15 Sessions**
Topics: Introduction, Coin changing problem, Multi stage graph – Optimal Binary Search Trees, warshall's, floyds,0/1 Knapsack, Prim's, Kruskal's, Dijkstra's Algorithm. Hamiltonian Path Problem, M Coloring Problem. Backtracking, - Backtracking – n-Queens problem.			
Text Book **T1**. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI Learning Private Limited.			

T2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, *Introduction to Algorithms*, 3rd ed. Cambridge, MA, USA: MIT Press, 2009.
References R1. AnanyLevitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education. R2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson.
E-Resources **W1**. https://onlinecourses.nptel.ac.in/noc19_cs47/preview

CSC2511-ANALYSIS OF ALGORITHMS LAB

Course Code: CSC2511	**Course Title:** Analysis of Algorithms lab **Type of Course: Lab**	**L- T-P- C**	0-0-2-1
Version No.	1.0		
Course Pre-requisites	Problem Solving Using C lab		
Anti-requisites	NIL		
Course Description	This course introduces students to fundamental algorithm design and analysis techniques through practical implementation. It covers recursion, searching and sorting algorithms, graph algorithms, greedy methods, tree data structures, and dynamic programming. The laboratory focuses on understanding algorithm efficiency and applying problem-solving techniques to computational problems.		
Course Objective	To understand fundamental algorithm design techniques and analyze their time complexity through practical implementation.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1: Implement recursive, searching, and sorting algorithms and analyze their time complexity. CO2: Apply graph algorithms to compute shortest paths and transitive closure. CO3: Construct Minimum Spanning Trees and solve optimization problems using greedy methods. CO4: Implement tree data structures and solve problems using dynamic programming techniques.		
Course Content:			
Module 1	Introduction to Algorithms, Recursion, Searching and Sorting		**8 Sessions**
Introduction to Algorithms and Time Complexity, Recursive & Non-recursive functions, Binary Search, Bubble Sort, Merge Sort, Quick Sort, Heap Sort			
Module 2	Graph Algorithms – Shortest Path		**8 Sessions**
Graph Representation (Adjacency Matrix/List), Dijkstra's Algorithm, Floyd's Algorithm, Warshall's Algorithm			
Module 3	Greedy Method and MST		**8 Sessions**
Greedy Technique, Kruskal's Algorithm, Prim's Algorithm, Travelling Salesman Problem (TSP), Assignment Problem (Greedy Method)			
Module 4	Trees and Dynamic Programming		**6 Sessions**
Binary Search Tree (BST), BST Operations (Insertion, Traversal), Dynamic Programming Concept, 0/1 Knapsack Problem			
List of Laboratory Tasks: 1.Write a recursive program to generate Fibonacci series. 2.Write a program to perform Binary Search on a sorted array. 3.Write a program to sort elements using Bubble Sort.			

4.Write a program to sort elements using Merge Sort.
5.Write a program to implement Quick Sort.
6.Write a program to sort elements using Heap Sort.
7.Write a program to find the shortest path using Dijkstra's Algorithm.
8.Write a program to find Minimum Spanning Tree using Kruskal's Algorithm.
9.Write a program to find Minimum Spanning Tree using Prim's Algorithm.
10.Write a program to solve the Travelling Salesman Problem (TSP).
11.Write a program to solve the Assignment Problem using Greedy method.
12. Write a program to find all-pairs shortest path using Floyd's Algorithm.
13. Write a program to find transitive closure using Warshall's Algorithm.
14. Write a program to implement Binary Search Tree (BST) with insertion and traversal.
15. Write a program to solve the 0/1 Knapsack problem using Dynamic Programming.

Targeted Application & Tools that can be used

Use of PowerPoint software for lecture slides and use of Ubuntu for lab programs to execute. Tool is Codetantra tool.

Project work/Assignment:

Assignment: Students should complete the lab programs by end of each practical session and module wise assignments before the deadline.

Text Book

T1 NarasimhaKarumanchi: *"Data Structures and Algorithms Made Easy in Java",* 5th Edition, CareerMonk Publications, 2017.
T2. Anany Levitin, 'Introduction to the Design and Analysis of Algorithms', 3rd edition, Pearson Education, 2021.

References

R1 Mark Allen Weiss: *"Data Structures and Algorithm Analysis in Java",* 4th Edition, Pearson Educational Limited, 2014.
R2 Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser: *"Data Structures and Algorithms in Java"*, 6th Edition, John Wiley & Sons, Inc., ISBN: 978-1-118-77133-4, 2014.
R3Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, 2017: *"Introduction to Algorithms",* 3rd Edition, PHI Learning Private Limited.

CSC2512-Operating Systems

Course Code: CSC2512	**Course Name:** Operating Systems Type of **Course:** Theory	**L- T-P-C**	**3-0-0-3**
Version No.	1		
Course Pre-requisites	Data Structures and Computer Organization		
Anti-requisites	NIL		
Course Description	The main objective of this course is to cover basic concepts of operating systems. Operating Systems functions, Basic Concepts, Notion of a process, Concurrent processes, Problem of mutual exclusion, Deadlock, Process Scheduling, Memory management, Multiprogramming, File systems; time sharing systems and their design consideration. This course will prepare students to develop software in and for Linux/UNIX environments. Also this course helps the students in UNIX operating system and their effective use for problem solving.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Operating Systems and Unix Programming and attain Skill Development through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1** Explain the basic architecture of Operating Systems. [Understand] **CO2** Apply CPU scheduling algorithms in different system scenarios. [Apply] **CO3** Apply deadlock management techniques to solve operating system problems. [Apply] **CO4** Construct memory management techniques using page replacement algorithms. [Apply] **CO5** Analyze file management system techniques for efficient data storage and access. [Analyze]		

Course Content:

Module 1	**Introduction to OS and System Structure**	**8 Sessions**

Topics:
Introduction: Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services,
Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine,
Resource Manager view, process view and hierarchical view of an OS. Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. Process Scheduling: Scheduling algorithms:, Multiprocessor scheduling: Real Time scheduling:

Module 2	**IPC and Deadlocks**			**7 Sessions**

Topics:
Inter-process Communication: Concurrent processes, precedence graphs, Critical Section, Race
Conditions, Mutual Exclusion, Deadlocks - prevention, avoidance, detection and recovery.
Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.
Banker's algorithm, Deadlock detection and Recovery

Module 3	Memory Management	8 Sessions
Topics: Memory Management: Logical and Physical address maps, Memory allocation: Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction.		
Module 4	**Virtual Memory and File Management**	**7 Sessions**
Topics: Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page allocation, Partitioning, Paging, Page fault, Working Set, Segmentation, Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU) File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods , Free-space management , directory implementation , efficiency and performance		
Text Book **T1.** Abraham Silberschatz, Peter B. Galvin, Greg Gagne-Operating System Concepts, Wiley, 10th Edition, 2019. **T2.** Tanenbaum, Andrew S., and Albert S. Woodhull. Operating systems: design and implementation. Vol. 68. Englewood Cliffs: Prentice Hall, 1997		
References **R1.** The Unix programming Environment by Brain W. Kernighan & Rob Pike, Pearson. **R2.** Introduction to Unix Shell Programming by M.G.Venkateshmurthy, Pearson		
E-Resources **W1**. https://nptel.ac.in/courses/106108101 **W2**. https://nptel.ac.in/courses/106106144 **W3**. https://nptel.ac.in/courses/117106113 **W4**. https://www.udemy.com/course/unix-getting-started/ **W5**. https://www.coursera.org/learn/unix		

CSC2513- Unix Programming

Course Code: CSC2513	**Course Name:** Unix Programming **Type of Course:** Theory	**L- T-P-C**	**0-0-2-1**
Version No.	1		
Course Pre-requisites	Data Structures and Computer Organization		
Anti-requisites	NIL		
Course Description	The main objective of this course is to cover basic concepts of operating systems. Operating Systems functions, Basic Concepts, Notion of a process, Concurrent processes, Problem of mutual exclusion, Deadlock, Process Scheduling, Memory management, Multiprogramming, File systems; time sharing systems and their design consideration. This course will prepare students to develop software in and for Linux/UNIX environments. Also this course helps the students in UNIX operating system and their effective use for problem solving.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Operating Systems and Unix Programming and attain Skill Development through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1** Explain the basic architecture of Operating Systems. [Understand] **CO2** Apply CPU scheduling algorithms in different system scenarios. [Apply] **CO3** Apply deadlock management techniques to solve operating system problems. [Apply] **CO4** Construct memory management techniques using page replacement algorithms. [Apply] **CO5** Analyze file management system techniques for efficient data storage and access. [Analyze]		
Course Content:			
Module 1	**Introduction to OS and System Structure**		**8 Sessions**
Topics: Introduction: Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS. Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching. Process Scheduling: Scheduling algorithms:, Multiprocessor scheduling: Real Time scheduling:			
Module 2	**IPC and Deadlocks**		**7 Sessions**
Topics: Inter-process Communication: Concurrent processes, precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Deadlocks - prevention, avoidance, detection and recovery. Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.			

Banker's algorithm, Deadlock detection and Recovery		
Module 3	**Memory Management**	**8 Sessions**
Topics: Memory Management: Logical and Physical address maps, Memory allocation: Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction.		
Module 4	**Virtual Memory and File Management**	**7 Sessions**
Topics: Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page allocation, Partitioning, Paging, Page fault, Working Set, Segmentation, Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU) File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods , Free-space management , directory implementation , efficiency and performance		
Text Book **T1**. Abraham Silberschatz, Peter B. Galvin, Greg Gagne-Operating System Concepts, Wiley, 10th Edition, 2019. **T2**. Tanenbaum, Andrew S., and Albert S. Woodhull. Operating systems: design and implementation. Vol. 68. Englewood Cliffs: Prentice Hall, 1997		
References **R1**. The Unix programming Environment by Brain W. Kernighan & Rob Pike, Pearson. **R2**. Introduction to Unix Shell Programming by M.G.Venkateshmurthy, Pearson		
E-Resources **W1**. https://nptel.ac.in/courses/106108101 https://nptel.ac.in/courses/106106144 **W3**.https://nptel.ac.in/courses/117106113 **W4**.https://www.udemy.com/course/unix-getting-started/ **W5**.https://www.coursera.org/learn/unix		

CSC2517- Software Engineering

Course Code: CSC2517	**Course Name:** Software Engineering **Type of Course:** Theory	**L- T-P- C**	**3-0-0-3**
Version No.	1		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course aims to equip students with a comprehensive understanding of the software development process and software project management principles. It covers key aspects such as software process models, requirement engineering, system analysis, design, implementation, and testing. Additionally, students will explore project evaluation, planning, effort estimation, and risk management, essential for effective software project execution. Through this course, students will gain the skills necessary to develop reliable software systems while managing project constraints effectively.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Fundamentals of Software Engineering and attain Skill Development through Participative Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Explain the fundamentals of software engineering, software process models, and agile development methodologies.[Understand] **CO2:** Describe software requirements engineering, requirements modeling techniques, and software design concepts. [Understand] **CO3:** Implement software testing techniques and software quality assurance practices to validate software systems. [Apply] **CO4:** Use project management concepts, estimation methods, scheduling techniques, and risk management practices in software projects. [Apply]		
Course Content:			
Module 1	**Introduction to Software Engineering & Process Models**		**11 Sessions**
Topics: Software and Software Engineering: Nature of Software, Software Engineering Practice, Software Myths, SDLC and Software Processes: Generic Model, Prescriptive Process Model, Unified Process Model, Agile Development: Extreme Programming, SCRUM			
Module 2	**Software Requirements and Design**		**10 Sessions**
Topics: Requirements Engineering: Eliciting requirements, Functional and non- Functional requirements, SRS, Requirements modeling : Developing Use Cases, Developing Activity diagram and Swimlane diagram, Design: Design concepts, Architectural design, Component based design, User interface design			
Module 3	**Software Testing And Quality Assurance**		**Software Testing And Quality Sessions**
Topics: Introduction to Software Testing: verification and validation, Test Strategies for conventional Software, Validation Testing, Whitebox Testing: Basis path testing, Blackbox Testing. Software			

Quality Assurance: Elements of software quality assurance, SQA Tasks, Goals and Metrics, Software configuration management: SCM process.		
Module 4	**Software Project Management**	**13 Sessions**
Topics: Project Management Concepts, Project Planning, Overview of metrics, Estimation for Software projects, Project Scheduling, Risk Management, Maintenance and Reengineering, Software Process Improvement (SPI): CMM Levels.		
Text Book **T1**. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", Seventh Edition, McGraw Hill International edition, 2009. **T2**. BobHughes,MikeCotterell,RajibMall,"Software ProjectManagement",VIEdition,McGraw-Hill, 2018		
References **R1**. Ian Sommerville, "Software Engineering, Ninth Edition", Pearson Education, 2008. **R2**.RajibMall,"FundamentalsofSoftwareEngineering",VIEdition,PHIlearningprivatelimited,2014.		
E-Resources **W1**. https://www.studocu.com/row/document/lead-city-university/software-engineering/software-engineering-lecture-note/10888094 **W2**. https://www.youtube.com/watch?v=WxkP5KR_Emk **W3**. https://www.youtube.com/watch?v=OVZYOItkUUs **W4**. https://unimelb.libguides.com/c.php?g=931690&p=6734359 **W5**. https://presiuniv.knimbus.com/user#/home **W6**. https://nptel.ac.in/courses/		

CHE7601 -Environmental Studies

<table>
<tr><td>Course Code: CHE7601</td><td colspan="2">Course Name :Environmental Studies
Type of Course: Theory</td><td>L- T- P- C</td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="7">NIL</td></tr>
<tr><td>Anti-requisites</td><td colspan="7">NIL</td></tr>
<tr><td>Course Description</td><td colspan="7">This course is designed to improve the learners' SKILL DEVELOPMENT by using PATICIPATIVE LEARNING techniques. This course aims to familiarize students with fundamental environmental concepts and their relevance to business operations, preparing them to address forthcoming sustainability challenges. It is designed to equip students with the knowledge and skills needed to make decisions that account for environmental consequences, fostering environmentally sensitive and responsible future managers.

This course is designed to cater to Environment and Sustainability</td></tr>
<tr><td>Course Objective</td><td colspan="7">The objective of the course is ‘SKILL DEVELOPMENT’ of the student by using ‘PARTICIPATIVE LEARNING’ techniques</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">On successful completion of this course the students shall be able to:
CO1. Describe the issues related to natural resources, ecosystems and biodiversity
• Identify environmental hazards affecting air, water and soil quality
• Recognize the importance of healthy environment and finding the sustainable methods to protect the environment
• Convert skills to address immediate environmental concerns through changes in environmental processes, policies, and decisions</td></tr>
<tr><td colspan="8">Course Content:</td></tr>
<tr><td>Module 1</td><td colspan="7">Understanding Environment, Natural Resources, and Sustainability</td></tr>
<tr><td colspan="8">Topics:
Classification of natural resources, issues related to Population growth and their overutilization, and strategies for their conservation. Water, air, soil, mineral, energy and food source. Effect of human activities on natural resources.
Concept of sustainability- Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs; Sustainable practices in managing resources, including deforestation, water conservation, Desalination – types, energy security, and food security issues, Life Cycle thinking and Circular Economy.</td></tr>
<tr><td>Module 2</td><td colspan="7">Ecosystems, Biodiversity, and Sustainable Practices</td></tr>
<tr><td colspan="8">Topics:
Ecosystems and ecosystem services: Various natural ecosystems, Major ecosystem types in India and their basic characteristics; forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance.</td></tr>
</table>

The importance of biodiversity, Types of biodiversity, Biodiversity and Climate Change, the threats it faces, hotspots, and the methods used for its conservation. Strategies for in situ and ex situ conservation, mega diverse nation.

Module 3	**Environmental Pollution, Waste Management, and Sustainable Development**

Topics:
Types of pollution- Chemical, - Biological, Biomedical, noise, air, water, soil, thermal, radioactive and marine pollution, and their impacts on society. Urbanization and Urban environmental problems; effects, and mitigation.
Causes of pollution, such as global climate change, ozone layer depletion, the greenhouse effect, and acid rain, with a particular focus on pollution episodes in India. Importance of adopting cleaner technologies; Solid waste management;

Sustainable Materials and Technologies: Biodegradable and compostable materials, Recycled and reclaimed materials (E-waste management), Sustainable manufacturing processes.

Module 4	**Social Issues, Legislation, and Practical Applications**

Topics:
Overview of key environmental legislation and the judiciary's role in environmental protection, including the Water (Prevention and Control of Pollution) Act of 1974, the Environment (Protection) Act of 1986, and the Air (Prevention and Control of Pollution) Act of 1981. Hazardous waste Rule 1989, Biomedical Waste handling 1998, Fly Ash Rule 1999, Municipal Solid Waste Rule 2000, Battery Rules 2001, E- Waste Rules 2011, Plastic waste management Rules 2016, Construction Demolition waste Rules 2016 National Biodiversity Action Plan (NBAP)
Major International Environmental Agreements: Convention on Biological Diversity (CBD), The Biological Diversity (Amendment) Act, 2023, United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement.
Major International organisations and initiatives: United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC).

Targeted Application & Tools that can be used:
Application areas are Energy, Environment and sustainability
Tools: Online Tools – NPTEL and Swayam.

Project work/Assignment:

Assessment Type

- Online exams (MCQs) will be conducted by the department of Chemistry

Online Link*:

1) Lecure by Dr. Samik Chowdhury, Dr. Sudha Goel, NPTEL course: Environmental Science, https://nptel.ac.in/courses/109105203, 2024.
2) Lecture by Dr. Padmavati, Dr Narendran Thiruthy, NPTEL Course: Biodiversity Protection, Farmers and Breeders Rights, https://nptel.ac.in/courses/129105008, 2024.

* Other source links are available in below Resources link.

Text Book

T1. G. Tyler Miller and Scott Spoolman (2020), Living in the Environment, 20th Edition, Cengage Learning, USA
T2. Poonia, M.P. Environmental Studies (3rd ed.), Khanna Book Publishing Co.
T3. Bharucha, E. Textbook of Environmental Studies (3rd ed.) Orient Blackswan Private Ltd.
T4. Dave, D., & Katewa, S. S. Text Book of Environmental Studies. Cengage Learning India Pvt Ltd.

T5. Rajagopalan, R. Environmental studies: from crisis to cure (4th ed.). Oxford University Press.
T6. Basu, M., & Xavier Savarimuthu, S. J. Fundamentals of environmental studies. Cambridge University Press.
T7. Roy, M. G. Sustainable Development: Environment, Energy and Water Resources. Ane Books.
T8. Pritwani, K. Sustainability of business in the context of environmental management. CRC Press.
T9. Wright, R.T. & Boorse, D.F. Environmental Science: Toward A Sustainable Future (13th ed,). Pearson.

Reference Books

R1. Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022), Conservation through Sustainable Use: Lessons from India. Routledge.
R2. William P. Cunningham and Mary Ann Cunningham (2020), Principles of Environmental Science: Inquiry & Applications, 9th Edition, McGraw-Hill Education, USA.
R3. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.
R4. Manahan, S.E. (2022). Environmental Chemistry (11th ed.). CRC Press. https://doi.org/10.1201/9781003096238
R5. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press

Resources:

W1. https://nptel.ac.in/courses/109105203
W2. https://archive.nptel.ac.in/courses/120/108/120108004/
W3. https://nptel.ac.in/courses/127105018
W4. https://onlinecourses.nptel.ac.in/noc23_lw06/preview
W5. https://onlinecourses.swayam2.ac.in/ini25_bt02/preview
W6. https://archive.nptel.ac.in/courses/120/108/120108002/
W7. https://onlinecourses.swayam2.ac.in/ini25_bt02/preview
W8. https://nptel.ac.in/courses/102104088
W9. https://nptel.ac.in/courses/124107165
W10. https://nptel.ac.in/courses/109106200
W11. https://archive.nptel.ac.in/content/storage2/courses/120108004/module1/lecture1.pdf
W12. https://onlinecourses.swayam2.ac.in/nou25_ge19/preview
W13. https://onlinecourses.swayam2.ac.in/ini25_hs01/preview
W14. http://kcl.digimat.in/nptel/courses/video/105105184/L32.html
W15. https://nptel.ac.in/courses/105105169

Topics relevant to Skill Development:

1. An attitude of enquiry.
2. Write reports

The topics related to Environment and Sustainability :

All topics in theory component are relevant to Environment and Sustainability.

CSC2514- Principles of Artificial Intelligence

Course Code: CSC2514	**Course Name**: Artificial Intelligence **Type of Course:** Theory	**L- T-P-C**	**3-0-0-3**
Version No.	1		
Course Pre-requisites	Mathematics: Logic, Algebra, Probability		
Anti-requisites	Nil		
Course Description	This Course will introduce the basic principles in artificial intelligence. It will cover representation schemes, problem solving paradigms, search strategies, knowledge representation and Probabilistic Reasoning. Topics include: AI methodology and fundamentals, intelligent agents, search algorithms, game playing, supervised and unsupervised learning, uncertainty and probability theory, probabilistic reasoning in AI and Bayesian networks		
Course Objective	This course is designed to improve the learners' EMPLOYABILITY SKILLS by using PROBLEM SOLVING Methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1.** Explain the basic concepts of Artificial Intelligence and application of AI in several domains such as business and governance domains. [Understand] **CO2.** Demonstrate knowledge of reasoning and knowledge representation for solving real world problems [Apply] **CO3** Analyze and illustrate how informed and uninformed search algorithms play vital role in problem solving. [Apply] **CO4** Explain learning probabilistic reasoning in AI. [Understand]		
Course Content:			
Module 1	**Introduction to Artificial Intelligence**		**10 Sessions**
Topics: Introduction to Artificial Intelligence, Definitions, foundation, History and Applications; Agents: Types of Agents, Structure of Intelligent agent and its functions, Agents and Environment. Case Studies: Agricultural Domain, Business and Marketing, Automatic Car Parking System.			
Module 2	**Logic based Knowledge Representation and Reasoning**		**10 Sessions**
Topics: Introduction to Knowledge representation, Knowledge-based Agents, Knowledge-Based Systems; Frame Structures, Propositional Logic, First order Logic, Inference in First Order Logic (FOL), Introduction to Reasoning, types of reasoning.			
Module 3	**Problem Solving by searching**		**12 Sessions**
Topics: Problem space and search, State space search techniques solving problems by searching: Classical Search, Adversarial Search, and Constraint Satisfaction Problem, Adversarial Search Methods.			
Module 4	**Learning and Probabilistic reasoning in AI**		**13 Sessions**
Topics: Introduction to learning, Learning Concepts, Methods and Models: Supervised Learning, Unsupervised Learning, Reinforcement Learning, ANN-based Learning, Probabilistic reasoning in AI, Bayesian networks. Making Simple Decisions: Beliefs and Desires under Uncertainty, Utility Theory, Making Complex Decisions: Sequential Decision Problems, Multiagent Decision Making.			

Text Book

T1. Stuart J. Russell and Peter Norvig, "Artificial intelligence: A Modern Approach", 4th edition, Upper Saddle River, Prentice Hall, 2020

T2. David L. Poole and Alan K. Mackworth,"Artificial Intelligence: Foundations of Computational Agents", 2nd edition, Cambridge University Press, 2020

References

R1. John Paul Mueller, Luca Massaron, "Artificial Intelligence for dummies", 2nd edition, Wiley, 2021.

R2. Daeyeol Lee, "Birth of Intelligence: From RNA to Artificial Intelligence", 1st edition, Oxford University Press, 2020.

E-Resources

W1.https://www.researchgate.net/file.PostFileLoader.html?id=5440e3bdd5a3f298288b45fe&assetKey=AS%3A273625985290242%401442248926315

CSC2502- Android Mobile Applications Development

Course Code: CSC2502	**Course Name:** Android Mobile Application Development **Type of Course**:Lab Integrated Course	**L- T-P-C**	**1-0-4-3**
Version No.	1		
Course Pre-requisites	CSA1504		
Anti-requisites	NIL		
Course Description	The course provides a basics of android platform and application life cycle. The goal of the course is to develop mobile applications with Android containing at least one of the following phone material components: GPS, accelerometer or phone camera, use simple GUI applications and work with database to store data locally or in a server. Topics include user interface design; user interface building; input methods; data handling; network techniques and URL loading; GPS and motion sensing. Android application framework and deployment. Power management, Screen resolution, Touch interface, Store data on the device.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Android Application Development and attain Skill Development through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1** Discuss the fundamentals of mobile application development and architecture. [Understand] **CO2** Illustrate mobile applications with appropriate android view. [Apply] **CO3** Demonstrate the use of services, broadcast receiver, notifications and content. [Apply] **CO4** Evaluate data persistence techniques, to perform CRUD operations. [Analyze] **CO5** Design and develop optimized Android applications. [Create]		
Course Content:			
Module 1	**Introduction and Architecture of Android**		**20 Sessions**
Topics: Android: History and features, Architecture, Development Tools, Android Debug Bridge (ADB), and Life cycle.			
Module 2	**User Interfaces, Intent and Fragments**		**25 Sessions**
Topics: Views, Layout, Menu, Intent and Fragments.			
Module 3	**Components of Android**		**25 Sessions**
Topics: Activities, Services, Broadcast receivers, Content providers, User Navigation			
Module 4	**Notifications and Data Persistence**		**20 Sessions**
Topics: Notification, Shared Preferences, SQLite database, Android Room with a View, Firebase			
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.

Text Book

T1. Dawn Griffiths, David Griffiths, "Head First Android Develoment", O'Reilly Media, 3rd edition, Nov 2021
T2. Pradeep kothari "Android Application Development - Black Book", dreamtechpress

References

R1. Bill Phillips, Chris Stewart, and Kristin Marsicano (Author) "Android Programming" 3rd edition, 2017
R2. The Big Nerd Ranch Guide, Big Nerd Ranch LLC, 5. The Big Nerd Ranch Guide, by" Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India Pvt Ltd, 2014.

E-Resources

W1. https://developers.google.com/certification/associate-android-developer/study-guide/android-core
W2. NPTEL course : https://onlinecourses.swayam2.ac.in/nou21_ge41/preview
W3. https://www.coursera.org/specializations/android-app-development
W4. https://www.coursera.org/learn/introduction-to-android-mobile-application-development

CSC2501 Data Modelling Visualization

<table>
<tr><td>Course Code: CSC2501</td><td colspan="3">Course Name: Computational Data Modelling and Visualization
Type of Course: Lab / Lab Integrated Course</td><td>L- T-P- C</td><td>1-0-4-3</td></tr>
<tr><td>Version No.</td><td colspan="5">1</td></tr>
<tr><td>Course Pre-requisites</td><td colspan="5">Python Programming</td></tr>
<tr><td>Anti-requisites</td><td colspan="5">NIL</td></tr>
<tr><td>Course Description</td><td colspan="5">The purpose of the course is to install a strong foundation of scientific process orientation that is the cornerstone of effective data handling, and creative design thinking appended with strong programming skills to create meaningful visualizations of data. The student should have prior knowledge of python programming and basic knowledge of data concepts. The associated laboratory provides an opportunity to strengthen student’s skillset in the arena of Data Preprocessing and Visualization. With a good knowledge in the fundamental concepts of the various libraries for handling and visualizing data the student can gain a stronghold in Data Science enabling the student to be an effective analyst for prospective employers.</td></tr>
<tr><td>Course Objective</td><td colspan="5">The objective of the course is to familiarize the learners with the concepts of Data Analysis and Visualization and attain EMPLOYABILITY through Experiential Learning techniques.</td></tr>
<tr><td>Course Out Comes</td><td colspan="5">On successful completion of the course the students shall be able to:
CO1 Understand the various types of data, apply and evaluate the principles of data visualization. [Apply]
CO2 Acquire skills to apply visualization techniques to a problem and its associated dataset. [Apply]
CO3 Create interactive visualization for better insight using various visualization tools [Apply]
CO4 Implement the visualization concepts practically using Python [Apply]</td></tr>
<tr><td colspan="6">Course Content:</td></tr>
<tr><td>Module 1</td><td colspan="2">Introduction to Data Modelling (Python Basics & EDA)</td><td>Assignment</td><td>Introduction to Data Modelling (Python Basics & EDA)</td><td>20 Sessions</td></tr>
<tr><td colspan="6">Topics:
Introduction to Data Science & Python, Overview of Data Modeling & Statistical Analysis, Python Libraries: NumPy, Pandas, Matplotlib, Seaborn, Data Importing & Preprocessing, Handling Missing Values & Outliers, Feature Engineering & Feature Selection,Exploratory Data Analysis (EDA)</td></tr>
<tr><td>Module 2</td><td colspan="2">Statistical Data Modelling & Machine Learning</td><td>Assignment</td><td>Statistical Data Modelling & Machine Learning</td><td>25 Sessions</td></tr>
<tr><td colspan="6">Topics:
Probability Distributions: Normal, Binomial, Poisson, Hypothesis Testing (t-test, ANOVA, Chi-Square), Correlation and Regression Analysis (Linear, Multiple, Polynomial), Principal Component Analysis (PCA) & Linear Discriminant Analysis (LDA), Time Series Analysis & Forecasting, Market Basket Analysis (Association Rule Mining).</td></tr>
<tr><td>Module 3</td><td colspan="2">Data Visualization Techniques</td><td>Assignment</td><td>Data Visualization Techniques</td><td>15 Sessions</td></tr>
</table>

Topics: Introduction to Data Visualization, Visualization Libraries in Python (Matplotlib, Seaborn, Plotly), Basic Plots (Bar, Line, Scatter, Histogram, Pie), Advanced Plots (Heatmaps, Boxplots, Violin Plots), Time Series Visualization, Geographic & Financial Data Visualization, Dashboard Development with Plotly Dash.				
Module 4	Big Data Handling in Python	Assignment	Big Data Handling in Python	15 Sessions
Topics: Big Data Handling in Python (Dask, Spark), Clustering Techniques (K-Means, Hierarchical Clustering), Deep Learning for Data Analysis (Introduction to TensorFlow/PyTorch), Streaming Data Visualization (Real-time data analysis), Financial Data Analysis & Visualization, Final Project: End-to-End Data Science Pipeline.				
List of Laboratory Tasks Labsheet -1 Working with Numpy Functions Labsheet -2 Pandas functions Labsheet -3 Acquiring and plotting data. Labsheet -4 Practicals based on Data Cleaning and Preparation Labsheet -5 Practicals based on Data Wrangling Labsheet -6 Statistical Analysis – such as Multivariate Analysis, PCA, LDA, Correlation regression and analysis of variance Labsheet – 7 Practicals based on Data Visualization using matplotlib Labsheet -8 & 9 Visualization of various massive dataset - Finance - Healthcare - Census Labsheet – 4 10 Practical based on Time Series Data Analysis-stock market Labsheet -11 Market-Basket Data analysis-visualization Labsheet -12 Text visualization using web analytics Labsheet -13 & 14 Financial analysis using Clustering, Histogram and HeatMap Labsheet -15 Visualization on Streaming dataset (Stock market dataset, weather forecasting)				
Text Book Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media. W.(2017)				
References Dr.Chun-hauh Chen, W.K.Hardle, A.Unwin, Handbook of Data Visualization, Springer publication, 2016. Christian Toninski, Heidrun Schumann, Interactive Visual Data Analysis, CRC press publication,2020 3. Alexandru C. Telea, Data Visualization: Principles and Practice, AK Peters, 2014.				
E-Resources 1. https://pythonprogramming.net/live-graphs-data-visualization-application-dash-python-tutorial/				

2. Google Data Analytics Professional Certificate | Coursera
3. Learning Python for Data Analysis and Visualization Ver 1 | Udemy
4. Data Science, Analytics and Visualization (DS) Courses | Chaminade University - PROD [Integrated] Catalog
5. Data Visualization Training and Certification Courses | Koenig Solutions (koenig-solutions.com)

CSC2515 Data Mining and Data Warehousing

Course Code: **CSC2515**	**Course Title:** Data Mining and Data Warehousing **Course:** Theory	**L-T-P-C**	**3-0-0-3**
Version No.	2.0		
Course Pre-requisites	Database Management Systems, Discrete Mathematics		
Anti-requisites	Nil		
Course Description	This course introduces the foundational concepts, architectures, and operations of data warehousing alongside advanced core techniques in data mining. Students will explore data preprocessing, dimensional modeling, and online analytical processing (OLAP). The curriculum covers exploratory data discovery patterns, including frequent itemset mining, supervised classification frameworks, and unsupervised cluster analysis. Practical conceptualization focuses on deriving hidden, actionable insights from corporate big data setups.		
Course Objectives	The objective of the course is to familiarize the learners with the design principles of enterprise data warehouses and architectural workflows for Knowledge Discovery in Databases (KDD). It aims to cultivate technical capabilities in selecting, analyzing, and applying algorithmic models to extract business intelligence from complex datasets.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Explain data warehouse components, multi-tiered architectures, and KDD stages. [Understand] **CO2:** Design multi-dimensional data schemas and implement standard OLAP operations. [Apply] **CO3:** Apply data cleaning, integration, reduction, and transformation operations. [Apply] **CO4:** Extract frequent patterns and hidden correlations using association rule mining. [Apply] **CO5:** Evaluate the performance of various classification models and clustering algorithms. [Analyze]		
Course Content:			
Module 1	**Data Warehousing and OLAP Technology**	**12 Sessions**	
Topics: Introduction to Data Warehousing. Operational Database Systems (OLTP) versus Data Warehouses (OLAP). Data warehouse characteristics, components, and multi-tiered architectures. Data modeling: multi-dimensional data cubes. Schema design: Star, Snowflake, and Fact Constellation schemas. OLAP servers: ROLAP, MOLAP, and HOLAP architectures. Basic OLAP operations: slice, dice, roll-up, drill-down, and pivot. Extraction, Transformation, and Loading (ETL) concepts.			

Module 2	Data Mining Fundamentals and Preprocessing	10 Sessions
Topics: Introduction to Data Mining and the Knowledge Discovery in Databases (KDD) process. System architectures and data mining functionalities. Major challenges and issues in data mining. Data objects and attribute types. The critical need for data preprocessing. Core preprocessing steps: data cleaning, data integration, data transformation, data reduction, data discretization, and concept hierarchy generation.		
Module 3	**Mining Frequent Patterns and Associations**	**11 Sessions**
Topics: Market basket analysis and basic association rule concepts (support and confidence measures). Efficient and scalable frequent itemset generation methods. The Apriori algorithm and generating association rules from frequent itemsets. Performance improvements: FP-Growth (Frequent Pattern Tree) algorithm. Mining multilevel and multidimensional association rules from relational databases and data warehouses. From association mining to correlation analysis.		
Module 4	**Classification and Cluster Analysis**	**12 Sessions**
Topics: Core concepts of supervised learning versus unsupervised learning. Classification process and decision tree induction algorithms (ID3, C4.5). Bayesian classification: Naive Bayes algorithm. Rule-based classification and K-Nearest Neighbor (KNN) classifiers. Evaluation metrics for classifier accuracy, precision, recall, and ROC curves. Cluster Analysis primitives and types of data. Partitioning clustering methods: K-Means and K-Medoids. Hierarchical clustering algorithms: BIRCH and AGNES. Density-based clustering (DBSCAN).		
Targeted Application & Tools that can be used: Python (Scikit-Learn, Pandas, NumPy), R Studio, Weka, RapidMiner, Microsoft SQL Server SSAS, Oracle Data Miner, Tableau.		
Project work/Assignment: Design an end-to-end business intelligence solution for an enterprise retail dataset. Construct a multi-dimensional star schema, implement ETL preprocessing scripts, and execute predictive classification and customer segmentation profiling using market-basket association rules and clustering.		
Text Books **T1.** J J. Han, M. Kamber, and J. Jian, Data Mining: Concepts and Techniques, 3rd ed., Waltham, MA, USA: Morgan Kaufmann, 2011. **T2.** R. Kimball and M. Ross, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, 3rd ed., Indianapolis, IN, USA: John Wiley & Sons, 2013.		
Reference Books **R1**. A. Berson and S. J. Smith, Data Warehousing, Data Mining, and OLAP, 1st ed., New York, NY, USA: McGraw-Hill, 2004. **R2**. P. Tan, M. Steinbach, and V. Kumar, Introduction to Data Mining, 2nd ed., Boston, MA, USA: Pearson, 2018.		
Web References **W1**. TDWI (The Data Warehousing Institute) Research **W2**. KDnuggets Analytics and Data Mining Articles		

CSC2516-Essentials of Cloud Computing

Course Code: CSC2516	**Course Name:** Essentials of Cloud Computing **Type of Course:** Theory	**L- T-P- C**	**3-0-0-3**
Version No.	1		
Course Pre-requisites	Computer Networks		
Anti-requisites	NIL		
Course Description	This course aims to introduce the core concepts of cloud computing to gain the foundational knowledge required for understanding cloud computing from a business perspective as also for becoming a cloud practitioner. From the course student will understand the definition and essential characteristics of cloud computing, its history, the business case for cloud computing, and emerging technology use cases enabled by cloud. This course covers on various cloud service models (IaaS, PaaS, SaaS), deployment models (Public, Private, Hybrid), the key components of a cloud infrastructure (VMs, Networking, Storage - File, Block, Object) and security issues in the cloud		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Essentials of Cloud Computing and attain Skill Development through Participative Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Explain the fundamentals of cloud computing, including components, deployment models, services, benefits, and limitations. [Understand] **CO2:** Describe virtualization concepts, types, and tools used in cloud computing environments. [Apply] **CO3:** Utilize cloud services such as SaaS, PaaS, and IaaS for real-world applications. [Apply] **CO4:** Develop secure cloud solutions and dynamic resource allocation for virtual machines in a cloud environment. [Apply]		
Course Content:			
Module 1	**Introduction to Cloud**		**10 Sessions**
Topics: Cloud computing basics: - Cloud computing components- Infrastructure-services- storage applications database services – Deployment models of Cloud- Services offered by Cloud- Benefits and Limitations of Cloud Computing			
Module 2	**Virtualization Fundamentals**		**10 Sessions**
Topics: Virtualization – Enabling technology for cloud computing- Types of Virtualization- Server Virtualization- Desktop Virtualization – Memory Virtualization – Application and Storage Virtualization- Tools and Products available for Virtualization			
Module 3	**Cloud Services**		**13 Sessions**
Topics: Getting started with SaaS - Understanding the multitenant nature of SaaS solutions- Understanding Open SaaS Solutions. Understanding Service Oriented Architecture PaaS- Benefits and Limitations of PaaS, Security as a Service, Understanding IaaS- Improving performance through Load balancing- Server Types within IaaS solutions- Utilizing cloud based NAS devices – Understanding Cloud based data storage- Cloud based database solutions- Cloud based block storage			
Module 4	**Cloud Computing Software Security Fundamentals**		**12 Sessions**

Topics:

Cloud Information Security Objectives, Cloud Security Services , Authentication , Authorization, Auditing, Accountability, Secure Cloud Software Requirements, Secure Development Practices, Approaches to Cloud Software Requirements Engineering.
Problem Solving: Design and implement dynamic resource allocation for virtual machine using cloud computing environment.

Text Book

T1. R. Buyya, C. Vecchiola, S T. Selvi, Mastering Cloud Computing, McGraw Hill (India) Pvt Ltd., 2013.
T2. Ronald L.Krutz, Russell vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley Publishing Inc., 2010

References

R1. Douglas E. Comer, "The Cloud Computing Book: The Future of Computing Explained", Chapman and Hall/CRC; 1st edition, July 2021
R2. Kris Jamsa, Cloud Computing: SaaS, PaaS, IaaS, "Virtualization, Business Models, Mobile, Security and more, Jones & Bartlett Learning Company, 2013

E-Resources

W1.https://onlinecourses.nptel.ac.in/noc21_cs14/preview#:~:text=Cloud%20computing%20is%20a%20scalable,etc.%2C%20over%20the%20Internet.

PPS3001-Problem Solving through Aptitude

Course Code: PPS3001	**Course Name:** Problem Solving through Aptitude **Type of Course:** Lab	**L- T-P-C**	**0-0-2-1**
Version No.	1		
Course Pre-requisites	Students should know the basic Mathematics & aptitude along with understanding of English		
Anti-requisites	NIL		
Course Description	The objective of this course is to prepare the trainees to tackle the questions on various topics and various difficulty levels based on Quantitative Ability, and Logical Reasoning asked during the placement drives. There will be sufficient focus on building the fundamentals of all the topics, as well as on solving the higher order thinking questions. The focus of this course is to teach the students to not only get to the correct answers, but to get there faster than ever before, which will improve their employability factor.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Aptitude and attain Skill Development through Problem Solving techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1** Recall all the basic mathematical concepts they learnt in high school. [Understand] **CO2** Identify the principle concept needed in a question. [Understand] **CO3** Solve the quantitative and logical ability questions with the appropriate concept. [Understand] **CO4** Analyze the data given in complex problems. [Understand]		
Course Content:			
Module 1	**Quantitative Ability**		**10 Sessions**
Topics: Introduction to Aptitude, working of Tables, Squares, Cubes, Number Series, Wrong number series, Letter series.			
Module 2	**Logical Reasoning**		**20 Sessions**
Topics: Linear & Circular Arrangement Puzzle, Coding & Decoding, Blood Relations, Directions, Ordering and Ranking, Clocks and Calendars			
Text Book **T1**. Quantitative Aptitude by R S Aggarwal **T2**. Verbal & Non-Verbal Reasoning by R S Aggarwal			
E-Resources **W1**. www.indiabix.com **W2**. www.youtube.com/c/TheAptitudeGuy/videos **W3**. Prepinsta.com			

CSA2508-Software Testing

Course Code: CSA2508	**Course Name:** Software Testing **Type of Course:** Theory	**L- T-P-C**	**3-0-0-3**
Version No.	1		
Course Pre-requisites	Software Engineering		
Anti-requisites	NIL		
Course Description	This course will examine fundamental software testing and related program analysis techniques. In particular, the important phases of testing will be reviewed, emphasizing the significance of each phase when testing different types of software. The course will also include concepts such as test generation, test oracles, test coverage, regression testing, mutation testing, program analysis (e.g., program-flow and data-flow analysis), and test prioritization.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Software Testing and attain Employability through Experiential learning.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1.** Describe the fundamentals of software testing for Quality assurance. [Understand] **CO2.** Develop Test cases to test Applications / Software's [Create] **CO3.** Write Bug reports found in Testing Applications / Software's. [Apply]		
Course Content:			
Module 1	**Fundamentals of Software Testing**		**20 Sessions**
Topics: Phases of Software Project – Quality assurance and Quality Control – Software Development Life Cycle (SDLC) Models – Software Testing and Its Types Software Testing Life Cycle (STLC).			
Module 2	**Test Case Development and Execution**		**20 Sessions**
Topics: Test Cases – Identification of Test case Scenarios – Test Case Template – Writing Test cases for Problems –Test Case Execution and Examples for Lab Exercises.			
Module 3	**Bug Reporting and Automation Testing**		**20 Sessions**
Topics: Defect Life Cycle, Bug Reporting – Template and Examples for Lab Exercises – Basics of Software Test Automation – Software Testing Metrics.			
Text Book **T1.** Ralf Bierig, Stephen Brown, Edgar Galvan, Joe Timoney, "Essentials of Software Testing", Cambridge University Press, 2021. **T2**. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, 2016.			
References **R1.** Cem Kaner, Jack Falk, Hung Q. Nguyen, "Testing Computer Software", Second edition, Wiley 2015. **R2.** Aditya P. Mathur, "Foundations of Software Testing _ Fundamental Algorithms and Techniques", Pearson Education, 2015			
E-Resources **W1.** https://www.pdfdrive.com/testing-computer-software-d8618500.html			

CSC2521-Blockchain Technology

Course Code: CSC2521	**Course Name**: Blockchain Technology **Type of Course:** Theory	**L- T-P-C**	**3-0-0-3**
Version No.	1		
Course Pre-requisites	Nil		
Anti-requisites	Nil		
Course Description	The purpose of the course is to provide an introduction to Blockchain technology with specific focus on industrial applications like Blockchain in Financial system, trade/supply chain management, agriculture industry, Healthcare sectors and Insurance system. With the knowledge of blockchain technology, Students will learn how these systems are built, how to interact with them.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Blockchain Technology and Applications and attain Skill Development through Problem solving methodologies.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Explain the fundamentals of blockchain technology, including incentives, proof of work, cryptographic hash functions, digital signatures, and storage methods. [Understand] **CO2:** Describe Bitcoin mechanics, transactions, blocks, mining processes, and the Ethereum ecosystem and programming concepts. [Understand] **CO3:** Choose Bitcoin and Ethereum concepts to implement basic blockchain transactions and scripts. [Apply] **CO4:** Select blockchain solutions for business applications in supply chain, manufacturing, healthcare, automobiles, and finance. [Apply]		
Course Content:			
Module 1	**Introduction to Blockchain**		**08 Sessions**
Topics: Incentives and proof of work. Simple Local Storage, Hot and Cold Storage, Online Wallets and Exchanges, Payment Services, Transaction Fees, Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures.			
Module 2	**Bitcoin**		**10 Sessions**
Topics: Bitcoin Mechanics: Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network, Limitations and improvements. Bitcoin mining: The task of Bitcoin miners, Mining Hardware, Energy consumption, Mining pools, Mining incentives and strategies.			
Module 3	**Ethereum**		**10 Sessions**
Topics: The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.			
Module 4	**Blockchains in Business**		**10 Sessions**
Topics:			

Blockchain in Supply Chain - Blockchain in Manufacturing - Blockchain in Automobiles - Blockchain in Healthcare- Blockchain in Financial Industry
Text Book **T1.** Bellaj Badr, Richard Horrocks, Xun (Brian) Wu, "Blockchain By Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger", Packt Publishing Limited, 2018.
References **R1.** Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", 2nd Edition, Packt Publishing Ltd, March 2018.
E-Resources **W1.** https://www.udemy.com/course/build-your-blockchain-az/

PPS3001-Problem Solving through Aptitude

Course Code: PPS3001	**Course Name:** Problem Solving through Aptitude **Type of Course:** Lab	L- T-P- C	0-0-2-1
Version No.	1		
Course Pre-requisites	Students should know the basic Mathematics & aptitude along with understanding of English		
Anti-requisites	NIL		
Course Description	The objective of this course is to prepare the trainees to tackle the questions on various topics and various difficulty levels based on Quantitative Ability, and Logical Reasoning asked during the placement drives. There will be sufficient focus on building the fundamentals of all the topics, as well as on solving the higher order thinking questions. The focus of this course is to teach the students to not only get to the correct answers, but to get there faster than ever before, which will improve their employability factor.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Aptitude and attain Skill Development through Problem Solving techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1** Recall all the basic mathematical concepts they learnt in high school. [Understand] **CO2** Identify the principle concept needed in a question. [Understand] **CO3** Solve the quantitative and logical ability questions with the appropriate concept. [Understand] **CO4** Analyze the data given in complex problems. [Understand]		
Course Content:			
Module 1	Quantitative Ability		10 Sessions
Topics: Introduction to Aptitude, working of Tables, Squares, Cubes, Number Series, Wrong number series, Letter series.			
Module 2	Logical Reasoning		20 Sessions
Topics: Linear & Circular Arrangement Puzzle, Coding & Decoding, Blood Relations, Directions, Ordering and Ranking, Clocks and Calendars			
Text Book T1. Quantitative Aptitude by R S Aggarwal T2. Verbal & Non-Verbal Reasoning by R S Aggarwal			
E-Resources 1. www.indiabix.com 2. www.youtube.com/c/TheAptitudeGuy/videos 3. Prepinsta.com			

CSC2522- Devops and Micro Services

Course Code: CSC2522	**Course Title:** Devops and Micro Services **Type of Course: Theory**	**L- T-P- C**	**3**	**0**	**0**	**3**
Version No.	1.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	This course introduces the principles and practices of DevOps and Microservices architecture. Students will learn how modern software systems are designed, developed, deployed, and maintained using continuous integration, continuous delivery, containerization, and cloud-native approaches. The course emphasizes collaboration between development and operations teams and hands-on exposure to industry-standard tools.					
Course Objective	This course aims to provide undergraduate students with a clear understanding of DevOps culture and microservices architecture used in modern software development.					
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1**: Explain the core concepts, principles, and benefits of DevOps and Microservices. [Understand] **CO2**: Describe the DevOps lifecycle, tools, and workflow used in modern software development. [Understand] **CO3**: Apply version control and CI/CD tools to automate build and deployment processes. [Apply] **CO4**: Implement microservices-based applications using containerization technologies. [Apply] **CO5:** Analyze system performance, scalability, and reliability in microservices architectures. [Analyze] **CO6**: Design and deploy a cloud-based microservices solution following DevOps best practices. [Analyze]					
Course Content:						
Module 1	**Introduction to DevOps and Software Delivery Lifecycle**					**11 Sessions**
Topics: Introduction – Traditional software development vs DevOps, Need for DevOps, DevOps culture, principles and benefits. DevOps Lifecycle – Plan, Code, Build, Test, Release, Deploy, Operate and Monitor. Version Control – Concepts of version control systems, Git basics, repositories, commit, branch, merge and GitHub overview. Build Automation – Introduction to build tools and CI concepts.						
Module 2	**Continuous Integration, Continuous Delivery and Automation**					**11 Sessions**
Topics: Continuous Integration – Concepts, benefits and workflow. CI/CD Tools – Jenkins architecture, pipeline concepts, automated build and testing. Configuration Management – Introduction, infrastructure automation basics. Monitoring and Logging – Need for monitoring, basic tools and alerting concepts.						

Module 3	Microservices Architecture	11 Sessions
Topics: Microservices – Introduction, characteristics and advantages. Monolithic vs Microservices architecture. Service Communication – RESTful services, synchronous and asynchronous communication. Service Discovery and API Gateway – Basic concepts and use cases. Data Management – Database per service concept. Fault Tolerance and Scalability in microservices.		
Module 4	**Containerization, Orchestration and Cloud Deployment**	**12 sessions**
Topics: Containerization – Virtualization vs containers, Docker architecture, images and containers. Docker Operations – Creating Dockerfiles, building and running containers. Container Orchestration – Introduction to Kubernetes, pods, services and deployments. Cloud Deployment – Overview of cloud platforms, deploying microservices on cloud. DevSecOps – Introduction to security in DevOps pipelines.		
Assignment: Students should complete the lab programs, tool-based exercises, and hands-on activities associated with each module by the end of each practical session and submit module-wise assignments before the prescribed deadline.		
Text Book **T1** Jez Humble, David Farley, Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation, Pearson Education. T**2** Sam Newman, Building Microservices, O'Reilly Media.		
References **R1** Gene Kim, Patrick Debois, John Willis, Jez Humble, The Phoenix Project, IT Revolution Press. **R2** Viktor Farcic, DevOps Tools Cookbook, Packt Publishing. **R3** Mark Richards, Microservices vs. Service-Oriented Architecture, O'Reilly Media. **R4** Nigel Poulton, Docker Deep Dive, Packt Publishing. **Web resources**: **W1.** https://aws.amazon.com/devops/what-is-devops/ **W2**. https://www.redhat.com/en/topics/devops **W3**. https://www.atlassian.com/devops		

CSC2518-Machine Learning

Course Code: CSC2518	**Course Title:** Machine Learning **Course:** Lab Integrated	**L-T-P-C**	**3-0-0-3**
Version No.	2.0		
Course Pre-requisites	Analysis of Algorithms		
Anti-requisites	Nil		
Course Description	This course introduces the fundamental concepts and techniques of Machine Learning (ML). Students will learn both the theoretical foundations and practical implementations of supervised and unsupervised learning algorithms. Topics include regression, classification, decision trees, support vector machines, clustering, dimensionality reduction, model evaluation, and overfitting. The course emphasizes hands-on learning using Python and popular ML libraries such as scikit-learn.		
Course Objectives	The objective of the course is to familiarize the learners with the concepts of Machine Learning Algorithms and attain Skill Development through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Explain basic machine learning concepts and applications. [Understand] **CO2:** Implement data preprocessing techniques for machine learning. [Apply] **CO3:** Utilize supervised learning algorithms to predict tasks. [Apply] **CO4:** Illustrate unsupervised learning and evaluation metrics. [Apply] **CO5:** Examine model performance and learning behavior. [Analyze]		
Course Content:			
Module 1	**Introduction to Machine Learning Algorithms**	**15 Sessions**	
Topics: Introduction to Machine Learning - Types of Machine Learning: Supervised, Unsupervised, Reinforcement - Key Concepts: Features, Labels, Training and Testing- Applications and Real-world Use Cases			
Module 2	**Data Preprocessing and Supervised Learning**	**10 Sessions**	
Topics: Data Cleaning, Normalization, and Encoding - Train-Test Split and Cross-Validation - Linear Regression and Logistic Regression - Decision Trees and K-Nearest Neighbors (KNN)			
Module 3	**Unsupervised Learning and Model Evaluation**	**10 Sessions**	
Topics: Clustering Techniques: K-Means, Hierarchical Clustering - Dimensionality Reduction: PCA - Model Evaluation Metrics: Accuracy, Precision, Recall, F1-score - Overfitting and Underfitting Concepts			

Module 4	Introduction to ML Tools and Case Studies	10 Sessions
Topics: Overview of Scikit-Learn and Python Libraries- Basic ML Workflow Implementation in Python - Mini Case Studies: Real-world Dataset Exploration- Ethical Considerations in ML		
Targeted Application & Tools that can be used: Linux / Vi Editor		
Project work/Assignment:		
Text Books **T1.** A. Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 2nd ed., Sebastopol, CA, USA: O'Reilly Media, 2019. [Note: The 3rd edition was released in 2022.] **T2.** S. Raschka and V. Mirjalili, *Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2*, 3rd ed., Birmingham, U.K.: Packt Publishing, 2020.		
Reference Books **R1.** T. Hastie, R. Tibshirani, and J. Friedman, *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*, 2nd ed., New York, NY, USA: Springer, 2020. **R2.** K. P. Murphy, *Probabilistic Machine Learning: An Introduction*, Cambridge, MA, USA: MIT Press, 2022.		
Web References **W1**. https://developers.google.com/machine-learning/crash-course **W2**. https://www.coursera.org/learn/machine-learning		

CSC2523 -Machine Learning Lab

Course Code: CSC2523	**Course Name:** MACHINE LEARNING LAB **Type of Course:** Lab	**L- T-P-C**	**0-0-2-1**
Version No.	1		
Course Pre-requisites	CSA1503		
Anti-requisites	NIL		
Course Description	A machine learning algorithm is a mathematical or computational procedure that is designed to learn patterns and relationships from data, and use that knowledge to make predictions, classifications, or decisions. These algorithms form the core building blocks of machine learning systems and enable computers to automatically learn from and analyze large amounts of data. The development and implementation of machine learning algorithms require careful consideration of factors such as data quality, feature engineering, model selection, hyperparameter tuning, and evaluation techniques to ensure reliable and accurate results.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Machine Learning Algorithms Lab and attain Skill Development through Experiential Learning techniques.		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1** Apply optimization and parameter tuning techniques for machine Learning algorithms [Apply] **CO2** Examine solutions for image classification and recommendation systems. [Analyze] **CO3** Build a Artificial Neural Networks (ANN) using TensorFlow [Create]		
Course Content:			
Module 1	**Introduction to Machine Learning Algorithms**		**8 Sessions**
Topics: Introduction: History and Concept of machine learning, chronological overview of machine learning algorithms, Machine learning methods example: Supervised Learning- Linear Regression, Unsupervised Learning- Principal Component Analysis (PCA), Ensemble Methods- Bagging using Random Fores.			
Module 2	**Introduction to machine learning techniques**		**7 Sessions**
Topics: Machine learning techniques example: Feature Selection/Extraction Techniques-Principal Component Analysis (PCA), Regularization Techniques- L1 Regularization (Lasso), Sampling Techniques-Oversampling(Synthetic Minority Over-sampling Technique (SMOTE)), Hyperparameter Optimization Techniques- Bayesian Optimization, Text Processing Techniques - Tokenization, Data Augmentation Techniques- Image Augmentation			
Module 3	**Knowledge Management**		**8 Sessions**
Topics: Building machine learning models - Recognizing handwritten digits in image classification tasks, Identifying frequently co-occurring items in market basket analysis, and Image classification, object detection, and recognition tasks.			
Module 4	**Capstone Project**		**7 Sessions**

Topics:
Image Classification:Apply a model that can accurately classify images into different categories, such as identifying different species of flowers, recognizing handwritten digits, or detecting objects in images, Recommendation System:Apply a recommendation system that suggests relevant items to users based on their preferences, such as building a movie recommendation
system, suggesting products to online shoppers, or recommending personalized news articles.

List of Laboratory Tasks

Lab Experiments: Use UCI repository and Kaggle dataset for each experiments.
Exp1:
(Two Session)
Level1: Introduction to Python Stack for Data Science, Core Python Libraries for data analysis, Anaconda platform and its installation, Executing programs on Jupiter IDE.
Level2: Write a Python program that utilizes expressions, types, statements, and variables to work with a simple dataset.
Experiment 2(Two Session)
Linear Regression: Implement linear regression to predict a continuous target variable based on input features.
Experiment 3 (Two Session)
Level1: Logistic Regression: Build a logistic regression model for binary classification problems.
Level2: Logistic Regression: Build a logistic regression model for Multi classification problems.
Experiment 4 (Two Session)
Principal Component Analysis (PCA): Implement PCA to reduce the dimensionality of data by projecting it onto a lower-dimensional space.
Experiment 5 (Two Session)
Neural Networks: Implement a basic neural network model using libraries like TensorFlow or Keras for tasks like image classification.
Experiment 6 (Two Session)
Level1: Implement a basic ANN model using TensorFlow or Keras for image classification tasks.Train the model on a labeled image dataset (e.g., MNIST or CIFAR-10) and evaluate its performance.
Level2: Use a dataset containing user-item ratings and build a model to recommend items based on user preferences

Text Book
T1. Manaranjan Pradhan, U Dinesh Kumar, "Machine Learning Using Python" Wiley, First Edition 2019.
T2. Pattern Recognition and Machine Learning" by Christopher Bishop: This book provides a comprehensive introduction to machine learning, covering both classical and modern techniques. It covers topics such as Bayesian methods, support vector machines, neural networks, and deep learning

References
R1. Stuart J. Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach," Pearson, Fourth Edition 2020
R2.Ethem Alpaydin, "Machine Learning: The New AI," MIT Press, First Edition 2016.

E-Resources
W1. https://nptel.ac.in/courses/
W2. https://www.udemy.com/course/
W3. https://www.coursera.org/learn/

CSC2519 Big Data Analytics

Course Code: CSC2519	Course Title: Big Data Analytics Type of Course: Lab Integrated	L-T-P-C	2	0	2	3
Version No.	1.0					
Course Pre-requisites	CSA1503					
Anti-requisites	NIL					
Course Description	This course introduces the concepts and applications of Big Data Analytics with emphasis on large-scale data processing, analytics, and practical implementation using modern frameworks. The course covers Big Data architecture, distributed storage, data processing models, Hadoop ecosystem, analytics techniques, and visualization approaches. Students will gain hands-on experience using data analytics tools and frameworks to process and analyze structured and unstructured data for real-world decision making.					
Course Objective	To enable learners to understand Big Data concepts and apply analytical techniques using modern tools and frameworks for solving data-driven problems.					

Course Outcomes	On successful completion of the course the students shall be able to:	
	CO1	Explain Big Data concepts, architecture and distributed processing techniques. [Understand]
	CO2	Apply Big Data storage and processing techniques using suitable frameworks. [Apply]
	CO3	Analyze structured and unstructured data using analytical approaches. [Apply]
	CO4	Develop data-driven solutions and visualizations for real-world applications. [Apply]
	CO5	Evaluate Big Data analytical outcomes and communicate insights using appropriate visualization and reporting techniques. [Apply]

Course Content:		
Module 1	Fundamentals of Big Data	8 Sessions
Topics: Introduction to Big Data, Evolution of Data Management, Characteristics of Big Data (Volume, Velocity, Variety, Veracity, Value), Types of Data, Structured Data, Semi-Structured Data, Unstructured Data, Big Data Architecture, Distributed Computing Concepts, Big Data Challenges, Big Data Applications, Introduction to Hadoop Ecosystem.		
Module 2	Big Data Storage and Processing	7 Sessions

Topics: Introduction to Hadoop, Hadoop Architecture, Hadoop Distributed File System (HDFS), HDFS Components, Data Storage Concepts, Data Blocks and Replication, Introduction to MapReduce, Map Operations, Reduce Operations, Data Processing Workflow, Introduction to YARN, Hadoop Ecosystem Components.		
Module 3	Big Data Analytics and Frameworks	8 Sessions
Topics: Introduction to Data Analytics, Data Collection and Preprocessing, Data Cleaning Techniques, Data Analysis Concepts, Introduction to Apache Spark, Spark Architecture, Resilient Distributed Datasets (RDD), DataFrames, Spark SQL, Data Transformation Techniques, Data Aggregation, Introduction to Data Visualization.		
Module 4	Big Data Applications	7 Sessions
Topics: Descriptive Analytics, Predictive Analytics, Business Intelligence Concepts, Recommendation Systems, Real-Time Analytics, Data Visualization Dashboards, Data Privacy and Ethics, Data Governance Concepts, Emerging Trends in Big Data Analytics.		
List of Experiments		30 Sessions
Install and configure Python, Jupyter Notebook/Google Colab, and required libraries for Big Data Analytics. Load, inspect, and preprocess structured and unstructured data using Python libraries. Perform data cleaning operations including handling missing values, duplicate records, and data transformation. Implement data manipulation techniques such as filtering, sorting, grouping, and aggregation using DataFrames. Perform Exploratory Data Analysis (EDA) and generate descriptive statistics for data interpretation. Design and visualize analytical reports using line charts, bar charts, scatter plots, and histograms. Demonstrate Hadoop Distributed File System (HDFS) operations for data storage and retrieval. Implement MapReduce concepts for processing large datasets. Develop programs using Apache Spark to perform distributed data processing. Perform data transformation and aggregation operations using Spark DataFrames. Implement descriptive and predictive analytics techniques for data analysis. Design interactive dashboards and visualize analytical outcomes using appropriate visualization tools. Compare different analytical approaches and evaluate performance using suitable metrics. Develop and present a mini project for solving a real-world problem using Big Data Analytics.		
Targeted Application & Tools Used Python, Google Colab / Jupyter Notebook, Hadoop, Apache Spark, Pandas, NumPy, Matplotlib.		
Textbooks T1: Triguero, Isaac, Salvador García, and Francisco Herrera. Large-Scale Data Analytics with Python and Spark. Cambridge University Press, 2023. T2: Kulkarni, Parag, Sara Joshi, and David Brown. Big Data Analytics. PHI Learning, 2024.		
References Books R1 Karau, Holden, Andy Konwinski, Patrick Wendell, and Matei Zaharia. Learning Spark: Lightning-Fast Data Analytics. 2nd ed., O'Reilly Media, 2020. R2: White, Tom. Hadoop: The Definitive Guide. 4th ed., O'Reilly Media, 2015. R3: Kleppmann, Martin. Designing Data-Intensive Applications. O'Reilly Media, 2017.		

E-Resources https://hadoop.apache.org/ https://spark.apache.org/ https://nptel.ac.in/courses/106104189

CSC2503-Internet of Things

Course Code: CSC2503	Course Name: **Internet of Things** Type of Course: Lab / Lab Integrated Course	L- T-P- C	1-0-4-3
Version No.	1		
Course Pre-requisites	The IoT course requires basic knowledge of programming (Python, C, or Arduino), electronics (sensors, actuators, microcontrollers), and networking (IP addressing, communication protocols). Familiarity with cloud computing for data storage and processing is beneficial. Logical thinking and problem-solving skills are essential for designing and troubleshooting IoT systems. These prerequisites ensure a smooth learning experience and practical application of IoT concepts.		
Anti-requisites	NIL		
Course Description	The Internet of Things (IoT) course provides a comprehensive understanding of IoT concepts, architectures, and applications. It covers hardware and software components, communication protocols, data analytics, and security. Learners will gain hands-on experience in building and deploying IoT solutions.		
Course Objective	To understand the fundamental concepts and architecture of IoT. To explore IoT communication protocols and networking technologies. To develop hands-on skills in sensor interfacing, data acquisition, and cloud integration. To implement security measure		
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Explain the fundamentals of IoT, including architecture, components, and communication technologies. [Understand] **CO2:** Select IoT networking protocols and cloud/edge computing concepts to implement IoT data transmission systems. [Apply] **CO3:** Choose the data collection, storage, and real-time analytics techniques to develop IoT dashboards and visualize data. [Apply] **CO4:** Design secure and optimized IoT systems for real-world applications using encryption and power management techniques. [Create]		
Course Content:			
Module 1	**Introduction to IoT**		**15 Sessions**
Topics: IoT Fundamentals and Architecture,IoT Components: Sensors, Actuators, and Microcontrollers, IoT Communication Technologies (Wi-Fi, Bluetooth, LoRa, Zigbee),Hands-on: Setting up a Basic IoT System			
Module 2	**IoT Communication and Networking**		**20 Sessions**
Topics:			

IoT Networking Protocols: MQTT, CoAP, HTTP,Cloud Computing for IoT: AWS, Google Cloud, and Azure IoT,Edge Computing and Fog Computing in IoT,Hands-on: Implementing MQTT for IoT Data Transmission		
Module 3	**IoT Data Processing and Analytics**	**25 Sessions**
Topics: IoT Data Collection and Storage Techniques,Real-time Data Analytics in IoT,AI and Machine Learning for IoT Applications,Hands-on: Building an IoT Dashboard for Data Visualization		
Module 4	**IoT Security and Applications**	**15 Sessions**
Topics: Security Challenges in IoT: Authentication, Encryption, and Privacy,Case Studies of IoT in Smart Cities, Healthcare, and Industrial Automation,IoT System Optimization and Power Management, Hands-on: Securing an IoT Network with Encryption Techniques		

List of Laboratory Tasks

1. Getting Started with Arduino/Raspberry Pi – Set up and run a simple LED blinking program.
2. Sensor Interfacing – Connect and read data from temperature, humidity, and motion sensors.
3. Actuator Control – Control a servo motor and buzzer based on sensor inputs.
4. Building a Smart Home Automation System – Control lights and fans using IoT-based relays.
IoT Communication and Networking
5. Connecting IoT Devices to Wi-Fi – Establish communication between a microcontroller and a Wi-Fi module.
6. Data Transmission using MQTT Protocol – Implement a publisher-subscriber model for IoT messaging.
7. HTTP and REST API Integration – Send sensor data to a cloud server and retrieve responses.
8. Bluetooth-based IoT Communication – Transfer data between IoT devices using Bluetooth.
Cloud Computing and Data Analytics
9. Storing IoT Data on the Cloud – Send real-time sensor data to Firebase/AWS IoT Core.
10. Visualizing IoT Data with Dashboards – Create live data graphs using ThingSpeak or Grafana.
11. Edge Computing for IoT – Process IoT data locally before sending it to the cloud
Security and Advanced Applications
12. Securing IoT Communication with Encryption – Implement AES or RSA encryption for IoT data transmission.
13. Building a Smart Surveillance System – Stream live camera feed using Raspberry Pi and OpenCV.
14. Energy Optimization in IoT Devices – Implement sleep modes in IoT devices to save power.
15. Building a Complete IoT Project – Integrate sensors, communication protocols, and cloud storage into a real-world application like a smart agriculture or healthcare monitoring system.

Text Book
T1. A. Bahga and V. Madisetti, Internet of Things: A Hands-on Approach, Universities Press, 2014.
T2. D. Hanes, G. Salgueiro, P. Grossetete, R. Barton, and J. Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, 2017.

References
R1. C. Pfister, Getting Started with the Internet of Things, O'Reilly Media, 2011.

R2. P. Raj and A. C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press, 2017.
E-Resources **W1.** https://www.coursera.org/specializations/internet-of-things?utm_source=chatgpt.com

CSC7000 - Summary Internship

Course Code: CSC7000	**Course Name:** Summer Internship **Type of Course:** NTCC	L-T-P-C	-	-	-	4
Version No.	1					
Course Description	The **Summer Internship** program is designed to provide students with industry exposure and hands-on experience in real-world IT environments. It allows students to apply their theoretical knowledge to practical scenarios, develop technical and professional skills, and understand workplace dynamics. The internship helps bridge the gap between academic learning and industry expectations, preparing students for future employment or entrepreneurship.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Summer Internship and attain Employability Skills through Experiential Learning techniques.					
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1** Describe professional ethics, teamwork, and communication in an industry setting. [Understand] **CO2** Apply programming, design, and development skills to real-world projects. [Apply] **CO3** Analyze industry requirements and understand workplace expectations. [Analyze] **CO4** Evaluate project challenges, propose solutions, and document technical work effectively [Evaluate] **CO5** Create a comprehensive project solution from design to presentation. [Create]					

Internship – Schedule

Week	Activity	Deliverable
Week 1	Orientation & Onboarding	Internship Proposal & Work Plan Submission
Week 2-3	Initial Project Research & Training	Daily Work Log
Week 4-5	Mid-Term Review & Progress Update	Mid-Term Progress Report
Week 6-7	Project Implementation & Problem Solving	Codebase/Prototype Development
Week 8	Documentation & Final Review	Final Internship Report
Week 9	Presentation & Viva	Internship Presentation & Evaluation

Rubrics:

Component
Internship Proposal & Work Plan
Technical Contribution & Performance
Final Report & Documentation

Presentation & Viva

Mini Project Schedule

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

Rubrics:

1. Project Scope, Planning And Task Definition
2. Literature Review And Problem identification
3. Preliminary Design Selection
4. Detailed System Design/Technical Details
5. End Term Viva
6. Project Report
7. *Supervisor
8. Publication/Certification

CSC7300-Project

Course Code: CSC7300	**Course Name:** Project **Type of Course:** NTCC	**L-T-P-C**	**-**	**-**	**-**	**8**
Version No.	1					
Course Description	The BCA Final Year Project is a capstone course designed to integrate knowledge and skills acquired throughout the BCA program. Students will work individually or in teams to develop a real-world software application, research-based project, or innovative solution using emerging technologies. The project encourages problem-solving, technical proficiency, and professional documentation, preparing students for careers in IT and software development.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Summer Internship and attain Employability Skills through Experiential Learning techniques.					
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1** Understand the principles of software development and project execution in real-world scenarios. [Understand] **CO2** Demonstrate teamwork, ethical practices, and project management skills in software development. [Apply] **CO3** Investigate the real-world problems and define a suitable problem statement for software development. [Analyze] **CO4** Document and present project reports, technical documentation, and findings effectively [Evaluate] **CO5** Design and develop an efficient software solution using appropriate methodologies and technologies [Create]					

Rubrics: Project Schedule

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

CIV7601 -Universal Human Values and Ethics

Course Code: CIV7601	Course Title: Universal Human Values and Ethics Type of Course: MAC course	L-T-P-C	-	-	-	0
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	The purpose of the course is to develop a holistic perspective in students' life. The course adopts a self-reflective methodology of teaching and is designed to equip the students to explore their role in all aspects of living as a part of the society. It presents a universal approach to value education by developing the right understanding of reality through the process of self-exploration. This self-exploration develops more confidence and commitment in students enabling them to critically evaluate their pre-conditioning and present beliefs. As an outcome of the holistic approach, the students will be able to practice the ethical conduct in the social and professional life. The prime focus throughout the course is toward affecting a qualitative transformation in the life of the student rather than just a transfer of information. This course is designed to cater to Human Values and Professional Ethics.					
Course Objective	The objective of the course is 'SKILL DEVELOPMENT' of the student by using 'SELF LEARNING' techniques					
Course Outcomes	On successful completion of this course the students shall be able to: **CO1**. Recognize the importance of Value Education through the process of self-exploration **CO2**. Explain the human being as the co-existence of the self and the body in harmony. **CO3**. Describe the role of foundational values in building harmonious relationships. **CO4**. Summarize the importance of a holistic perspective in developing ethical professional behavior.					
Course Content:						
Module 1	**Introduction to Value Education**			**5 Sessions**		
Topics: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.						
Module 2	**Harmony in the Human Being**			**5 Sessions**		
Topics:						

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health

Module 3	**Harmony in the Family and Society**	**5 Sessions**

Topics:
Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

Module 4	**Implications of the Holistic Understanding – A Look at Professional Ethics**	**5 Sessions**

Topics:
Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Strategies for Transition towards Value-based Life and Profession

Targeted Application & Tools that can be used
Application areas are Personal life, Education and Career, Workplace , Society and Environmental Responsibility
Tools: Online Tools – NPTEL and Swayam.

Project work/Assignment:

Assessment Type

- Online exams (MCQs) will be conducted by the Department of Civil Engineering through Linways.

Online Link*:
W1. UHV II - https://www.youtube.com/watch?v=NhFBzn5qKIM&list=PLWDeKF97v9SO8vvjC1KyqteziTbTjN1So&pp=0gcJCWMEOCosWNin
W2. Lecture by Dr. Kumar Sambhav, NPTEL course: Universal Human Values, https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

W3. Lecture by Dr. Padmavati, Dr Narendran Thiruthy, NPTEL Course: Biodiversity Protection, Farmers and Breeders Rights, https://nptel.ac.in/courses/129105008, 2024.
* Other source links are available in below Resources link.

Text Book
T1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
T2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2019.
T3. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.

Reference Books
R1. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
R2. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986.
R3. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
R4. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
R5. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.

Resources: **R1**. https://onlinecourses.swayam2.ac.in/imb25_mg195/preview **R2**. https://onlinecourses.nptel.ac.in/noc25_mg141/preview **R3**. https://onlinecourses.swayam2.ac.in/ini25_hs52/preview **R4**. https://onlinecourses.nptel.ac.in/noc25_hs219/preview **R5**. https://onlinecourses.swayam2.ac.in/cec25_mg14/preview **R6**. https://onlinecourses.swayam2.ac.in/imb25_mg195/preview **R7**. https://onlinecourses.swayam2.ac.in/imb25_mg196/preview
Topics relevant to Skill Development: 1. An attitude of enquiry. 2. Write reports The topics related to Human values and Professional ethics: All topics in are relevant to Human values and Professional ethics.

Discipline Specific Elective

Track 1 -Full stack

CSC3500 .Net Programming Using C#

Course Code: **CSC3500**	Course Name: .Net Programming Using C# Type of Course: Lab / Lab Integrated Course	L- T-P- C	1-0-4-3
Version No.	1		
Course Pre-requisites	Familiarity with any programming language such as C, C++, Java, or Python including Basic knowledge of OOP concepts, including classes, objects, inheritance, polymorphism, and encapsulation		
Anti-requisites	Nil		
Course Description	This course provides an in-depth exploration of .NET programming using C#, enabling students to design and develop modern applications efficiently. The students will gain a solid foundation in the .NET framework and C# programming language, focusing on object-oriented principles, graphical user interface development, web and desktop application creation, and integration with databases. The course also emphasizes best practices and design patterns, ensuring the development of robust, scalable, and secure applications.		
Course Objective	The objective of the course .NET programming using C# is to familiarize the learners with the concepts of .Net Framework architectures, C# Programming language and attain SKILL DEVELOPMENT through EXPERIENTIAL LEARNING techniques		
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1** Use OOPS concepts in C# for solutions to real-world problems [Apply] **CO2** Design and implement robust console-based and desktop applications using C# and the .NET framework. [Create] **CO3** Create interactive GUI-based applications in C# to enhance user experience. [Create] **CO4** Develop database-driven applications using ADO.NET for efficient data management [Create]		

Course Content:				
Module 1	Introduction to .NET Framework	Assignment	Introduction to .NET Framework	15 Sessions
Topics: Understanding .NET Framework: An overview of the .NET, Key benefits of .NET Platform, Introduction to .NET framework and .NET, Architecture-.Net Framework Class Libraries-CLR- Name Space, Assemblies, MSIL, Understanding Common Type Systems (CTS), Common Language Specifications, Introduction to Visual Studio.Net, Languages supported by .NET, Different Applications of .NET.				
Module 2	C# Language Basics	Assignment	C# Language Basics	15 Sessions
Topics: The C# Language: Working with system Data Types and C# Keywords, Literals, and Variables, Operators, Type Conversion and Casting, Program Control Statements, Looping Statements, Understanding Arrays and Strings, Methods and Classes. Collections.				

Collections. Introduction to Windows Forms- The System Windows.Forms Namespace, Windows Forms Development, Windows Forms and Web Services				
Module 3	Object oriented with C#	Assignment	Object oriented with C#	25 Sessions
Topics: The architecture of a class in C#, Instance, Class & Reference variables, Access Modifier, Abstract Classes, Constructors, Destructors, Inheritance in C#, Method Overloading, Method Overriding, Operator Overloading, Method Hiding, Access modifies: private, pubic, protected, internal, protected internal, new, Abstract classes, Sealed classes, Creating Interfaces, Implementing Interface inheritance.				
Module 4	Database Programming Using ADO.NET	Assignment	Database Programming Using ADO.NET	20 Sessions
Topics: Database Programming Using ADO.NET -Introduction, and Evolution of ADO.NET, Understanding the Role of Managed Provider and ADO.NET Objects, Connecting to Database and Connection Pooling, Performing Insert, Update and Delete Operations, Fetching Data from the database - Executing Select Statements				

List of Laboratory Tasks

Experiment No. 1:
Level 1: Install Visual Studio, a robust IDE for developing .NET applications on Windows.
Level 2: Identify the Components of Integrated Development Environments.
Experiment No. 2:
Level 1: Identify the types of Projects supported by the .NET Framework
Level 2: Identify the controls that are available for Windows Form Applications. List any 10 Common Controls and their basic Properties
Experiment No. 3:
Level 1: Create a console application in C# that performs basic arithmetic operations (addition, subtraction, multiplication, and division).
Level 2: Create a console application in C# for Simple Interest and Compound Interest
Experiment No 4:
Level 1: University wants to store the student details. Get the student details such as Roll number, fname, lname, Semester, Specialization and display all details. Design a windows application form to accept user input.
Level 2: Design a Windows application to calculate the Simple Interest (SI) by providing Principal (p), Rate(r) and Time (t). Hint: S.I= (p × r × t)/100
Experiment No. 5:
Level 1 Write a C# program that calculates the sum of the digits of a given positive integer using the while loop. The program should:
Take a positive integer as input from the user.
Use a while loop to extract and add each digit of the number.
Display the final sum of the digits.
Level 2: Write a C# program that takes the marks of a student as input and calculates their grade based on the following criteria:
Marks >= 90: Grade A
Marks >= 80 and < 90: Grade B
Marks >= 70 and < 80: Grade C
Marks >= 60 and < 70: Grade D
Marks >= 50 and < 60: Grade E
Marks < 50: Fail
Experiment No. 6:
Level 1: Create a C# Program to implement Vowels Program using Select Case.
Level 2: Create a C# program to Print Fibonacci Series for the given input
Experiment No 7:
Level 1: Define a class 'student' with data members stno, stname and age. Also include following: Default Constructor and parameterized constructor. Display method to show all details.
Level 2: 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
Experiment No. 8:
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: Write a C# Program to find out the area of the triangle, square, and rectangle using method overloading. Experiment No. 9: Level 1: Write a C# program where the Student class inherits from the Person class. The Person class contains Name and Age properties, and the Student class adds the Course property. Display the information of a student by calling both the Person and Student methods. Level 2: Write a C# program where the Teacher class inherits from the Person class. Override the DisplayInfo method in the Teacher class to show both the teacher's personal information and their subject. Experiment No. 10: Level 1: Create a Class called Rectangle and store length, width using constructor. Calculate the area using that. Create tabletop using rectangle class and calculate the cost of painting that table top. (Use single inheritance) Level 2: Admin executive of the university is entering the university name for the students. If he enters the name wrongly, exception should be raised.
Text Book • Andrew Troelsen Philip Japikse, "Pro C# 10 with .NET 6 Foundational Principles and Practices in Programming", 11th Edition, Apress Publishers, USA, 2022 • Herbert Schildt, "C# 4.0: The Complete Reference", Tata McGraw-Hill Publishers, 4th Edition, 2017
References • Thuan L. Thai ".Net Framework Essentials: Introducing the .net Framework", O'reilly Media Inc 2004, [ISBN: 978-0-59-600505-4] • Mark J. Price, "C# 12 and .NET 8 – Modern Cross-Platform Development Fundamentals", 8th Edition, Packt Publishing, 2023 [ISBN 978-1-83763-587-0].
E-Resources https://www.codecademy.com/learn/learn-c-sharp https://dotnet.microsoft.com/en-us/learn/csharp https://www.learncs.org/ https://www.codechef.com/learn/course/c-sharp https://csharp-station.com/

CSC3501 No SQL

Course Code: **CSA3501**	**Course Name:** NoSQL **Type of Course:**	L- T-P- C	1-0-4-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course provides an in-depth understanding of NoSQL databases, their architecture, and their applications in modern data-driven environments. Students will explore the key concepts, types, and use cases of NoSQL databases, focusing on their scalability, flexibility, and performance advantages over traditional relational databases. The course covers various NoSQL database models, including Key-Value, Document-Oriented, Column-Family, and Graph Databases, with practical examples and hands-on experience. Students will gain the skills to design, implement, and manage NoSQL databases for real-world applications such as Big Data, IoT, and E-commerce systems.		
Course Objective	The course No SQL aims to equip BCA students with foundational knowledge and practical skills in NoSQL databases, focusing on their architecture, types, and applications. Students will learn to design, implement, and manage scalable, distributed systems.		

Course Outcomes	**On successful completion of the course the students shall be able to:**	
	CO1 Understand NoSQL Fundamentals	[Understand]
	CO2 Perform Practical NoSQL Operations	[Apply]
	CO3 Apply NoSQL in Real-World Scenarios	[Apply]
	CO4 Analyze distributed database architectures by implementing Replication strategies.	[Analyze]
	CO5 Implement keyspaces and tables in Cassandra	[Analyze]
	CO6 Design Scalable Systems	[Analyze]
Course Content:		
Module 1	Introduction to NoSQL Databases	7 Sessions
Topics: Overview of NoSQL and its importance, Differences between SQL and NoSQL databases, Installation and setup of NoSQL databases (MongoDB, Cassandra, Redis, Neo4j) , Introduction to basic NoSQL commands.		
Module 2	Document-Oriented and Key-Value Databases	7 Sessions
Topics: Understanding document-oriented databases (MongoDB) , CRUD operations in MongoDB, Data modeling and schema design in MongoDB, Introduction to key-value stores (Redis) , Working with Redis data structures (strings, lists, sets, and hashes).		
Module 3	Column-Family Databases (Cassandra)	8 Sessions
Topics: Introduction to column-family databases and their architecture, Basics of Apache Cassandra and its use cases , Creating keyspaces and tables in Cassandra, Performing CRUD operations using CQL (Cassandra Query Language) , Data partitioning, replication, and consistency in Cassandra.		
Module 4	Graph Databases (Neo4j)	8 Sessions
Topics: Introduction to graph databases and their applications Nodes, relationships, and properties in Neo4j , Querying graph databases using Cypher ,Real-world use cases of graph databases, Indexing, aggregation, and performance optimization in MongoDB, Sharding and replication in NoSQL databases, Security and access control in NoSQL databases.		
List of Experiments		30 Sessions

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

Text Books

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

T2 MongoDB: The Definitive Guide by Kristina Chodorow.

Reference Books	
R1	Cassandra documentation: https://cassandra.apache.org/doc/latest/
R2	Adam Fowler, “NoSQL For Dummies”, Wiley, 2015.

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

CSC3502 Front-End Development using Java Script

Course Code: **CSC3502**	Course Name: Front-End Development using Java Script Type of Course: Lab / Lab Integrated Course	L- T-P- C	1-0-4-3
Version No.	1		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This intermediate course enables students to perform front-end development using Javascript, with emphasis on employability skills. The course covers key technologies and architectures that enables the student to design and implement front-end. On successful completion of this course, the student shall be able to pursue a career in front end development. The students shall develop strong problem-solving skills as part of this course.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Front-end Development using Javascripts and attain Employability Skills through Experiential Learning techniques.		
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1** Design and develop static web pages using HTML5 elements and CSS3 [Apply] **CO2** Develop responsive web pages using CSS, JavaScript and bootstrap. [Apply] **CO3** Demonstrate the concepts of Angular.js to develop a web front-end. [Apply] **CO4** Illustrate the concepts of React.js to develop a web front-end. [Apply]		

Course Content:				
Module 1	Introduction to Front-End Development	Assignment	Introduction to Front-End Development	20 Sessions
Topics: Web development basics, Introduction to HTML5 structure, Semantic elements, Forms and inputs, Introduction to CSS3 styling, Selectors and properties, Box model, Flexbox and Grid, Introduction to JavaScript, Variables, Data types, Operators, Conditional statements, Loops, Functions.				
Module 2	Advanced JavaScript & Interactive Web Elements	Assignment	Advanced JavaScript & Interactive Web Elements	25 Sessions
Topics: JavaScript Events, DOM Manipulation, Form validation, Local and session storage, ES6 concepts (Arrow functions, Spread/Rest Operators, Destructuring), Introduction to Bootstrap, Grid system, Forms, Navigation bars, Buttons, Cards, Tables, Modal windows.				
Module 3	AJAX, jQuery & Responsive Web Design	Assignment	AJAX, jQuery & Responsive Web Design	15 Sessions
Topics: Understanding AJAX and asynchronous JavaScript, Fetch API vs. XMLHTTPRequest, Handling JSON data, jQuery basics, Selectors, Effects (Hide, Show, Toggle, Fade, Slide), Event handling in jQuery, Animations, Creating a dynamic content loader with AJAX & jQuery.				
Module 4	AngularJS & Django Integration	Assignment	AngularJS & Django Integration	15 Sessions
Topics:				

Introduction to AngularJS, Directives, Controllers, Data binding, Routing, Creating Angular components, Fetching API data with Angular, Introduction to Django, Creating views and templates, Static files and media, Connecting Django with Angular for dynamic web applications.

List of Laboratory Tasks

Experiment No. 1: [4 + 1 Practical Sessions]
Level 1: Familiarization of HTML and CSS basics.
Level 2: Create an HTML webpage showcasing biodata with CSS styling.
Shape
Experiment No. 2: [4 + 1 Practical Sessions]
Level 1: Design an interactive web page for a new restaurant using CSS3 features.
Level 2: Create a simple web form to gather user information.
Shape
Experiment No. 3: [5 + 1 Practical Sessions]
Level 1: Practice basic JavaScript exercises, including creating a canvas drawing application.
Level 2: Implement JavaScript exercises for form validation.
Shape
Experiment No. 4 [5 + 1 Practical Sessions]
Level 1: Create a student registration form using JavaScript.
Level 2: Design an RSVP form using Bootstrap form controls.
Shape
Experiment No. 5 [4 + 1 Practical Sessions]
Level 1: Create a responsive image grid using Bootstrap 5.
Level 2: Write a JavaScript program using AJAX to dynamically load content and implement jQuery effects like fading.
Experiment No. 6 [5 + 1 Practical Sessions]
Level 1: Create an AngularJS application module and controller in app.js.
Level 2: Design an "AngularJS Solar System Explorer" for planet data visualization.
Experiment No. 7 [5 + 1 Practical Sessions]
Level 1 : Develop a simple Django app that displays an unordered list of fruits and ordered list of selected students for an event
Level 2: Develop a layout.html with a suitable header (containing navigation menu) and footer with copyright and developer information. Inherit this layout.html and create 3 additional pages: contact us, About Us and Home page of any website.

Text Book

- Fender, Young, “Front-end Fundamentals”,Leanpub, 2015
- Northwood, Chris, “The Front End Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer”,APress, 2018

References

- Flanagan D S, “Javascript : The Definitive Guide” 7th Edition. 7th ed. O'Reilly Media; 2020.
- Alex Libby, Gaurav Gupta, and AsojTalesra. “Responsive Web Design with HTML5 and CSS3 Essentials”,Packt Publishing, 2016

E-Resources

Mozilla Developer Network (MDN): https://developer.mozilla.org/en-US/
W3Schools - HTML, CSS & JavaScript: https://www.w3schools.com/
CSS Tricks: https://css-tricks.com/
JavaScript.info (Advanced JS Concepts): https://javascript.info/
Bootstrap 5 Documentation: https://getbootstrap.com/docs/5.0/getting-started/introduction/
jQuery Documentation: https://api.jquery.com/
AngularJS Guide: https://angularjs.org/
Django Official Documentation: https://docs.djangoproject.com/en/stable/

CSC3503 Web Application Deployment on Cloud

Course Code: **CSC3503**	**Course Title:** Web Application Deployment on Cloud **Type of Course: Discipline Elective**	L-T-P-C	1	0	4	3
Version No.	1.0					

Course Pre-requisites	Web Development, Database Management Systems, Basic Networking, and familiarity with Full Stack Development.
Anti-requisites	NIL
Course Description	This course introduces students to modern cloud computing concepts and web application deployment practices. It covers cloud service models, cloud infrastructure, virtualization, containerization, deployment automation, and cloud-native application hosting. Students will gain practical experience in deploying, managing, monitoring, and scaling web applications on leading cloud platforms using industry-standard tools and services.
Course Objective	To equip learners with the knowledge and practical skills required to deploy, manage, monitor, and scale web applications on cloud platforms using modern deployment tools, containerization technologies, and cloud services while following industry best practices.
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain cloud computing concepts, service models, and deployment models. [Understand] CO2 Deploy web applications on cloud platforms using Infrastructure as a Service (IaaS) and Platform as a Service (PaaS). [Apply] CO3 Utilize containerization and orchestration tools for application deployment and management. [Apply] CO4 Configure cloud storage, databases, networking, and security services for web applications. [Apply] CO5 Monitor, optimize, and scale cloud-hosted applications based on performance requirements. [Analyze]

Course Content:

Module 1	Fundamentals of Cloud Computing	4 Sessions

Topics:
Introduction to Cloud Computing, Characteristics of Cloud Computing, Service Models (IaaS, PaaS, SaaS), Deployment Models (Public, Private, Hybrid, Community Cloud), Virtualization Concepts, Cloud Architecture, Cloud Providers Overview (AWS, Microsoft Azure, Google Cloud Platform), Cloud Resource Management.

Module 2	Cloud Infrastructure and Web Application Hosting	4 Sessions

Topics:
Cloud Compute Services, Virtual Machines, Cloud Storage Services, Cloud Networking Fundamentals, Domain Name System (DNS), Web Hosting Concepts, Hosting Static and Dynamic Websites, Database Hosting, Cloud Security Fundamentals, Identity and Access Management (IAM), Backup and Recovery Strategies.

Module 3	Containerization and Deployment Automation	4 Sessions

Topics:
Introduction to Containers, Docker Architecture, Docker Images and Containers, Dockerfile Creation, Docker Compose, Container Registries, Introduction to Kubernetes, Container Orchestration Concepts, Continuous Integration, Continuous Deployment (CI/CD), GitHub Actions, Automated Deployment Pipelines.

Module 4	Monitoring, Scaling, and Cloud-Native Deployment	3 Sessions

Topics:
Application Monitoring, Logging and Debugging, Performance Optimization, Load Balancing, Auto Scaling, Serverless Computing, Cloud-Native Applications, Microservices Deployment, Security Best Practices, Cost Optimization, Deploying Full Stack Applications on Cloud Platforms.

List of Experiments	60 Sessions

1. Create and configure a cloud account on AWS/Azure/GCP.
2. Launch and manage virtual machines.
3. Configure cloud storage services.
4. Deploy a static website on cloud hosting.
5. Deploy a dynamic web application on a cloud server.
6. Configure cloud-based databases.
7. Register and configure a domain name.

8. Create Docker images for web applications. 9. Deploy applications using Docker containers. 10. Use Docker Compose for multi-container applications. 11. Configure container registries. 12. Implement CI/CD pipelines using GitHub Actions. 13. Deploy applications using automated workflows. 14. Monitor cloud-hosted applications. 15. Configure load balancing and auto scaling. 16. Deploy a full-stack web application on a cloud platform. 17. Implement security policies and access controls. 18. Mini Project: End-to-End Deployment of a Full Stack Application on Cloud. 19. Implement Infrastructure as Code (IaC) using Terraform for automated cloud resource provisioning. 20. Deploy and manage containerized applications using Kubernetes orchestration.
Targeted Application & Tools Used AWS/Azure/GCP, Docker, Kubernetes, Git & GitHub, GitHub Actions/Jenkins, Linux, Nginx, Apache Server, VS Code, MongoDB, MySQL, Node.js, React.js, Express.js, Cloud Storage and Monitoring Tools.
Textbooks **T1.** Thomas Erl, Ricardo Puttini, and Zaigham Mahmood, *Cloud Computing: Concepts, Technology & Architecture*, Pearson. **T2.** Nigel Poulton, *The Docker Deep Dive*, Latest Edition.
References Books **R1.** Michael J. Kavis, *Architecting the Cloud*, Wiley. **R2.** Brendan Burns, Joe Beda, and Kelsey Hightower, *Kubernetes: Up and Running*, O'Reilly. **R3.** Adrian Mouat, *Using Docker*, O'Reilly.
E-Resources 1. Amazon Web Services Documentation 2. Microsoft Azure Documentation 3. Google Cloud Documentation 4. Docker Documentation 5. Kubernetes Documentation

CSC3504 Agile Structures and Frameworks

Course Code: CSC3504	Course Name: Agile Structures and Frameworks Type of Course: Theory Course	L- T-P- C	3-0-0-3
Version No.	1		
Course Pre-requisites	Software Engineering		
Anti-requisites	Nil		
Course Description	This course imparts knowledge to students in the basic concepts of Agile Software Process, methodology and its development The objective of this course is to provide the fundamentals concepts of Agile and its Significance. This course covers the Agile and its methodologies. The objective of the course is to understand the Agility and Assurance.		
Course Objective	The objective of the course Agile Structures and Frameworks is EMPLOYBILITY of student by using PARTICIPATIVE LEARNING techniques		

Course Out Comes	**On successful completion of the course the students shall be able to:** • Understand the basic concepts of Agile Software Process [Understand] • Comprehend the various Agile Methodologies [Understand] • Design Agile Software Process [Apply] • Apply principles of Agile Testing [Apply]

Course Content:				
Module 1	Introduction	Assignment	Introduction	10 Sessions
Topics: Introduction to Agile technology, Iterative and Evolutionary Methods, Agile – Agile Development. Agile Values, Agile Principles, Compare and Contrast the agile with traditional methods. Agile Benefits. Agile Estimation Techniques. Case Study				
Module 2	Agile and Its Significance	Quiz/ Assignment	Agile and Its Significance	12 Sessions
Topics: Agile Story : Evolutionary delivery ,Scrum Demo, Planning game, Sprint back log, adaptive planning. Agile Motivation – Problems With The Waterfall - Research Evidence. Scrum : Method Overview ,Life cycle phases and Work product roles and practices.				
Module 3	Agile methodology	Assignment	Agile methodology	13 Sessions
Topics: Extreme Programming: Method Overview ,Life cycle phases and Work product roles and practices. Unified process : Method Overview ,Life cycle phases and Work product roles and practices. EVO : Method Overview ,Life cycle phases and Work product roles and practices. Case Study.				
Module 4	Agility and Quality Assurance	Assignment	Agility and Quality Assurance	10 Sessions
Topics: Agile product development – Agile Metrics – Feature Driven Development (FDD). Agile approach to Quality Assurance. Test Driven Development – Agile approach in Global Software Development. Agile Technology Tools.				
Text Book • Craig Larman, "Agile and Iterative Development – A Manager's Guide", Pearson Education – 2006 • Edward Scatter "Brilliant Agile Project Management: A Practical Guide to Using Agile, Scrum and Kanban, 2015				
References • Chetankumar Patel, Muthu Ramachandran, Story Card Maturity Model (SMM): A Process Improvement Framework for Agile Requirements Engineering Practices, Journal of Software, Academy Publishers, Vol 4, No 5 (2009), 422-435, Jul 2009. • Hazza& Dubinsky, Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer 2009				
E-Resources https://presiuniv.knimbus.com/user#/home				

CSC3505 Full Stack Development using MERN Stack

Course Code: CSC3505	Course Name: **Full Stack Development using MERN Stack** Type of Course: Lab / Lab Integrated Course	L- T-P- C	2-0-2-3
Version No.	1		

Course Pre-requisites	Basic knowledge of Web Development including HTML, CSS, JavaScript, browser architecture, client-server communication, and database fundamentals. Familiarity with programming concepts and object-oriented programming is desirable.
Anti-requisites	NIL
Course Description	This course provides a comprehensive understanding of Full Stack Web Application Development using the MERN Stack comprising MongoDB, Express.js, React.js, and Node.js. The course integrates theoretical concepts with extensive laboratory practice to enable learners to design, develop, test, deploy, and maintain modern web applications. Students will gain hands-on experience in developing responsive user interfaces, RESTful APIs, database-driven applications, and complete full-stack solutions following industry standards and best practices.
Course Objective	To enable learners to design and develop full-stack web applications using the MERN stack by integrating frontend, backend, and database technologies. The course emphasizes practical skills in building responsive user interfaces, developing RESTful APIs, managing databases, and deploying scalable web applications following industry best practices.
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Explain the architecture, components, and workflow of MERN Stack applications. **[Understand]** **CO2:** Develop backend services and RESTful APIs using Node.js and Express.js. **[Apply]** **CO3:** Design interactive and reusable user interface components using React.js. **[Apply]** **CO4:** Implement CRUD operations and database management using MongoDB. **[Apply]** **CO5:** Integrate frontend, backend, and database components to develop full-stack web applications. **[Create]** **CO6:** Deploy, test, and maintain MERN-based applications following industry best practices. **[Apply]**

Course Content:		
Module 1	**Introduction to Full Stack Development and Node.js**	**7 Sessions**
Topics: Introduction to Full Stack Development, MERN Stack Architecture, Client-Server Architecture, Web Development Frameworks, Node.js Fundamentals, Node.js Runtime Environment, Node Package Manager (NPM), Node Modules, Events and Event Loop, Callbacks, Asynchronous Programming, File System Operations, HTTP Module, Creating Web Servers using Node.js.		
Module 2	**Backend Development using Express.js**	**8 Sessions**
Topics: Introduction to Express.js, Express Application Structure, Routing, Middleware, Request and Response Handling, RESTful API Development, CRUD Operations, Express Router, Error Handling, API Testing using Postman, Authentication Concepts, MVC Architecture, Backend Application Development.		
Module 3	**MongoDB and Database Integration**	**7 Sessions**
Topics: Introduction to NoSQL Databases, MongoDB Architecture, Database and Collection Management, Documents and BSON, CRUD Operations in MongoDB, Query Operators, Update Operators, Aggregation Framework, Data Modeling, MongoDB Administration, MongoDB with Node.js, Mongoose ODM, Database Integration and Optimization.		

Module 4	React.js and Full Stack Application Development	8 Sessions

Topics:
Introduction to React.js, JSX, React Components, Props and State, Event Handling, Forms and Validation, React Hooks, Component Lifecycle, React Router, API Integration, State Management, Responsive UI Development, MERN Stack Integration, Full Stack Application Development, Deployment and Performance Optimization.

List of Laboratory Tasks (30 Sessions)

Experiment 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.
Level 2: Practice creating branches and merging changes. Push changes to a remote repository (e.g., GitHub, GitLab).

Experiment 2:
Level 1: Install Node.js and npm on local machines.
Level 2: Create a simple Node.js application. Use npm to manage dependencies and install packages.

Experiment 3:
Level 1: Implement basic server functionalities such as handling HTTP requests.
Level 2: Implement basic server functionalities such as handling HTTP responses.

Experiment 4:
Level 1: Run and test the Node.js application locally.
Level 2**:** Creating Application with npm init and Installed Modules.

Experiment 5:
Level 1: Create a message.txt file in the same directory and add some content in node.js
Level 2: Creating Web-based Node Application.

Experiment 6:
Level 1: Creating a server in Node
Level 2: Read request and return response in Node.

Experiment 7:
Level 1: Create a Calculator Node.js Module with functions add, subtract and multiply. And use the Calculator module in another Node.js file.
Level 2: Create node.js program with the content 'FS module' to perform file operations.

Experiment 8:
Level 1: Install MongoDB on local machines or a virtual environment. Configure MongoDB to run as a service.
Level 2: Access the MongoDB shell and perform basic database operations (e.g., creating databases, collections, inserting documents).

Experiment 9:
Level 1: Perform CRUD operations (Insert, Update, Delete and Query Documents) on 'Student' Database.
Level 2: Do queries involving MongoDB update operator.

Experiment 10:
Level 1: Perform different query modifiers on 'Student' Database
Level 2: Implement different aggregation commands on 'Student' Database.

Experiment 11:
Level 1: Perform CRUD operations (Insert, Update, Delete and Query Documents) on Employee Information Database.
Level 2: Do queries involving MongoDB update operator.

Experiment 12:
Level 1: Perform different query modifiers on Employee Database
Level 2: Implement different aggregation commands on Employee Information Database.

Experiment 13:
Connect a Node.js application to MongoDB using the official MongoDB Node.js driver

Experiment 14:
Implement basic server functionalities such as handling HTTP requests and responses.

Run and test the Node.js application locally

Experiment 15:

Level 1: Learn about the basics of npm commands such as npm init, npm install, and npm publish.

Level 2: Explore the npm registry to search for and install existing Node.js modules.

Experiment 16:

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

Experiment 17:

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 18:

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

Experiment 19:

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

Experiment 20:

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).

Text Book

T1. Vasan Subramanian, *Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node*, 2nd Edition, Apress, 2020.

T2. Brad Dayley, Brendan Dayley, and Caleb Dayley, *Node.js, MongoDB and Angular Web Development*, 2nd Edition, Addison-Wesley, 2021.

References

R1. Chris Northwood, The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer, 3rd Edition, Apress, 2023.

R2. Kirupa Chinnathambi, Learning React: A Hands-On Guide to Building Web Applications Using React and Redux, 3rd Edition, Addison-Wesley, 2022.

R3. Ethan Brown, Web Development with Node and Express, O'Reilly Media, Latest Edition.

R4. Alex Banks and Eve Porcello, Learning React, O'Reilly Media, Latest Edition.

E-Resources

W1. https://www.tutorialspoint.com/the_full_stack_web_development/index.asp

W2. https://www.coursera.org/specializations/full-stack-react

W3. https://www.udemy.com/course/the-full-stack-web-development/

W4. https://react.dev/

W5. https://nodejs.org/en/docs

W6. https://www.mongodb.com/docs/

Track 2 - AIML and Data Science

CSC3507 Deep Learning

Course Code: CSC3507	Course Name: Deep Learning Type of Course: Lab Integrated		L- T-P- C	2-0-2-3
Version No.	1			
Course Pre-requisites	NIL			
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 the course the students shall be able to:** • Describe the feed-forward and deep networks. [Understand] • Design single and multi-layer feed-forward deep networks and tune various hyper-parameters. [Apply] • Implement deep neural networks to solve a problem. [Apply] • Analyze performance of deep networks. [Apply]			
Course Content:				
Module 1	Introduction to Deep Learning	Assignment	ntroduction to Deep Learning	8 Sessions
Topics: 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	Quiz/ Assignment	Convolution Neural Networks	8 Sessions
Topics: Convolution Neural Networks : Introduction to convolution neural networks: stacking, striding and pooling, applications like image, and text classification.				
Module 3	Sequence Modeling	Assignment	Sequence Modeling	7 Sessions
Topics:				

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	Assignment	Autoencoders	7 Sessions

Topics:
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 sessions**

Basic Deep Learning Programs

1. Basic Neural Network Implementation – Implement a simple feedforward neural network using TensorFlow/PyTorch.
2. Activation Function Comparison – Visualize and compare the effects of ReLU, Sigmoid, and Tanh.
3. Training a Multi-Layer Perceptron (MLP) – Train an MLP on the MNIST dataset for digit classification.
4. Loss Function Exploration – Implement and compare Mean Squared Error (MSE) and Cross-Entropy loss.
5. Gradient Descent Optimization – Implement different optimizers (SGD, Adam, RMSprop) and analyze their effects.

Convolutional Neural Networks (CNNs) Programs

6. Building a CNN from Scratch – Implement and train a CNN for image classification using the CIFAR-10 dataset.
7. Transfer Learning with Pre-trained Models – Fine-tune a ResNet or VGG model for custom image classification.
8. Object Detection using YOLO – Use YOLOv5 for real-time object detection in images.
9. Image Segmentation using U-Net – Implement semantic segmentation for medical images.
10. Data Augmentation for CNNs – Apply rotation, flipping, and zooming to improve dataset variability.

Recurrent Neural Networks (RNNs) and NLP Programs

11. Implementing a Simple RNN – Build an RNN for predicting time-series data.
12. Sentiment Analysis using LSTM – Train an LSTM network to classify movie reviews as positive or negative.
13. Text Generation using LSTMs – Train an LSTM model to generate text based on input sequences.
14. Machine Translation using Seq2Seq – Implement a sequence-to-sequence model for English-to-Spanish translation.
15. Text Classification using BERT – Fine-tune a BERT model for text classification tasks.

Model Optimization and Deployment Programs

16. Hyperparameter Tuning with Grid Search – Optimize batch size, learning rate, and number of layers.
17. Regularization Techniques – Implement dropout and batch normalization to reduce overfitting.
18. Model Compression using Quantization – Reduce deep learning model size for mobile deployment.
19. Deploying a Deep Learning Model with Flask – Create a REST API to serve a trained model for real-world applications.
20. Real-time Object Detection with OpenCV and TensorFlow – Build a live webcam-based object detection system.

Text Book

- Bunduma, N. (2017). Fundamentals of Deep Learning. O'reilly Books
- Heaton, J. (2015). Deep Learning and Neural Networks, Heaton Research Inc.

References

- Deng, L., & Yu, D. (2009). Deep Learning: Methods and Applications (Foundations and Trends in Signal Processing). Publishers Inc.
- Hall, M.L, (2011). Deep Learning. VDM Verlag

E-Resources
http://imlab.postech.ac.kr/dkim/class/csed514_2019s/DeepLearningBook.pdf

CSC3513 Natural Language Processing

Course Code: CSC3513	**Course Name: Natural Language Processing** Type of Course: Lab Integrated	L-T-P-C	2-0-2-3
Version No.	1		
Course pre-requisites	Programming in Python, Data Structures, Fundamentals of Machine Learning		
Anti-requisites	NIL		
Course Description	This course introduces the fundamental concepts, techniques, and applications of Natural Language Processing (NLP). It enables computers to process, understand, and generate human language. The course covers text preprocessing, linguistic analysis, machine learning techniques for NLP, deep learning architectures, and transformer-based models. On successful completion of this course, students will be able to develop intelligent language-processing applications such as sentiment analysis systems, chatbots, machine translation systems, and text summarization tools.		
Course Objective	The objective of this course is to familiarize learners with the concepts, techniques, and tools of Natural Language Processing and develop skills for analyzing, processing, and generating human language using machine learning and deep learning approaches.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1: Explain the fundamentals, linguistic concepts, and applications of Natural Language Processing. [Understand] CO2: Apply text preprocessing and feature extraction techniques for NLP tasks. [Apply] CO3: Develop machine learning models for text classification and sentiment analysis. [Apply] CO4: Implement advanced NLP applications using deep learning and transformer-based architectures. [Apply] CO5: Examine the performance of NLP models using appropriate evaluation techniques. [Analyze] CO6: Evaluate NLP solutions for real-world language processing applications. [Analyze]		
Course Content:			
Module 1	Fundamentals of Natural Language Processing		11 Sessions
Topics: Introduction to Natural Language Processing, Applications of NLP, Challenges in NLP, NLP Pipeline, Corpus and Linguistic Resources, Lexical Analysis, Morphological Analysis, Syntax Analysis, Semantic Analysis, Pragmatics, Introduction to NLP Libraries (NLTK and spaCy).			
Module 2	Text Preprocessing and Feature Engineering		11 Sessions
Topics: Text Cleaning and Normalization, Tokenization, Stop-word Removal, Stemming, Lemmatization, Part-of-Speech Tagging, Named Entity Recognition (NER), Bag of Words (BoW), TF-IDF Representation, Word Embeddings (Word2Vec and GloVe), Feature Extraction Techniques			
Module 3	Machine Learning for NLP		12 Sessions
Topics: Text Classification, Sentiment Analysis, Naïve Bayes Classifier, Logistic Regression, Support Vector Machines (SVM), N-gram Language Models, Topic Modeling, Information Retrieval Concepts, Model Evaluation Metrics: Accuracy, Precision, Recall, F1-Score, Confusion Matrix.			
Module 4	Deep Learning and Transformer-Based NLP		11 Sessions
Topics: Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), Sequence-to-Sequence Models, Attention Mechanism, Transformer Architecture, BERT, GPT Models, Machine Translation, Question Answering Systems, Chatbots and Conversational AI, Generative AI Applications in NLP.			

Text Books
T1 Speech and Language Processing. **T2** Natural Language Processing with Python
Reference Books
R1 Practical Natural Language Processing **R2** Deep Learning for Natural Language Processing
E-Resources • NLTK Documentation • spaCy Documentation • Hugging Face Transformers Documentation • Stanford NLP Resources • Google NLP Guide

CSC3510 Generative AI

CSA3505 Generative AI

Course Code: CSA3505	**Course Name:** Generative AI Applications **Type of Course:** Integrated	L- T- P- C	2-0-2-3
Version No.	1		
Course pre-requisites	Basics of Programming and Artificial Intelligence		
Anti-requisites	NIL		
Course Description	This course provides the opportunity for students to explore and develop applications using Generative Artificial Intelligence technologies. Students will learn the fundamentals of generative AI models, prompt engineering, text and image generation, chatbot development, AI-assisted content creation, and deployment of AI applications. Topics include: Introduction to Generative AI, large language models, prompt engineering, generative text and image applications, AI-powered chatbots, ethical AI practices, APIs for AI integration, and deployment of generative AI applications.		
Course Objective	The objective of the course is to familiarize learners with the concepts of Generative AI Applications and enable skill development through experiential learning techniques using modern AI tools and platforms.		
Course Outcomes	**On successful completion of the course the students shall be able to:** CO1 Explain the fundamentals of Generative AI and large language models [Understand] CO2 Apply prompt engineering techniques for AI content generation [Apply] CO3 Develop AI-powered text and image generation applications [Apply] CO4 Design chatbot and virtual assistant applications using Generative AI [Apply] CO5 Utilize APIs and cloud platforms for integrating AI services [Apply] CO6 Build and deploy Generative AI applications with ethical considerations [Apply]		
Course Content:			
Module 1	Fundamentals of Generative AI		8 Sessions
Topics: Introduction to Generative AI, AI applications, large language models, basics of neural networks, generative AI tools and platforms.			
Module 2	Prompt Engineering and AI Content Generation		8Sessions
Topics: Prompt engineering techniques, text generation, AI-assisted content creation, image generation basics.			

Module 3	Chatbots and AI Application Development	7 Sessions
Topics: Chatbot development, virtual assistants, AI APIs, integration of generative AI into applications.		
Module 4	Deployment and Ethical AI Practices	7 Sessions
Topics: Cloud deployment of AI applications, testing and maintenance, AI ethics, responsible AI usage and security considerations.		
List of Experiments		30 Sessions
Experiment – 1:Write a program to generate text using a Generative AI tool. Experiment – 2:Create a simple AI chatbot for greeting users. Experiment – 3:Develop an application to generate stories using prompts. Experiment – 4:Implement prompt engineering techniques for better AI responses. Experiment – 5:Create an AI-based email drafting application. Experiment – 6: Develop a text summarization application using AI APIs. Experiment – 7:Build an AI-powered question answering system. Experiment – 8:Implement language translation using Generative AI tools. Experiment – 9:Create an AI image generation application. Experiment – 10: Develop a voice-to-text conversion application using AI APIs. Experiment – 11:Build a recommendation system using Generative AI concepts. Experiment – 12:Implement sentiment analysis on customer reviews. Experiment – 13:Create a resume or content generator using AI. Experiment – 14:Deploy a Generative AI application on a cloud platform. Experiment – 15:Design and develop an end-to-end Generative AI application integrating chatbot, text generation, and image generation features.		
Text Books **T1** Tom Taulli, "Generative AI: How ChatGPT and Other AI Tools Will Revolutionize Business", Apress, 2023. **T2** Bernard Marr, "Generative AI in Practice", Wiley Publications, 2024.		
Reference Books **R1** Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", MIT Press, 2016.. **R2** Ashish Vaswani et al., "Attention Is All You Need", Neural Information Processing Systems, 2017. **R3** David Foster, "Generative Deep Learning", O'Reilly Media, 2022..		
E-Resources 1. OpenAI Documentation 2. Hugging Face Documentation 3. TensorFlow Tutorials 4. Coursera Generative AI Courses 5. Google AI Resources		

CSC3511 Computer Vision

Course Code: CSA3506	**Course Name:** Computer Vision Applications **Type of Course:**	L- T-P- C	3-0-0-3
Version No.	1		
Course pre-requisites	NIL		
Anti-requisites	NIL		

Course Description	This subject emphasis on fundamentals of Image processing and Computer vision. Students will gain the knowledge of Image Formation, Image Enhancement and Segmentation. Students will also learn various feature extraction techniques. This subject has more emphasis on core vision tasks through Motion estimation and Object as well as pattern recognition. Students shall explore the areas where automation can be possible through Image processing and Computer Vision.
Course Objective	Course Objectives • To introduce students to the fundamentals of digital image processing and computer vision concepts. • To enable students to understand image enhancement, segmentation, and feature extraction techniques for visual data analysis. • To develop the ability to implement object recognition and motion estimation techniques using modern computer vision algorithms. • To explore real-world applications of computer vision in areas such as face recognition, OCR, surveillance, and automation systems.
Course Outcomes	**On successful completion of the course the students shall be able to:** **CO1:** Explain the fundamentals of digital image processing, image formation, and computer vision systems. **[Understand]** **CO2:** Utilize image enhancement and segmentation techniques for digital image analysis. **[Apply]** **CO3:** Implement feature extraction and object recognition techniques. **[Apply]** **CO4:** Examine computer vision applications in real-world domains. **[Analyze]** **CO5:** Employ machine learning and deep learning techniques for image analysis. **[Apply]** **CO6:** Evaluate the performance and challenges of computer vision systems. **[Analyze]**

Course Content:

Module 1	**Introduction**	12 Sessions
Introduction: Digital Image fundamentals, Image Sensing and acquisition, Sampling and Quantization, Image formation models, Overview of Computer Vision, Applications of Image processing and Computer Vision		
Module 2	**Image Enhancement and Segmentation**	12 Sessions
Image Enhancement: Image enhancement in spatial domain, Basic grey level Transformations, Histogram Processing Techniques, Spatial Filtering, Image smoothing and Image Sharpening, Image enhancement process in frequency domain, Low pass filtering, High pass filtering **Image Segmentation:** point, line and edge detection, Thresholding, Regions Based segmentation, Edge linking and boundary detection		
Module 3	**Feature Extraction and Object Recognition**	13 Sessions
Feature Extraction: Importance of Features, Feature extraction techniques, Histogram of Oriented Gradient (HOG), Scale Invariant Feature Transform (SIFT), Background subtraction techniques, Image Matching, Principal Component Analysis (PCA) **Object Recognition and Motion Estimation:** Object Recognition techniques: Viola-Jones, Yolo, Deep learning algorithms for Object Recognition. Optical Flow, Gaussian Mixture Model (GMM), Structure of Motion, Motion Estimation.		
Module 4	**Applications of Image Processing and Computer vision**	13 Sessions
Applications of Image Processing and Computer vision: Face Recognition, Facial Expression Recognition, Optical Character Recognition, Automated Video Surveillance		

Text Books

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

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

Reference Books

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

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

E-Resources

NPTEL Courses:

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

CSC3508 Statistical Analysis using R Programming

Course Code: CSC3508	Course Name: Statistical Analysis using R Programming Type of Course: Lab / Lab Integrated Course	L- T-P- C	2-0-2-3
Version No.	1		
Course Pre-requisites	Nil		
Anti-requisites	Nil		
Course Description	This course introduces fundamental and advanced statistical techniques using R Programming for data analysis. Students will learn data manipulation, visualization, hypothesis testing, regression analysis, and machine learning techniques in R. The course covers both descriptive and inferential statistics, enabling students to interpret real-world datasets effectively. Hands-on sessions with R packages like ggplot2, dplyr, and caret will enhance analytical skills. By the end of the course, students will be able to apply statistical methods to solve complex data-driven problems.		
Course Objective	The objective of the course is to familiarize the learners with the concepts of Statistical Analysis using R Programming attain Employability Skills through Experiential Learning techniques.		
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1** Apply basic R functions pertaining to fundamental data analysis. [Apply] **CO2** Interpret data using appropriate statistical methods [Apply] **CO3** Demonstrate the decision trees concept with the given dataset. [Apply] **CO4** Demonstrate the Mining concepts for both Data and Text. [Apply]		

Course Content:

Module 1	Introduction	Assignment	Introduction	7 Sessions
Topics: Introduction to R, Overview of data analysis, Working with directory in R, Loading and handling data in R, Data Visualization with ggplot2, Data Transformation with dplyr.				
Module 2	Exploratory Data Analysis	Assignment	Exploratory Data Analysis	8 Sessions
Topics: Exploring a new dataset, Anomalies in numerical data, Visualizing relations between variables, Assumptions of Linear Regression, Validating Linear Assumption, Missing Values, Covariation, Patterns and Models, gglot2 Calls.				
Module 3	Regression Analysis	Assignment	Regression Analysis	7 Sessions
Topics: Introduction, Types of Regression Analysis Models, Linear Regression, Simple Linear Regression, Non-Linear Regression, Regression Analysis with Multiple Variables, Cross Validation, Principal Component Analysis, Factor Analysis.				
Module 4	Classification	Assignment	Classification	8 Sessions
Topics: Introduction, Different types of Classification, Logistic Regression, Support Vector Machines, K-Neatest Neighbors, Naïve Bayes Classifier, Decision Tree Classification, Random Forest Classification, Evaluation.				

List of Laboratory Tasks (30 Sessions)

1. Using with and without R objects on console
2. Using mathematical functions on console
3. Write an R script, to create R objects for calculator
4. Write an R script to find basic descriptive statistics using summary, str, quartile function on mtcars& cars datasets.

5. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location. b. Reading Excel data sheet in R 6.Find the data distributions using box and scatter plot. 7. Find the outliers using plot. 8. Plot the histogram, bar chart and pie chart on sample data 9.Find the correlation matrix. 10. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data 11.Create a regression model for a given dataset 12.Install relevant package for classification. 13. Choose classifier for classification problem. c. Evaluate the performance of classifier. 14.Install relevant package for classification. 15. Choose classifier for classification problem. c. Evaluate the performance of classifier.
Text Book • Hadley Wickham and Garrett Grolemund, "R for Data Science", O'reilly, 2017. • Tilman M. Davies, "The Book of R: A First Course in Programming and Statistics", No Starch Press, 2016.
References • Dr.BharatiMotwani, "Data Analytics using R", Wiley, 2019. • Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley, 2017
E-Resources https://www.geeksforgeeks.org/r-programming-for-data-science/ https://r4ds.had.co.nz/

CSC3509 UX Analytics

Course Code: CSC3509	Course Name: UX Analytics Type of Course: Lab Integrated Course	L- T-P- C	2-0-2-3
Version No.	1		
Course Pre-requisites	NIL		
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 the course the students shall be able to:** • Describe the feed-forward and deep networks. [Understand] • Design single and multi-layer feed-forward deep networks and tune various hyper-parameters. [Apply] • Implement deep neural networks to solve a problem. [Apply] • Analyze performance of deep networks. [Apply]		
Course Content:			
Module 1	Introduction to Deep Learning	Assignment	ntroduction to Deep Learning	8 Sessions

Topics: 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	User Behavior Analysis and UX Metrics	Quiz/ Assignment	UX Metrics Analysis	8 Sessions
Topics: User Behavior Tracking, Clickstream Analysis, User Engagement Metrics, Bounce Rate, Conversion Rate, Session Duration, Customer Satisfaction Metrics, Net Promoter Score (NPS), Task Success Rate, UX Benchmarking.				
Module 3	UX Evaluation and Analytics Tools	Assignment	Analytics Tools Exploration	7 Sessions
Topics: Usability Testing Methods, Heuristic Evaluation, A/B Testing, Heatmaps, Eye Tracking Concepts, Web Analytics Fundamentals, Event Tracking, Dashboard Creation, Data Visualization Techniques.				
Module 4	Data-Driven UX Optimization	Assignment	UX Improvement Strategy	7 Sessions
Topics: User Feedback Analysis, Funnel Analysis, User Retention Analysis, Personalization Strategies, Predictive Analytics for UX, Mobile UX Analytics, Ethical Considerations in UX Analytics, Emerging Trends in UX Research and Analytics.				

List of Laboratory Tasks **30 sessions**

Lab Session 1: Create user personas and user journey maps for a selected application.
Lab Session 2: Conduct user research and prepare a user requirements report.
Lab Session 3: Perform heuristic evaluation of a website or mobile application.
Lab Session 4: Analyze website usability using predefined usability principles.
Lab Session 5: Measure and evaluate UX metrics for a selected digital platform.
Lab Session 6: Use web analytics tools to monitor user interactions.
Lab Session 7: Track and analyze user engagement metrics.
Lab Session 8: Create and interpret heatmaps for user interaction analysis.
Lab Session 9: Conduct an A/B testing experiment and analyze results.
Lab Session 10: Design and create UX analytics dashboards.
Lab Session 11: Perform funnel analysis for a user workflow.
Lab Session 12: Analyze customer feedback and satisfaction metrics.
Lab Session 13: Visualize UX data using charts and reporting tools.
Lab Session 14: Develop recommendations for improving user experience based on analytics findings.
Lab Session 15: Mini Project – UX Analytics Study and Improvement Proposal for a Digital Product.

Text Book

- Rex Hartson and Pardha Pyla, *The UX Book: Agile UX Design for a Quality User Experience*, 3rd Edition, Morgan Kaufmann.
- Jeff Sauro and James R. Lewis, *Quantifying the User Experience: Practical Statistics for User Research*, 2nd Edition, Morgan Kaufmann.

References

- Steve Krug, *Don't Make Me Think: A Common Sense Approach to Web Usability*, New Riders.
- Tom Tullis and Bill Albert, *Measuring the User Experience*, Morgan Kaufmann.

E-Resources
http://imlab.postech.ac.kr/dkim/class/csed514_2019s/DeepLearningBook.pdf
https://www.nngroup.com/articles/?utm_source=chatgpt.com
https://www.interaction-design.org/?utm_source=chatgpt.com

CSC3512 Social Network Analytics

Course Code: CSC3512	Course Name: **Social Network Analytics** Type of Course: Lab Integrated Course	L- T-P- C	2-0-2-3
Version No.	1		
Course Pre-requisites	Data Structures, Database Management Systems, Fundamentals of Data Analytics		
Anti-requisites	NIL		
Course Description	This course introduces the concepts, methodologies, and tools used to analyze social networks and online communities. Students will learn graph theory fundamentals, network structures, centrality measures, community detection, information diffusion, sentiment analysis, and social media analytics. The laboratory component provides hands-on experience in collecting, processing, visualizing, and analyzing social network data using modern analytics tools and frameworks.		
Course Objective	On successful completion of the course the students shall be able to understand social network structures, analyze relationships and interactions among entities, and apply analytical techniques to extract meaningful insights from social media and network data through participative learning techniques.		
Course Out Comes	**On successful completion of the course the students shall be able to:** • Explain the concepts and structures of social networks and online communities. **[Understand]** • Apply graph-based techniques and network metrics for social network analysis. **[Apply]** • Utilize analytical tools for community detection, sentiment analysis, and social media mining. **[Apply]** • Analyze information diffusion, user behavior, and influence patterns in social networks. **[Analyze]**		

Course Content:				
Module 1	Fundamentals of Social Networks	Assignment	Introduction to Social Network Analysis	8 Sessions
Topics: Introduction to Social Networks, Types of Social Networks, Graph Representation of Networks, Nodes and Edges, Network Structures, Social Network Data Sources, Network Visualization Techniques, Applications of Social Network Analytics.				
Module 2	Network Measures and Analysis	Quiz/ Assignment	Network Metrics and Centrality Analysis	8 Sessions
Topics: Network Properties, Degree Centrality, Closeness Centrality, Betweenness Centrality, Eigenvector Centrality, Network Density, Clustering Coefficient, Reciprocity, Strong and Weak Ties, Similarity Measures, Link Analysis and PageRank Algorithm.				
Module 3	Community Detection and Social Media Analytics	Assignment	Social Media Data Mining	7 Sessions
Topics: Community Structures, Community Detection Algorithms, Modularity, Social Media Analytics, User Behavior Analysis, Recommendation Systems, Link Prediction, Trend Analysis, Network-Based Pattern Discovery.				
Module 4	Information Diffusion and Emerging Applications	Assignment	Influence and Sentiment Analysis	7 Sessions

Topics:
Information Diffusion Models, Influence Propagation, Viral Marketing, Opinion Mining, Sentiment Analysis, Social Media Trends, Ethical Issues in Social Network Analytics, Privacy Considerations, Emerging Applications of Social Network Analytics.

List of Laboratory Tasks **30 sessions**

Lab Session 1: Create and visualize social network graphs using network analysis tools.
Lab Session 2: Perform graph representation and network construction from social data.
Lab Session 3: Calculate degree, closeness, and betweenness centrality measures.
Lab Session 4: Analyze network density, clustering coefficient, and connectivity.
Lab Session 5: Implement PageRank algorithm for ranking network entities.
Lab Session 6: Perform similarity analysis and link prediction in social networks.
Lab Session 7: Collect and preprocess social media datasets.
Lab Session 8: Visualize social network structures using graph visualization tools.
Lab Session 9: Detect and analyze communities in social networks.
Lab Session 10: Perform sentiment analysis on social media content.
Lab Session 11: Analyze information diffusion and influence propagation.
Lab Session 12: Develop recommendation models using social network data.
Lab Session 13: Analyze trending topics and social media interactions.
Lab Session 14: Create dashboards and visual reports for social network analytics.
Lab Session 15: Mini Project – Analysis and Visualization of a Real-World Social Network Dataset.

Text Book

- **T1.** Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, *Social Media Mining: An Introduction*, Cambridge University Press.
- **T2.** Matthew A. Russell, *Mining the Social Web*, O'Reilly Media.

References

- **R1.** Albert-László Barabási, *Network Science*, Cambridge University Press.
- **R2.** Stanley Wasserman and Katherine Faust, *Social Network Analysis: Methods and Applications*, Cambridge University Press.
- **R3.** Charu C. Aggarwal, *Social Network Data Analytics*, Springer.
- **R4.** David Easley and Jon Kleinberg, *Networks, Crowds, and Markets: Reasoning About a Highly Connected World*, Cambridge University Press.

E-Resources

- NetworkX Documentation
- Gephi Documentation
- Kaggle Social Network Datasets
- NPTEL Courses on Data Analytics and Social Networks
- Google Colab Platform

CSC3513 Time Series Analysis and Forecasting

Course Code: CSC3513	Course Name: Time Series Analysis and Forecasting Type of Course: Theory Course	L- T-P- C	3-0-0-3
Version No.	1		
Course Pre-requisites	Statistics, Mathematics Fundamentals, Basics of Data Analysis		
Anti-requisites	Nil		

Course Description	This course introduces the concepts and techniques used in analyzing time-dependent data and forecasting future trends. Students will learn time series components, smoothing techniques, forecasting models, trend analysis, seasonality, and predictive methods used in business, finance, healthcare, weather prediction, and other real-world applications. The course emphasizes practical understanding of forecasting methods and interpretation of results.
Course Objective	On successful completion of the course, the students shall be able to understand time series data, apply forecasting techniques, analyze trends and seasonal patterns, and make data-driven predictions using statistical methods through participative learning techniques.
Course Out Comes	**On successful completion of the course the students shall be able to:** • Explain the fundamental concepts of time series data and forecasting techniques. [Understand] • Apply smoothing and trend analysis methods to time series datasets. [Apply] • Analyze seasonal and cyclical patterns in time-dependent data. [Analyze] • Evaluate forecasting models for predicting future observations and decision making. [Evaluate]]

Course Content:

Module 1	Introduction to Time Series Analysis	Assignment	Understanding Time Series Data	10 Sessions
Topics: Introduction to Time Series Data, Types of Time Series, Components of Time Series – Trend, Seasonality, Cyclical and Irregular Variations, Time Series Visualization, Data Collection and Preparation, Applications of Time Series Analysis, Introduction to Forecasting.				
Module 2	Trend and Smoothing Techniques	Quiz/ Assignment	Forecasting using Moving Averages	12 Sessions
Topics: Trend Analysis, Moving Average Method, Weighted Moving Average, Exponential Smoothing, Simple Exponential Smoothing, Double Exponential Smoothing, Forecast Accuracy Measures, Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE).				
Module 3	Seasonal Analysis and Forecasting Models	Assignment	Seasonal Forecasting Models	13 Sessions
Topics: Seasonality Detection, Seasonal Indices, Seasonal Adjustment Methods, Forecasting with Trend and Seasonality, Linear Regression for Forecasting, Time Series Decomposition, Introduction to Autoregressive Models, Forecast Evaluation Techniques.				
Module 4	Advanced Forecasting and Applications	Assignment	Time Series Forecasting Applications	10 Sessions
Topics: Introduction to ARIMA Concepts, Forecasting Business and Financial Data, Demand Forecasting, Sales Forecasting, Weather Forecasting Applications, Healthcare Forecasting Applications, Challenges in Forecasting, Emerging Trends in Predictive Analytics and Forecasting.				

Text Book

- Douglas C. Montgomery, Cheryl L. Jennings and Murat Kulahci, Introduction to Time Series Analysis and Forecasting, 2nd Edition, Wiley, 2015.
- Robert H. Shumway and David S. Stoffer, Time Series Analysis and Its Applications, 4th Edition, Springer, 2017.

References

- Spyros G. Makridakis, Steven C. Wheelwright and Rob J. Hyndman, Forecasting: Methods and Applications, 3rd Edition, Wiley.
- Rob J. Hyndman and George Athanasopoulos, Forecasting: Principles and Practice, OTexts, Latest Edition.

E-Resources

- NPTEL – Time Series Analysis Courses – https://nptel.ac.in
- Forecasting: Principles and Practice – https://otexts.com/fpp3
- IBM Time Series Forecasting Resources – https://www.ibm.com/topics/time-series-analysis

- Towards Data Science – Time Series Analysis Tutorials – https://towardsdatascience.com

CSC2531 Business Intelligence and decision support systems

Course Code: CSC2531	Course Name: Business Intelligence and Decision Support Systems Type of Course: Lab Integrated Course		L- T-P- C	2-0-2-3
Version No.	1			
Course Pre-requisites	NIL			
Anti-requisites	NIL			
Course Description	This course introduces the concepts, tools, and techniques of Business Intelligence (BI) and Decision Support Systems (DSS) used for organizational decision-making. The course covers data warehousing, data integration, Online Analytical Processing (OLAP), data visualization, dashboard development, predictive analytics, and business reporting. Through practical laboratory exercises, students gain hands-on experience in transforming raw data into meaningful insights for strategic, tactical, and operational decision-making.			
Course Objective	On successful completion of the course the students shall be able to familiarize the learners with the concepts of Business Intelligence and Decision Support Systems and attain skill development through participative learning techniques.			
Course Out Comes	• Explain the concepts and architecture of Business Intelligence and Decision Support Systems. **[Understand]** • Analyze organizational data using data warehousing and analytical techniques. **[Analyze]** • Develop reports, dashboards, and visualizations for business decision-making. **[Apply]** • Evaluate business problems and support decision-making using BI tools and predictive analytics. **[Apply]**			
Course Content:				
Module 1	Introduction to Business Intelligence and Decision Support Systems	Assignment	BI Fundamentals	8 Sessions
Topics: Introduction to Business Intelligence, Evolution of Business Intelligence, Decision Support Systems, Types of Decision Support Systems, Components of DSS, Business Intelligence Architecture, Data Sources for BI, Business Performance Management, Applications of BI in Organizations.				
Module 2	Data Warehousing and Data Integration	Quiz/ Assignment	Data Warehousing	8 Sessions
Topics: Data Warehousing Concepts, Data Warehouse Architecture, ETL Process, Data Cleaning and Data Transformation, Data Marts, Metadata Management, OLTP and OLAP Systems, Data Integration Techniques, Data Warehouse Design and Implementation.				
Module 3	Data Analytics and Visualization	Assignment	Data Analytics and Reporting	7 Sessions
Topics:				

Business Analytics Fundamentals, Descriptive Analytics, Predictive Analytics, Data Mining Concepts, Online Analytical Processing (OLAP), Multidimensional Data Analysis, Data Visualization Techniques, Business Reporting, Dashboard Design Principles and KPI Measurement.				
Module 4	Advanced BI and Decision Support Applications	Assignment	Decision Support Applications	7 Sessions
Topics: Predictive Modeling for Decision Support, Machine Learning in Business Intelligence, Real-Time Business Intelligence, Big Data and BI, Executive Information Systems, Knowledge Management Systems, Decision-Making Models, Business Intelligence Applications in Finance, Marketing, Healthcare and Supply Chain Management.				
List of Laboratory Tasks **30 sessions** 1. Installation and Familiarization of Business Intelligence Tools. 2. Data Collection and Preparation from Multiple Data Sources. 3. Data Cleaning and Transformation using ETL Processes. 4. Design and Creation of a Data Warehouse Schema. 5. Implementation of Star and Snowflake Schemas. 6. Data Loading and Integration into a Data Warehouse. 7. Creation and Analysis of OLAP Cubes. 8. Multidimensional Data Analysis using OLAP Operations. 9. Business Reporting using BI Tools. 10. Development of Interactive Dashboards. 11. KPI Identification and Dashboard Visualization. 12. Predictive Analytics using Business Data Sets. 13. Data Mining for Business Pattern Discovery. 14. Decision Support System Design for a Business Scenario. 15. Mini Project on Business Intelligence and Decision Support System Development.				
Text Book • Efraim Turban, Ramesh Sharda, Dursun Delen, Business Intelligence, Analytics and Data Science: A Managerial Perspective, Pearson. • Carlo Vercellis, Business Intelligence: Data Mining and Optimization for Decision Making, Wiley.				
References • Ralph Kimball and Margy Ross, *The Data Warehouse Toolkit*, Wiley. • David Loshin, *Business Intelligence: The Savvy Manager's Guide*, Morgan Kaufmann.				
E-Resources • Microsoft Power BI Documentation • Tableau Learning Resources • IBM Business Intelligence Resources • Oracle Business Intelligence Documentation				

CSC3514 Ethical and Responsible AI

CSC3514 – Ethical and Responsible AI

Course Code: CSC3509	Course Name: **Ethical and Responsible AI** Type of Course: Theory Course	L- T-P- C	3-0-0-3
Version No.	1		

Course Pre-requisites	Introduction to Artificial Intelligence / Machine Learning Fundamentals
Anti-requisites	NIL
Course Description	This course introduces the principles, frameworks, and practices required for the ethical development, deployment, and governance of Artificial Intelligence systems. Students will explore issues related to fairness, accountability, transparency, privacy, bias mitigation, explainability, safety, security, and regulatory compliance in AI systems. The course emphasizes responsible AI practices through case studies, industry standards, and emerging global AI governance frameworks. Learners will gain the ability to evaluate AI systems from ethical, societal, legal, and technical perspectives and design AI solutions that align with human values and societal well-being.
Course Objective	On successful completion of the course, students shall be able to understand ethical challenges associated with AI technologies and develop responsible AI systems that are fair, transparent, accountable, and aligned with legal and societal expectations.
Course Out Comes	**On successful completion of the course the students shall be able to:** • Explain the ethical, legal, and societal implications of AI technologies. [Understand] • Identify and analyze bias, fairness, and accountability issues in AI systems. [Analyze] • Evaluate AI models using responsible AI principles and governance frameworks. [Evaluate] • Design AI solutions that incorporate transparency, privacy, safety, and ethical considerations. [Create]

Course Content:

Module 1	Foundations of Ethical AI	Assignment	Ethical AI Case Study Analysis	12 Sessions
Topics: Introduction to AI Ethics, Evolution of Responsible AI, Ethical Theories and Decision-Making, Human-Centered AI, Societal Impact of AI, AI Risks and Challenges, Stakeholder Analysis, AI Ethics Principles and Frameworks.				
Module 2	Fairness, Bias, and Accountability in AI	Quiz/ Assignment	Bias Detection and Fairness Assessment	13 Sessions
Topics: Sources of Bias in Data and Algorithms, Fairness Metrics, Algorithmic Discrimination, Bias Mitigation Techniques, Accountability in AI Systems, AI Auditing, Impact Assessment, Ethical Decision-Making in AI Applications.				
Module 3	Transparency, Explainability, and Privacy	Assignment	Explainable AI Evaluation Report	10 Sessions
Topics: Explainable AI (XAI), Interpretability Techniques, Model Transparency, Trustworthy AI Systems, Data Privacy Principles, Privacy-Preserving AI, Differential Privacy, Federated Learning Ethics, Secure Data Handling, Consent and Data Governance.				
Module 4	AI Governance, Regulations, and Future Directions	Assignment	Responsible AI Governance Framework Design	10 Sessions
Topics: AI Governance Models, Global AI Regulations and Policies, Risk Management in AI, AI Safety and Security, Responsible Generative AI, Environmental Impact of AI, Ethical AI in Healthcare and Finance, Emerging Trends in Responsible AI, Sustainable and Inclusive AI Development.				

Text Book

- Mark Coeckelbergh, AI Ethics, MIT Press.
- Virginia Dignum, Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way, Springer.

References

- Luciano Floridi, Ethics of Artificial Intelligence, Oxford University Press.
- Michael Kearns and Aaron Roth, The Ethical Algorithm, Oxford University Press.
- Stuart Russell, Human Compatible: Artificial Intelligence and the Problem of Control, Penguin Books.

E-Resources
OECD AI Principles UNESCO Recommendation on the Ethics of AI NIST AI Risk Management Framework Responsible AI Resources by Microsoft

CSC3515 Predictive analytics

Course Code: CSA3512	Course Name: Predictive Analytics Type of Course:	L- T-P- C	3-0-0-3
Version No.	1		
Course Pre-requisites	Basic Communication General Knowledge about Descriptive Analytics		
Anti-requisites	NIL		
Course Description	This course introduces learners to predictive analytics, data mining, and their applications in business, healthcare, and marketing. It covers data preprocessing, predictive algorithms (regression, decision trees, clustering, classification), time-series forecasting, and basic big-data concepts. The emphasis is on understanding methods, applying them in labs, and interpreting results for managerial decisions.		
Course Objective	The objective of the course is to familiarize learners with the concepts of Predictive Analytics and their applications in real-world decision-making scenarios. It aims to enhance employability skills through experiential learning by engaging students in hands-on data analysis, modeling, and interpretation using industry-relevant tools.		
Course Out Comes	**On successful completion of the course the students shall be able to:** **CO1** Understand the basics of analytics and predictive analytics and their use in real-world decision making [Understand] **CO2** Clean and explore data using descriptive statistics and visualizations [Apply] **CO3** Apply regression, decision trees, Naïve Bayes, k-NN, and k-means clustering to solve practical problems [Apply] **CO4** Build and evaluate time-series forecasts and use multiple regression for numeric predictions [Analyze] **CO5** Identify ethical issues in data mining and big data and explain results for data-driven decisions [Evaluate]		
Course Content:			
Module 1	Introduction to Predictive Analytics	Assignment	Introduction to Predictive Analytics	12 Sessions
Topics: Analytics- Definition, importance, Analytics in decision making, Applications, Challenges, Experts perception on analytics, Popularity in Analytics, Predictive analytics in business Scenarios- case studies				
Module 2	Predictive Analytics & Data Mining	Assignment	Predictive Analytics & Data Mining	13 Sessions
Topics:				

Predictive Analytics- Definition, Importance and application; Predictive Analytics – Marketing, Health care & other industries; Skills and roles in Predictive Analytics, Tools & Software, Data Mining – Definition, applications, Types of patterns, Data mining tools & dark side of data mining.				
Module 3	Data, Methods & Algorithms for Predictive Analytics	Assignment	Data, Methods & Algorithms for Predictive Analytics	10 Sessions
Topics: Nature, Pre-processing of data for analytics, Data Mining methods; Prediction, Classification- Decision tress, Cluster analysis, K means clustering, Association, Predictive analytics misconception, Algorithms - Naïve Bays, nearest neighbour, Regression - Simple linear regression (SLR) using OLS method, Multiple linear regression (MLR), Violation of Ordinary least squares (OLS) method - Auto correlation, Heteroscedasticity , multicollinearity				
Module 4	Business Forecasting & Decisions Trees with Big Data in Predictive Analytics	Assignment	Business Forecasting & Decisions Trees with Big Data in Predictive Analytics	10 Sessions
Topics: Business Forecasting, Time Series Data and Time Series Analysis- based Forecasting, Forecasting Accuracy, Auto-regressive and Moving average model, Decision Trees : Introduction to decision trees; Analysis – unstructured data . Fundamental concepts of Big data, Challenges and problems in data analytics stream analytics– A/B Testing Data preparation, cleaning, and exploratory analysis using data visualization and descriptive statistics, Applications of multiple regression for numeric prediction				
Text Book • T1 : Predictive Analytics Delen, D. (2020). Predictive Analytics: Data Mining, Machine Learning and Data Science for Practitioners. Upper Saddle River, NJ, USA: FT Press. (Pearson Publication)				
References • R1 Dinesh Kumar, U. (2021). Business Analytics: The Science of data-Driven Decision Making. • R2 Business Analytics - Data Analysis & Decision Making", S. Christian Albright and Wayne L. Winston, Cengage Publication, 5th Edition, 2012				
E-Resources W1.https://www.sas.com/en_in/insights/analytics/predictive-analytics.html W2. https://www.techtarget.com/searchbusinessanalytics/definition/predictive-analytics W3. https://www.cio.com/article/228901/what-is-predictive-analytics-transforming-data- intofuture-insights.html W4. https://www.simplilearn.com/what-is-predictive-analytics-article W5. https://www.northeastern.edu/graduate/blog/predictive-analytics/				

Track 3 -Cloud Computing

CSC3516 Virtualization and Cloud Infrastructure Management

Course Code: CSC3516	Course Name: Virtualization and Cloud Infrastructure Management Type of Course: Lab Integrated Course	L- T-P- C	2-0-2-3
Version No.	1		
Course Pre-requisites	Computer Networks, Operating Systems		
Anti-requisites	NIL		
Course Description	This course introduces students to virtualization technologies and cloud infrastructure management. It focuses on virtual machines, hypervisors, cloud service models, resource provisioning, storage and network virtualization, cloud deployment platforms, and infrastructure automation. The laboratory component provides hands-on experience in creating, configuring, monitoring, and managing virtualized cloud environments using industry-standard tools.		
Course Objective	On successful completion of the course the students shall be able to familiarize themselves with virtualization technologies and cloud infrastructure management practices and attain skill development through participative learning techniques.		
Course Out Comes	On successful completion of the course the students shall be able to: • Explain virtualization concepts and cloud infrastructure components. **[Understand]** • Configure and manage virtual machines, storage, and networking resources. **[Apply]** • Deploy and monitor cloud infrastructure services using virtualization platforms. **[Apply]** • Analyze performance, scalability, and security issues in virtualized environments. **[Analyze]**		
Course Content:			
Module 1	Introduction to Virtualization and Cloud Infrastructure	Assignment	Introduction to Virtualization	8 Sessions
Topics: Introduction to Cloud Computing, Characteristics of Cloud Computing, Virtualization Concepts, Hypervisors, Virtual Machines, Hosted and Bare-Metal Hypervisors, Benefits of Virtualization, Virtualization Architectures, Multi-Tenancy Concepts.			
Module 2	Compute, Storage and Network Virtualization	Quiz/ Assignment	Cloud Resource Management	8 Sessions
Topics: Compute Virtualization, CPU and Memory Virtualization, Storage Virtualization, Network Virtualization, Virtual LANs, Virtual Switching, Resource Pooling, Resource Allocation and Provisioning.			
Module 3	Cloud Infrastructure Platforms	Assignment	Cloud Infrastructure Platforms	7 Sessions
Topics: Cloud Service Models (IaaS, PaaS, SaaS), OpenStack Architecture, Virtual Machine Deployment, Cloud Resource Monitoring, Infrastructure Management, Container Basics, Docker Fundamentals.			
Module 4	Infrastructure Automation and Management	Assignment	Infrastructure Automation	7 Sessions

Topics:
Infrastructure Automation Concepts, Infrastructure as Code (IaC), Load Balancing, High Availability, Disaster Recovery, Cloud Monitoring, Performance Optimization, Cloud Cost Management.

List of Laboratory Tasks **30 sessions**

Lab Session 1: Install and configure a virtualization platform such as VirtualBox or VMware Workstation.
Lab Session 2: Create and configure a virtual machine with a guest operating system.
Lab Session 3: Demonstrate snapshot creation, restoration, and cloning of virtual machines.
Lab Session 4: Configure and test virtual network connectivity between multiple virtual machines.
Lab Session 5: Create, attach, and manage virtual storage devices for a virtual machine.
Lab Session 6: Monitor CPU, memory, storage, and network utilization of virtual machines.
Lab Session 7: Install and explore the architecture and services of an OpenStack cloud environment.
Lab Session 8: Provision and manage virtual machine instances using OpenStack.
Lab Session 9: Install and configure Docker in a Linux environment.
Lab Session 10: Create, deploy, and manage containerized applications using Docker.
Lab Session 11: Configure Docker networking and implement persistent storage using Docker volumes.
Lab Session 12: Implement load balancing for virtualized services using suitable tools.
Lab Session 13: Perform infrastructure monitoring and log analysis in a cloud environment.
Lab Session 14: Analyze and optimize cloud resource utilization for improved performance.
Lab Session 15: Develop and demonstrate a mini project for deploying and managing a virtualized cloud infrastructure.

Text Book

- Thomas Erl, Ricardo Puttini, and Zaigham Mahmood, *Cloud Computing: Concepts, Technology and Architecture*, Pearson Education.
- Matthew Portnoy, *Virtualization Essentials*, Wiley Publications.

References

- Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi, *Mastering Cloud Computing*, McGraw Hill.
- Tim Mather, Subra Kumaraswamy, and Shahed Latif, *Cloud Security and Privacy*, O'Reilly Media.

E-Resources

- OpenStack Documentation
- Docker Documentation
- NPTEL Cloud Computing Courses
- Linux Foundation Cloud Learning Resources

CSC3517 Distributed Systems and Microservices Architecture

Course Code: CSA3517	Course Name: Distributed Systems and Microservices Architecture Type of Course: Lab Integrated Course	L- T-P- C	2-0-2-3
Version No.	1		
Course Pre-requisites	Data Structures, Computer Networks		
Anti-requisites	NIL		
Course Description	This course introduces the principles and architectures of distributed systems and modern microservices-based application development. Students will learn distributed computing models, communication mechanisms, consistency and fault tolerance techniques, service-oriented architectures, API management, containerization, and orchestration. The laboratory component		

	provides hands-on experience in developing, deploying, and managing distributed and microservices-based applications using industry-standard tools and platforms.
Course Objective	On successful completion of the course the students shall be able to familiarize themselves with distributed computing principles and microservices architectures and attain skill development through participative learning techniques.
Course Out Comes	**On successful completion of the course the students shall be able to:** • Explain the fundamental concepts and architectures of distributed systems. [Understand] • Develop distributed applications using communication and coordination mechanisms. [Apply] • Design and deploy microservices-based applications using modern development tools. [Apply] • Analyze performance, scalability, reliability, and fault tolerance in distributed environments. [Analyze]

Course Content:

Module 1	Introduction to Distributed Systems	Assignment	Fundamentals of Distributed Systems	8 Sessions
Topics: Introduction to Distributed Systems, Characteristics of Distributed Systems, Distributed Computing Models, Client-Server Architecture, Peer-to-Peer Systems, Middleware Concepts, Distributed Communication, Remote Procedure Calls (RPC), Distributed System Challenges.				
Module 2	Communication and Coordination in Distributed Systems	Quiz/ Assignment	Distributed Communication Models	8 Sessions
Topics: Inter-Process Communication, Message Passing Systems, Distributed Coordination, Logical Clocks, Clock Synchronization, Mutual Exclusion, Consistency Models, Fault Tolerance and Recovery Mechanisms.				
Module 3	Microservices Architecture	Assignment	Designing Microservices	7 Sessions
Topics: Introduction to Microservices, Monolithic vs Microservices Architecture, Service-Oriented Architecture (SOA), Service Discovery, API Gateway, RESTful Services, Microservices Design Principles, Data Management in Microservices.				
Module 4	AutoencodersContainerizatio n and Orchestration	Assignment	Microservices Deployment	7 Sessions
Topics: Containerization Concepts, Docker Fundamentals, Container Networking, Container Security, Introduction to Kubernetes, Service Deployment, Scaling and Load Balancing, Monitoring and Logging in Microservices Environments.				

List of Laboratory Tasks **30 sessions**

1. Client-Server Communication using Sockets
Develop a client-server application to send and receive messages using socket programming.
2. Multi-Client Chat Application
Develop a chat application that allows multiple users to communicate through a server.
3. Remote Procedure Call (RPC) Application
Create an application that invokes functions or services from a remote system using RPC.
4. Message Passing Application
Implement communication between two distributed processes using message passing techniques.
5. Distributed File Sharing System
Develop a simple file-sharing application that allows users to upload and download files over a network.
6. REST API Development
Create RESTful APIs using Python or Node.js to perform CRUD operations on data.
7. Microservice Development
Develop a simple application using multiple microservices that communicate with each other.

8. Service Discovery Implementation Implement a service discovery mechanism to locate and access available microservices. **9. API Gateway Configuration** Configure an API Gateway to manage and route requests to different microservices. **10. Docker Installation and Container Creation** Install Docker and create containers for running distributed applications. **11. Containerizing a Microservice Application** Package a microservice application into a Docker container and execute it. **12. Docker Compose for Multi-Service Applications** Deploy multiple microservices together using Docker Compose. **13. Kubernetes Deployment** Deploy and manage a microservice application using Kubernetes. **14. Monitoring and Logging of Microservices** Implement logging and monitoring for microservice-based applications. **15. Mini Project – Distributed Microservices-Based Application** Design and deploy a simple distributed application using microservices, Docker, and Kubernetes.
Text Book • George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, Distributed Systems: Concepts and Design, 5th Edition, Pearson Education. • Sam Newman, Building Microservices, 2nd Edition, O'Reilly Media.
References • Andrew S. Tanenbaum and Maarten Van Steen, *Distributed Systems: Principles and Paradigms*, Pearson Education. • Chris Richardson, *Microservices Patterns*, Manning Publications. • Eberhard Wolff, *Microservices: Flexible Software Architecture*, Addison-Wesley.
E-Resources • Docker Documentation – https://docs.docker.com • Kubernetes Documentation – https://kubernetes.io/docs/home/ • Microservices.io Learning Resources – https://microservices.io • NPTEL Distributed Systems Course – https://nptel.ac.in/courses/106106168 • Linux Foundation Cloud Native Learning Resources – https://training.linuxfoundation.org/cloud-native/

CSC3518 Cloud DevOps and CI/CD Automation

Course Code: CSC3518	Course Name: Cloud DevOps and CI/CD Automation Type of Course: Lab Integrated Course	L- T-P- C	2-0-2-3
Version No.	1		
Course Pre-requisites	NIL		
Anti-requisites	NIL		
Course Description	This course introduces students to DevOps culture, Cloud Computing platforms, Continuous Integration (CI), Continuous Delivery/Deployment (CD), Infrastructure as Code (IaC), containerization, orchestration, and cloud-native application deployment. The course emphasizes automation of software development, testing, deployment, and monitoring using modern DevOps tools and cloud services. Through hands-on laboratory exercises, students gain practical experience		

	in building CI/CD pipelines, managing containers, deploying applications on cloud platforms, and implementing DevOps best practices.
Course Objective	On successful completion of the course, students shall be able to familiarize themselves with DevOps methodologies, cloud deployment models, CI/CD automation tools, and cloud-native application deployment practices through participative and experiential learning.
Course Out Comes	**On successful completion of the course the students shall be able to:** • Explain DevOps principles, cloud computing concepts, and software delivery pipelines. **[Understand]** • Configure source code management, continuous integration, and continuous deployment workflows. **[Apply]** • Deploy and manage applications using containers and orchestration platforms. **[Apply]** • Implement cloud-based DevOps solutions and monitor application performance. **[Analyze]**

Course Content:

Module 1	Introduction to Cloud Computing and DevOps	Assignment	Cloud & DevOps Fundamentals	8 Sessions
Topics: Introduction to Cloud Computing, Cloud Service Models (IaaS, PaaS, SaaS), Cloud Deployment Models (Public, Private, Hybrid, Multi-cloud), Introduction to DevOps, DevOps Lifecycle and Culture, Agile and DevOps Relationship, Version Control Fundamentals, Introduction to Git and GitHub.				
Module 2	Continuous Integration and Continuous Delivery (CI/CD)	Quiz/ Assignment	CI/CD Pipeline Implementation	8 Sessions
Topics: Software Development Lifecycle (SDLC), Continuous Integration Concepts, Continuous Delivery and Continuous Deployment, Build Automation Tools, Jenkins Architecture and Setup, Automated Testing in CI Pipelines, Pipeline as Code, CI/CD Workflow Design and Best Practices.				
Module 3	Containerization and Orchestration	Assignment	Docker and Kubernetes	7 Sessions
Topics: Introduction to Containers, Docker Architecture, Docker Images, Containers, Volumes and Networks, Docker Compose, Container Registry Management, Introduction to Kubernetes, Pods, Deployments, Services and ConfigMaps, Scaling and Managing Containerized Applications.				
Module 4	Cloud DevOps Automation and Monitoring	Assignment	Cloud Deployment and Monitoring	7 Sessions
Topics: Infrastructure as Code (IaC), Terraform Fundamentals, Configuration Management Concepts, Introduction to Ansible, Cloud Deployment using AWS, Azure and GCP, Monitoring and Logging, Prometheus and Grafana Basics, DevSecOps and Security Best Practices.				

List of Laboratory Tasks **30 sessions**

1. Installation and Configuration of Git and GitHub Repository Management.
2. Branching, Merging, Pull Requests and Version Control Operations using Git.
3. Cloud Resource Provisioning and Deployment of a Simple Web Application on a Cloud Virtual Machine.
4. Installation and Configuration of Jenkins for Continuous Integration.
5. Creation of Automated Build and Testing Pipelines using Jenkins.
6. Implementation of Continuous Integration and Continuous Deployment (CI/CD) Workflows.
7. Creating and Managing Docker Containers and Images.
8. Building Multi-Container Applications using Docker Compose.
9. Container Image Management using Docker Hub or Private Registries.

10. Deployment and Management of Applications using Kubernetes Pods, Deployments and Services. 11. Scaling and Load Balancing of Containerized Applications in Kubernetes. 12. Infrastructure Provisioning using Terraform and Infrastructure as Code (IaC) Practices. 13. Configuration Management and Automation using Ansible. 14. Application Monitoring, Logging and Visualization using Prometheus and Grafana. 15. End-to-End Cloud Native Application Deployment Project integrating Git, Jenkins, Docker, Kubernetes and Cloud Services.
Text Book • Joakim Verona, *Practical DevOps*, Packt Publishing. • Gene Kim, Jez Humble, Patrick Debois & John Willis, *The DevOps Handbook*, IT Revolution Press.
References • Kief Morris, *Infrastructure as Code*, O'Reilly Media. • Nigel Poulton, *Docker Deep Dive*, Leanpub. • Brendan Burns, Joe Beda & Kelsey Hightower, *Kubernetes: Up and Running*, O'Reilly Media.
E-Resources • Docker Documentation • Jenkins Documentation • Kubernetes Documentation • Terraform Documentation

CSC3519 Edge Computing and Fog Computing

CSC3519-Edge Computing and Fog Computing

Course Code: CSA3519	Course Name: Edge Computing and Fog Computing Type of Course: Lab Integrated Course	L- T-P- C	2-0-2-3
Version No.	1		
Course Pre-requisites	Computer Networks, Internet of Things Fundamentals		
Anti-requisites	NIL		
Course Description	This course introduces the concepts, architectures, and applications of Edge Computing and Fog Computing. It focuses on extending cloud computing capabilities closer to data sources for reducing latency, improving real-time processing, and enhancing resource utilization. Students will learn edge and fog architectures, IoT integration, data analytics, resource management, security challenges, and emerging applications. The laboratory component provides hands-on experience in developing and deploying edge-enabled applications using modern IoT and cloud technologies.		
Course Objective	On successful completion of the course the students shall be able to familiarize themselves with the concepts of Edge and Fog Computing and attain skill development through participative learning techniques for designing low-latency distributed computing solutions.		

Course Out Comes	**On successful completion of the course the students shall be able to:** • Explain the concepts, architectures, and technologies of Edge and Fog Computing. **[Understand]** • Develop applications that integrate IoT devices with edge and fog infrastructures. **[Apply]** • Implement resource management and data processing techniques in edge environments. **[Apply]** • Analyze performance, security, and scalability issues in Edge and Fog Computing systems. **[Analyze]**

Course Content:

Module 1	Introduction to Edge and Fog Computing	Assignment	Introduction to Edge Computing	8 Sessions

Topics:
Introduction to Cloud Computing and IoT, Need for Edge Computing, Fundamentals of Edge Computing, Fog Computing Concepts, Edge vs Fog vs Cloud Computing, Characteristics and Benefits of Edge Computing, Edge Computing Architectures, Fog Computing Architectures.

Module 2	Edge Infrastructure and Resource Management	Quiz/ Assignment	Edge Resource Management	8 Sessions

Topics:
Edge Nodes and Gateways, Resource Provisioning, Workload Distribution, Data Processing at the Edge, Virtualization in Edge Environments, Container-Based Edge Computing, Resource Scheduling, Quality of Service (QoS) Considerations.

Module 3	IoT Integration and Data Analytics	Assignment	IoT-Based Edge Applications	7 Sessions

Topics:
IoT and Edge Integration, Sensor Networks, Data Collection and Processing, Real-Time Analytics, Stream Processing, Edge Intelligence, Machine Learning at the Edge, Smart Devices and Edge Services.

Module 4	Security, Applications, and Emerging Trends	Assignment	Edge Security and Applications	7 Sessions

Topics:
Security Challenges in Edge and Fog Computing, Privacy Preservation, Authentication and Access Control, Edge Security Frameworks, Smart Cities, Smart Healthcare, Industrial IoT Applications, Autonomous Systems, Emerging Trends in Edge Computing.

List of Laboratory Tasks **30 sessions**

Lab Session 1: Configure and connect IoT devices for data collection in an edge environment.
Lab Session 2: Develop a basic sensor data acquisition system using IoT devices.
Lab Session 3: Implement data transmission between IoT devices and edge nodes.
Lab Session 4: Configure and simulate an edge computing architecture using suitable tools.
Lab Session 5: Deploy and manage services on an edge gateway.
Lab Session 6: Perform real-time data processing at the edge.
Lab Session 7: Implement resource monitoring and management in edge devices.
Lab Session 8: Develop a simple fog computing environment for distributed data processing.
Lab Session 9: Configure containerized applications for edge deployment using Docker.
Lab Session 10: Implement stream processing for real-time IoT data analytics.
Lab Session 11: Develop a smart monitoring application using edge computing concepts.
Lab Session 12: Analyze latency and performance in cloud and edge environments.
Lab Session 13: Implement security mechanisms for edge-enabled applications.
Lab Session 14: Deploy and evaluate an IoT-edge integrated application.
Lab Session 15: Mini Project – Design and implement an Edge/Fog Computing solution for a real-world application.

Text Book

- **T1.** Rajkumar Buyya and Satish Narayana Srirama, *Fog and Edge Computing: Principles and Paradigms*, Wiley Publications.

• **T2.** Flavio Bonomi, Rodolfo Milito, Jiang Zhu and Sateesh Addepalli, *Fog Computing and Its Role in the Internet of Things*, Cisco Press.
References • **R1.** Zaigham Mahmood, *Cloud Computing: Methods and Practical Approaches*, Springer. • **R2.** K. Anitha Kumari and B. Sathish Babu, *Edge Computing: Fundamentals and Applications*, CRC Press. • **R3.** Weisong Shi, Schahram Dustdar, *The Promise of Edge Computing*, IEEE Computer Society Publications.
E-Resources • NPTEL Courses on IoT and Edge Computing • IEEE Edge Computing Resources • Linux Foundation Edge Projects Documentation • Eclipse IoT Documentation • OpenFog Consortium Resources

CSC3520 Cloud Security and Cryptographic Techniques

Course Code: CSA3520	Course Name: Cloud Security and Cryptographic Techniques Type of Course: Lab Integrated Course	L- T-P- C	2-0-2-3
Version No.	1		
Course Pre-requisites	Computer Networks, Fundamentals of Computer Systems		
Anti-requisites	NIL		
Course Description	This course introduces the fundamentals of cloud security and cryptographic techniques used to protect modern cloud-based systems and communication networks. Students will learn security principles, encryption methods, authentication mechanisms, digital signatures, cloud identity management, and security monitoring. The laboratory component provides hands-on experience in implementing cryptographic algorithms, analyzing secure communication, and exploring cloud security tools and configurations.		
Course Objective	On successful completion of the course the students shall be able to familiarize themselves with cloud security principles and cryptographic techniques and attain skill development through participative learning techniques.		
Course Out Comes	**On successful completion of the course the students shall be able to:** • Explain cloud security concepts and cryptographic fundamentals. [Understand] • Apply symmetric and asymmetric encryption techniques to secure data. [Apply] • Configure authentication and access control mechanisms in cloud environments. [Apply] • Analyze cloud security threats and evaluate appropriate protection mechanisms. [Analyze]		

Course Content:				
Module 1	Introduction to Cloud Security and Cryptography	Assignment	Cloud Security Basics	8 Sessions
Topics: Introduction to Cloud Computing, Cloud Security Challenges, Shared Responsibility Model, Security Goals (Confidentiality, Integrity, Availability), Cryptography Fundamentals, Encryption and Decryption, Classical Cryptographic Techniques, Security Threats in Cloud Environments.				
Module 2	Symmetric and Asymmetric Cryptography	Quiz/ Assignment	Encryption Techniques	8 Sessions

Topics: Symmetric Encryption Concepts, DES and AES, Asymmetric Cryptography, RSA Algorithm, Diffie-Hellman Key Exchange, Hash Functions, Secure Hash Algorithms (SHA), Message Authentication Codes (MAC).				
Module 3	Authentication in Cloud Systems	Assignment	Authentication in Cloud Systems	7 Sessions
Topics: Identity and Access Management (IAM), Authentication Mechanisms, Multi-Factor Authentication (MFA), Role-Based Access Control (RBAC), Digital Signatures, Public Key Infrastructure (PKI), Certificates and Certificate Authorities, Secure Communication using SSL/TLS.				
Module 4	Cloud Security Monitoring and Emerging Trends	Assignment	Cloud Security Analysis	7 Sessions
Topics: Cloud Security Monitoring, Security Logging, Firewalls, Intrusion Detection Systems, Malware Protection, Cloud Compliance Basics, Zero Trust Security Concepts, Emerging Trends in Cloud and Cyber Security.				

List of Laboratory Tasks **30 sessions**

1. Classical Cryptography using Caesar Cipher
Develop a program to perform encryption and decryption using the Caesar Cipher technique and analyze its effectiveness in securing information.

2. Classical Cryptography using Playfair Cipher
Develop a program to perform encryption and decryption using the Playfair Cipher and demonstrate secure message transmission.

3. Data Encryption using DES
Implement the Data Encryption Standard (DES) algorithm to encrypt and decrypt data and study its role in secure communication.

4. Secure Communication using AES
Implement the Advanced Encryption Standard (AES) algorithm and evaluate its effectiveness in protecting sensitive information.

5. Public Key Cryptography using RSA
Generate RSA public and private keys and perform encryption and decryption of messages using the generated keys.

6. Data Integrity Verification using Hash Functions
Implement cryptographic hash functions to generate message digests and verify the integrity of transmitted data.

7. Digital Signature Generation and Verification
Develop an application to create and verify digital signatures for ensuring authentication and non-repudiation.

8. Analysis of SSL/TLS Certificates
Examine SSL/TLS certificates used by secure websites and study their role in establishing trusted communication.

9. Network Traffic Analysis using Wireshark
Capture and analyze encrypted network traffic using Wireshark to understand secure communication protocols.

10. User Authentication in Cloud Environment
Configure and test user authentication mechanisms in a cloud environment to ensure secure access to resources.

11. Identity and Access Management (IAM) in Cloud Platforms
Explore Identity and Access Management (IAM) services and configure users, roles, and permissions for cloud resources.

12. Cloud Security Monitoring and Logging
Monitor cloud security events and analyze system logs to identify security incidents and unauthorized activities.

13. Vulnerability Assessment of Cloud Applications
Perform a basic vulnerability assessment of a cloud-hosted application and identify potential security weaknesses.

14. Cloud Security Best Practices Study Study and document cloud security best practices related to data protection, access control, monitoring, and compliance. **15. Mini Project – Secure Cloud-Based Application** Design and implement a secure cloud-based application by incorporating encryption techniques, authentication mechanisms, access control policies, and security monitoring features.
Text Book • William Stallings, *Cryptography and Network Security: Principles and Practice*, 8th Edition, Pearson Education, 2022. • Vic (J.R.) Winkler, *Securing the Cloud: Cloud Computer Security Techniques and Tactics*, 2nd Edition, Elsevier, 2021.
References • Behrouz A. Forouzan, *Cryptography and Network Security*, McGraw-Hill Education, 2017. • Tim Mather, Subra Kumaraswamy, and Shahed Latif, *Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance*, O'Reilly Media, 2009.
E-Resources • https://owasp.org • https://nptel.ac.in • https://docs.aws.amazon.com/security • https://learn.microsoft.com/en-us/azure/security

CSC3521 Blockchain Technologies

Course Code: CSC3521	Course Name: Blockchain Technologies Type of Course: Lab Integrated Course		L- T-P- C	2-0-2-3
Version No.	1			
Course Pre-requisites	NIL			
Anti-requisites	NIL			
Course Description	This course introduces the fundamental concepts of Blockchain Technology, distributed ledger systems, cryptographic techniques, consensus mechanisms, smart contracts, and decentralized applications. The course provides both theoretical and practical knowledge of blockchain platforms and their applications in finance, healthcare, supply chain management, and digital identity systems. Through laboratory exercises, students gain hands-on experience in developing blockchain networks, creating smart contracts, and building decentralized applications.			
Course Objective	On successful completion of the course the students shall be able to familiarize the learners with the concepts of Blockchain Technology and attain skill development through participative learning techniques.			
Course Out Comes	**On successful completion of the course the students shall be able to:** • Describe the fundamentals of blockchain technology and distributed ledger systems. **[Understand]** • Analyze cryptographic techniques and consensus mechanisms used in blockchain networks. **[Analyze]** • Develop smart contracts and decentralized applications using blockchain platforms. **[Apply]** • Evaluate blockchain solutions for real-world applications and security challenges. **[Apply]**			
Course Content:				
Module 1	Blockchain Fundamentals	Assignment	Blockchain Fundamentals	8 Sessions

Topics: Introduction to Blockchain Technology, Evolution of Blockchain, Distributed Ledger Technology, Blockchain Architecture, Blocks and Chain Structure, Peer-to-Peer Networks, Cryptographic Hash Functions, Merkle Trees, Public and Private Blockchains, Blockchain Applications.				
Module 2	Cryptography and Consensus Mechanisms	Quiz/ Assignment	Consensus Mechanisms	8 Sessions
Topics: Cryptography Fundamentals, Symmetric and Asymmetric Encryption, Digital Signatures, Public Key Infrastructure, Consensus Algorithms, Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake, Byzantine Fault Tolerance, Security Challenges in Blockchain.				
Module 3	Smart Contracts and Decentralized Applications	Assignment	Smart Contracts	7 Sessions
Topics: Introduction to Smart Contracts, Ethereum Blockchain, Solidity Programming Basics, Smart Contract Development Life Cycle, Decentralized Applications (DApps), Ethereum Virtual Machine, Token Standards, Decentralized Finance Concepts, Smart Contract Testing and Deployment.				
Module 4	Blockchain Platforms and Emerging Applications	Assignment	Blockchain Applications	7 Sessions
Topics: Hyperledger Framework, Permissioned Blockchains, Blockchain for Supply Chain Management, Blockchain in Healthcare, Digital Identity Management, Cryptocurrency Ecosystem, Non-Fungible Tokens (NFTs), Blockchain Scalability, Interoperability and Future Trends.				

List of Laboratory Tasks **30 sessions**

1. Installation and Configuration of Blockchain Development Environment.
2. Creation of Cryptographic Hash Functions and Hash Verification.
3. Implementation of Simple Blockchain using Python.
4. Generation and Verification of Digital Signatures.
5. Public and Private Key Encryption Demonstration.
6. Creation and Validation of Blockchain Transactions.
7. Simulation of Peer-to-Peer Blockchain Network.
8. Implementation of Proof of Work Consensus Algorithm.
9. Simulation of Proof of Stake Consensus Mechanism.
10. Development of Basic Smart Contracts using Solidity.
11. Deployment of Smart Contracts on Ethereum Test Network.
12. Creation of ERC-20 Token Smart Contract.
13. Smart Contract Testing and Debugging.
14. Development of a Simple Decentralized Application (DApp).
15. Mini Project on Blockchain-based Application Development.

Text Book

- Melanie Swan, *Blockchain: Blueprint for a New Economy*, O'Reilly Media.
- Imran Bashir, *Mastering Blockchain*, Packt Publishing.

References

- Andreas M. Antonopoulos, Mastering Bitcoin, O'Reilly Media.
- Narayanan, Bonneau, Felten, Miller and Goldfeder, Bitcoin and Cryptocurrency Technologies, Princeton University Press.

E-Resources

- Ethereum Documentation
- Hyperledger Documentation
- Solidity Documentation

- Blockchain Demo Resources