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PROCEEDINGS OF 20th ACADEMIC COUNCIL MEETING

07th June 2024

Information Technology



PROCEEDINGS OF

20th ACADEMIC COUNCIL MEETING

07th JUNE 2024

KARPAGAM COLLEGE OF ENGINEERING

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KARPAGAM COLLEGE OF ENGINEERING, COIMBATORE - 641032
REGULATIONS 2023
CHOICE BASED CREDIT SYSTEM

Common to all BE. / B.Tech. Full Time Programmes

(For the students admitted to B.E. / B.Tech. Programmes from the Academic Year 2023 - 2024 onwards)

1. PRELIMINARY DEFINITIONS AND NOMENCLATURE

In this Regulation, unless the context otherwise specifies:

AY	Academic Year
CIA	Continuous Internal Assessment
CAM	Continuous Assessment Marks
CBCS	Choice Based Credit System
Programme	A degree with a major specialization in an Engineering/ Technology discipline offered by the College
Course	Course is any subject of study that may be classified as Theory only, Lab only, Lab embedded Theory, Project embedded Theory or Project.
ESE	End Semester Examination
UG	Under Graduate
University	Anna University, Chennai, India
College	Karpagam College of Engineering, Coimbatore, India

2. PREAMBLE

Students of today are much different from the students of the past in many ways. They want to be independent and like to make decisions on their own. Employers expect students to have the right attitude with diverse skill sets to work in a team. The present rigid, cohort system of learning doesn't allow the students in selecting the courses of their choice to become a holistic personality.

In this direction KCE is introducing the Choice Based Credit System (CBCS) into its academic curriculum, wherein the students can register for courses of their choice to enable fast, average and slow learners to plan and pace the same in a Semester. Thus students can register for more/average/less Credits within the prescribed limits, based on their learning activity as observed and alter the pace of learning within the broad framework of academic course and credit requirements. CBCS allows students in deciding their academic plan and permits students to alter it as they progress with their study.

Students will have the option of choosing courses from a „Group of courses“ within each classification. Ample options are given to choose

interdisciplinary courses from other programmes which will help the student to develop additional skills. Slow learners will also benefit since a few important courses will be offered in both semesters.

CBCS offers flexibility for students to plan their own curriculum in addition to the enhancement of their skill levels. A Faculty Advisor facilitates a student in identifying the courses based on programme requirements, course prerequisites, student's ability and interest in various academic disciplines towards their academic progression.

3. ADMISSION PROCEDURE

3.1 Students for the eight semesters BE/B.Tech. Degree Programme shall be admitted as per the regulations of Department of Technical Education, Government of Tamil Nadu, Chennai.

3.2 Lateral entry admission

(i) The candidates who possess the Diploma in Engineering/Technology awarded by the State Board of Technical Education, Tamil Nadu or its equivalent are eligible to apply for Lateral entry admission to the third semester of BE/B.Tech., as per the rules fixed by Government of Tamil Nadu.

(OR)

(ii) The candidates who possess the Degree in Science (B.Sc.) (10+2+3 stream) with Mathematics as a subject at the B.Sc. Level are eligible to apply for Lateral entry admission to the third semester of BE/B.Tech. Such candidates shall undergo two additional Engineering subject(s) in the third and fourth semesters as prescribed by the Institution.

4. PROGRAMMES OFFERED

A student may be offered admission to any one of the programmes of study approved by the University and offered at Karpagam College of Engineering, Coimbatore.

Details of programmes currently offered by Karpagam College of Engineering, Coimbatore are listed below

1. B.E. Mechanical Engineering(ME)
2. B.E. Civil Engineering(CE)
3. B.E. Electronics and Communication Engineering(EC)
4. B.E. Electronics and Telecommunications Engineering(ET)
5. B.E Electrical and Electronics Engineering(EE)
6. B.E. Computer Science and Engineering(CS)

7. B.E. Computer Science and Engineering (Cyber Security)(CY)
8. B.E. Computer Science and Design(CD)
9. B.E. Computer Science and Technology(CT)
10. B.Tech. Artificial Intelligence and Data Science(AD)
11. B.Tech. Information Technology(IT)

5. STRUCTURE OF THE PROGRAMMES

5.1 Credit Assignment

Each course is assigned with number of credits based on the following:

Contact period in a week	Credit
1 Lecture Period	1
1 Tutorial Period	1
2 Practical Periods (Laboratory / Seminar / Project Work / etc.)	1

5.2 Categorisation of Courses

Every BE/B.Tech. Programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows:

- i. **Humanities and Social Science (HS)** include courses such as Technical English, Employability Skills, Engineering Ethics and Human Values, Communication Skills Environmental Science and Engineering and management courses.
- ii. **Basic Science (BS)** include courses such as Mathematics, Physics, Chemistry etc.
- iii. **Engineering Science (ES)** include courses such as Engineering practices, Engineering Graphics, Basics of Electrical/Electronics/ Mechanical / Computer Engineering, Instrumentation etc.
- iv. **Professional Core (PC)** courses include the core courses relevant to the chosen specialization or programme.
- v. **Professional Elective (PE)** courses include the elective courses relevant to the chosen specialization/programme.
- vi. **Open Elective (OE)** courses include the list of courses offered by a programme to the students of other programme students from the list of courses.
- vii. **Employability Enhancement Courses (EEC)** includes Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.
- viii. **Vacation Courses (VC)**, the courses listed under various categories

shall be offered to the students during vacation, also as and when required and deemed necessary. A student is permitted to register for a maximum of TWO courses only. The conditions for Registration/Assessment shall be vide clause 7 and 11. The marks/score/grades of such courses shall appear in the grade sheet of the immediate subsequent semester.

- ix. **Mandatory Courses (MC)** include courses in which credits are to be acquired as part of degree requirements and shall be awarded grades but shall not be part of either GPA (or) CGPA.

5.2.1 The minimum credits to be earned by the regular students is **165** for the completion of the BE./B.Tech. programme with the distribution of credits in different categories as given below:

S. No.	Category	Range of Credits (%)		Suggested Breakdown of Credits (for Total of 165)
		Min	Max	
1.	Humanities and Social Sciences (HS), including Management.	6	10	13
2.	Basic Sciences (BS) including Mathematics, Physics, Chemistry.	12	17	23
3.	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Civil/Electrical/Electronics/Mechanical/Computer Engineering, and Instrumentation.	12	19	23
4.	Professional Core (PC), relevant to the chosen specialization/Programme.	30	40	52
5.	Professional Electives (PE), relevant to the chosen specialization/Programme.	10	14	18
6.	Open Electives (OE), from other technical and/or emerging subject areas.	10	14	18
7.	Employability Enhancement Courses (EEC), including mini project, internship, project work.	10	14	18
8.	Mandatory Courses (MC)	-	-	NIL
Total Minimum Credits to be earned for completion of UG Programme				165

5.2.2 The minimum credits to be earned by the lateral entry students is 124 for the completion of the programme with the distribution of minimum credits in different categories as given below:

S. No.	Category	Range of Credits (%)		Suggested Breakdown of Credits (for Total of 124)
		Min	Max	
1.	Humanities and Social Sciences (HS), including Management.	3	5	05
2.	Basic Sciences (BS) including Mathematics, Physics, Chemistry.	4	6	07
3.	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Civil/Electrical/Electronics/Mechanical/Computer Engineering, and Instrumentation.	6	8	10
4.	Professional Core (PC), relevant to the chosen specialization/Programme.	30	45	52
5.	Professional Electives (PE), relevant to the chosen specialization/Programme.	8	15	17
6.	Open Electives (OE), from other technical and/or emerging subject areas.	8	12	15
7.	Employability Enhancement Courses (EEC), including mini project, internship, project work.	10	15	18
8.	Mandatory Courses (MC)	-	-	NIL
Total Minimum Credits to be earned for completion of UG Programme				124

5.3. Personality and Character Development (No Credits)

Students will be encouraged to enroll in any one of the personality and character development programmes (NSS/Sports/YRC) and undergo training for about 40 hours and attend a camp of about seven days. The training shall include classes on hygiene and health awareness and also training in first-aid.

- **National Service Scheme (NSS)** will have social service activities in and around the College.
- **Sports** will have Games, Drills and Physical exercises.
- **Youth Red Cross (YRC)** will have activities related to social services in and around the College. The training activities will be carried out during the weekends and the camp will normally be during the vacation.

5.4 Number of Courses per Semester

Curriculum in a semester shall normally have a blend of 8 to 12 courses

including Theory/Lab/Lab Embedded Theory/Project Embedded Theory/Laboratory courses. Each course may have credits assigned as per clause 5.1.

5.5. Industrial Training/Internship

- 5.5.1.** The students should undergo Industrial training/Internship for a period as specified in the Curriculum during summer/winter vacation. The training has to be undergone continuously for the entire period. The students may undergo Internship at Industries/Research organization/Reputed Institution in India/Abroad (after due approval from the Department Consultative Committee).
- 5.5.2.** The Industrial Training/Internship is mandatory for students to complete the Programme and should earn the credit under EEC category. The credits earned will be indicated in the Grade Sheet.
- 5.5.3.** The student is allowed to undergo a maximum of 6 weeks Industrial Training during the entire duration of study.

DURATION OF TRAINING / INTERNSHIP	CREDITS
2 Weeks	1
4 Weeks	2
6 Weeks	3

5.6 Industrial Visit

Every student is required to go for at least one Industrial/Field Visit every semester starting from the second semester of the Programme. The Heads of Departments shall ensure that necessary arrangements are made in this regard.

5.7 Online Courses/Self Study Courses

- 5.7.1** Students may be permitted to earn credit of maximum four online courses/Self Study courses with the due approval of Department Consultative Committee without any redundancy.
- 5.7.2** Students may be permitted to go for online courses (which are provided with certificate through **proctored examination**) with the approval of Department Consultative Committee subject to a maximum of **NINE credits**.
- 5.7.3** The student can opt for **FOUR** Self Study/online courses provided the student does not have current arrears and maintains a CGPA of greater than 8.0.
- 5.7.4** The student can opt for **FOUR** Self Study/online courses provided the student does not have current arrears and maintains a CGPA of 7.5 to 8.0.

The Department may offer self study courses. The purpose of the course is to permit the student to study a course of their choice. The students shall study on their own under the guidance of a faculty member. No formal lectures need to be delivered. The syllabus of the course and mode of assessment shall be approved by the Department Consultative Committee and forwarded to the Dean/Academics for the formal approval of course. The Head of the Department shall be responsible for the periodic monitoring and evaluation of the course before the commencement of the semester.

- 5.7.5** The self study course/online course can be considered instead of elective course. If a student opts for more than one self study/online course (vide clause 5.7.3 and 5.7.4) he/she can substitute more number of electives.

5.8 Medium of Instruction, learning and evaluation

The medium of instruction is English for all courses, examinations, seminar presentations and project/thesis/dissertation reports.

6. DURATION OF THE PROGRAMMES

- 6.1** A student is normally expected to complete the BE/B.Tech. Programme in 8 Semesters (for HSC students) and 6 semesters (for Lateral Entry students) but in any case not more than 14 Semesters for HSC students and not more than 12 semesters for Lateral Entry students.
- 6.2** Each semester shall normally consist of 90 teaching days (including examination days). The Head of the Department shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus covering the full content of the syllabus for the course being taught.
- 6.3** The total duration for completion of the programme reckoned from the commencement of the first semester to which the student was admitted shall not exceed the maximum duration specified in clause 6.1 irrespective of the period of break of study (vide clause 17) or prevention (vide clause 8.4) in order that the student may be eligible for the award of the degree (vide clause 15).

7. COURSE ENROLLMENT AND REGISTRATION

- 7.1** Each student, shall be assigned to a Faculty Advisor (vide clause 9) who shall advice and counsel the student about the details of the academic

programme and the choice of courses considering the student's academic background and career objectives.

- 7.2. Depending on academic and non academic resources available to each programme, courses offered may vary. Students will get a chance to make their own plan of study by changing the pace with which they study (fast/normal/slow) and to opt for a faculty member of their choice.
- 7.3 The number of credits registered for during a semester should not be less than 14 credits and should not exceed 30 credits.
- 7.4 Every student shall enroll for the courses of the succeeding semester during the current semester. However, the student shall confirm the enrollment by registering for the courses within the first **FIVE** working days after the commencement of the concerned semester.
- 7.5 No courses shall be offered by a Department unless a minimum of 30 students register for that course.
- 7.6 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.
- 7.6.1 Students on admission shall register for **all the courses prescribed in the curriculum in the student's first Semester of study without any choice.**
- 7.6.2 The enrollment for all the courses of the Semester II to VIII will commence 10 working days prior to the last working day of the preceding semester. The student shall enroll for the courses with the guidance of the Faculty Advisor. If the student wishes, the student may drop or add courses (vide clause 7.7) within **FIVE** working days after the commencement of the semester concerned and complete the registration process duly authorized by the Faculty Advisor. Also the student is allowed to register for a course in which the student has failed earlier through he has not enrolled at the end of previous semester as above mentioned. However, the student is allowed to register for the course, wherein the student has been stopped due to shortage of attendance during current semester

7.7 Flexibility to Add or Drop courses

7.7.1 From the II to VIII semesters, the student has the option of registering for additional courses or dropping existing courses. Total number of credits of such courses cannot exceed seven per semester. However the maximum number of credits the student can register in a particular semester cannot exceed 30 credits.

7.7.2 A student has to earn the minimum number of credits specified in the curriculum of the respective Programme of study in order to be eligible to obtain the degree. However, if the student wishes, he/she is permitted to earn more than the number of credits prescribed in the curriculum of the student's programme.

7.7.3 The student shall register for the project work in the VII/VIII semester only.

7.8 Reappearance Registration

7.8.1 If a student fails in a course, it will be taken as an arrear. The student can retain the already earned Continuous Assessment marks for **ONE** subsequent appearance only and thereafter he/she will solely be assessed by the performance in the End Semester Examination only.

7.8.2 If the theory course, in which the student has failed, is a professional elective or an open elective, the student may register for the same or any other professional elective or open elective course respectively in the subsequent semesters.

7.8.3 The student who fails in any Laboratory Course shall also take it as an arrear.

7.8.4 If a student is prevented from writing End Semester Examination of a course due to lack of attendance, the student has to register for that course again, when offered next, attend the classes and fulfill the attendance requirements as per clause 8. If the course, in which the student has lack of attendance, is a Professional Elective or an Open Elective, the student may register for the same or any other Professional Elective or Open Elective course respectively in the subsequent semesters.

8. REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION OF A COURSE

A student who has fulfilled the following conditions (vide clause 8.1 and 8.2) shall be deemed to have satisfied the attendance requirements for appearing for End Semester Examination of a particular course.

- 8.1** Ideally every student is expected to attend all periods and earn 100% attendance. However, the student shall secure not less than 80% attendance course wise taking into account the number of periods required for that course as specified in the curriculum.
- 8.2** If a student secures attendance between 70% and less than 80% in any course in the current semester due to medical reasons (hospitalization/ accident/specific illness) or due to participation in the College/University/ State/National/International level Sports/Technical events with prior permission from the Head of the Department concerned, the student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the end semester examination of that course. In all such cases, the students should submit the required documents on joining after the absence to the Head of the Department through the Faculty Advisor.
- 8.3** A student shall normally be permitted to appear for End Semester Examination of the course if the student has satisfied the attendance requirements (vide Clause 8.1 – 8.2) and has registered for examination in those courses of that semester by paying the prescribed fee.
- 8.4** Students who do not satisfy clause 8.1 and 8.2 and who secure **less than 70%** attendance in a course will not be permitted to write the End-Semester Examination of that course. The student has to register and repeat this course in a subsequent semester when it is offered next (vide clause 7.8.4).
- 8.5** A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of letter grades/marks.
- 8.6** However if the student has a backlog of more than **FOUR** courses (Cumulatively from the I semester) for which he/she is stopped from appearing for the End Semester Examination at the end of any semester of an Academic Year, he/she will be prevented from registering for any new course in the next two consecutive semesters. During this period, the student is to register for the stopped courses, which may be offered for other batches of students, and complete all the requirements for the

completion of each course as given in clause 11 and 12. He/she may be permitted to rejoin the programme only when the backlog of courses is less than or equal to **FOUR**.

8.7 Readmission from one regulation to another regulation:

A student took admission in a particular Regulations, detained due to lack of percentage of attendance for more than **FOUR** courses cumulatively from first semester or exam fee not paid category is permitted to take re-admission (clause 8.6) at appropriate level under any regulations prevailing in the institute subject to the following rules and regulations.

- If the student has already passed any course(s) of readmitted program in the earlier regulation/ semester of study, such courses are exempted in the new scheme to appear for the course(s).
- If the student has arrear in any course(s) of readmitted program in the earlier regulation/semester of study, such courses are to be passed by the students based on new regulations only.
- After rejoining, the student is required to study the courses as prescribed in the new regulations for the re-admitted program at that level and thereafter.
- The courses that are not done in the earlier regulations/semester as compared with readmitted program need to be cleared after readmission by appearing for the examinations conducted time to time under the new regulations.
- In general, after transition, course composition and number of credits/semester shall be balanced between earlier and new regulations on case to case basis.

9. FACULTY ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a teacher of the Department who shall function as Faculty Advisor for those students throughout their period of study. The Faculty Advisor shall advise the students in registering of courses, authorizes the process, monitor their attendance and progress and counsel them periodically. If necessary, the Faculty Advisor may also discuss with or inform the parents about the progress/performance of the

students concerned.

The responsibilities for the faculty advisor shall be:

- To inform the students about the various facilities and avenues available to enhance the student's curricular and co-curricular activities.
- To guide on enrollment and registration of the courses.
- To authorize the final registration of the courses at the beginning of each semester.
- To monitor the academic and general performance of the students including attendance and to counsel them accordingly.

10. COURSE COMMITTEES

10.1 COMMON COURSE COMMITTEE

A theory course handled by more than one teacher shall have a "**Common Course Committee**" comprising of all teachers teaching that course and some students who have registered for that course. There shall be two student representatives from each batch of that course. One of the teachers shall be nominated as Course Coordinator by the Head of the Department offering that course duly approved by the Dean/Academics.

The first meeting of the Common Course Committee shall be held within **FIVE** days from the date of commencement of the semester. The nature and weightage of the continuous assessments shall be decided in the first meeting, within the framework of the Regulations. **The subsequent meetings in a semester may be held once in a fortnight.** During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to the whole batch.

In addition the "Common Course Committee" (without the student representatives) shall meet to ensure uniform evaluation of continuous assessments after arriving at a common scheme of evaluation for the assessments (vide clause 11).

Wherever feasible, the common course committee (without the student representatives) shall prepare a common question paper for the continuous assessment tests. The question paper for the end semester examination is common for a common course. **The remedial classes shall be planned in these meeting to improve the students performance wherever deemed to be necessary.**

10.2 MULTIPLE COURSES COMMITTEE

If a programme has in a semester, course(s) handled by a single teacher, there will be a “Multiple Courses Committee” comprising of all the above teachers and two student representatives from each course. One of the above teachers, nominated by the Head of the Department shall coordinate the activities of this committee. The function of this committee is **similar to that of the common course committee.**

10.3 OVERALL MONITORING COMMITTEE

10.3.1 In addition, there shall be a overall monitoring committee for each semester of a programme which comprises of (i) the Course Coordinators/Course teachers (as applicable), (ii) the Faculty-in-charge of the programme and (iii) the Head of Department. This overall monitoring committee shall meet periodically to discuss academic related matters, progress and status of the students of the semester concerned.

10.3.2 The overall monitoring committee can invite the Faculty Advisors or students for any of the committee meetings if necessary.

11. ASSESSMENT PROCEDURE FOR THE AWARD OF MARKS

All BE/B.Tech. Programmes consist of Theory Courses, Laboratory Courses and Employability Enhancement Courses. Employability Enhancement Courses include Project Work, Seminar, Professional Practices, Case Study and Industrial/Practical Training. Appearance in End Semester Examination/Final Assessment Examination is mandatory for all courses including Theory, Laboratory and Project work.

Performance in each course of study shall be evaluated based on (i) Continuous Assessments throughout the semester and (ii) End Semester Examination/Final assessment Examination at the end of the semester. For Theory Courses out of 100 marks, the maximum marks for Continuous Assessment is fixed as 40 and the End Semester Examination carries 60 marks. For Laboratory Courses out of 100 marks, the maximum marks for Continuous Assessment is fixed as 60 and the Final Assessment Examination carries 40 marks. The continuous assessment is 40 marks for the Project Work and project report evaluation and viva-voce examination carries 60 marks. All other courses included under Employability Enhancement Courses are evaluated by Continuous Assessments only. Each course shall be evaluated for a maximum of 100 marks as shown below:

S. No.	Category of course	Continuous Assessments	End Semester Examinations
1	Theory	40 Marks	60 Marks
2	Laboratory	60 Marks	40 Marks
3	Project Work	40 Marks	60 Marks
4	Lab Embedded	50 Marks	50 Marks
5	All other EEC Courses	100 Marks	-

Every teacher is required to maintain an „**ATTENDANCE AND ASSESSMENT RECORD**“ for every semester which consists of attendance marked in each theory/Laboratory/EEC class, the assessment marks and the record of class work (topics covered), separately for each course handled by the teacher. This should be submitted to the Head of the Department periodically (every fortnight) for checking the syllabus coverage and the records of assessment marks and attendance. The Head of the Department will affix his/her signature and date after due verification. At the end of the semester, the record should be verified by the Head of the Institution who shall keep this document in safe custody (for five years). The records of attendance and assessment of both current and previous semesters should be available for inspection by the competent authorities.

11.1 ASSESSMENT FOR THEORY COURSES:

For Theory Courses out of 100 marks, the maximum marks for Continuous Assessment is fixed as 40 and the End Semester Examination carries 60 marks. Continuous Assessment comprises of three Continuous Internal Assessment (CIA) tests, conducted by the course instructor/coordinator/department. The Continuous Internal Assessment (CIA) marks will be awarded on the basis of continuous assessment made during the semester as per guidelines given below.

S.No.	Category	Max. Marks
1	CIA Test I (one and a half hours)	5
2	CIA Test II (one and a half hours)	10
3	CIA Test III (one and a half hours)	10
4.	Assignment / Quiz / Online exam	10
5.	Unit test (I and II)	5
CIA Total Marks		40

The total marks obtained in the three CIA tests put together shall be converted to 25 marks, two unit tests put together shall be converted to 5 marks and assessment of assignments/ quiz/online exams shall be converted to 10 marks and rounded to the nearest integer. A minimum of two CIA tests would be conducted in a day and a CIA test would be of one and a half hours durations each. Students will not have regular classes on the scheduled day of these tests. In case a student misses the CIA test or unit test due to medical reasons (hospitalization/accident/specific illness) or due to participation in the College/University/State/National/International level Sports events with prior permission from the Head of the Department and approval from the Dean/Academics, a **Reassessment** may be given at the end of the semester through the recommendation of the tutor and HoD concerned. Best two out of three CIA shall be considered for internal marks calculation.

The End Semester Examination for theory courses will be of three hours duration. Appearance in the End Semester Examination is mandatory requirement for passing the courses having ESE component.

11.2 ASSESSMENT FOR LABORATORY COURSES:

All the Laboratory courses shall be evaluated internally. For Laboratory Courses out of 100 marks, the maximum marks for Continuous Assessment is fixed at 60 and the **final assessment carries 40 marks**. Every laboratory exercise/experiment shall be evaluated based on the student performance during the laboratory class and the students record maintenance. The total marks for all the laboratory exercises shall be reduced to 35 marks. There shall be at least two online tests/ viva voce/ assessment. The total marks in the two assessments shall be reduced to 20 marks and the maintenance of record shall be assessed for five marks. The final assessment for Laboratory courses will be of three hours duration.

S.No	Category	Max. Marks
1	Observation and Record	35
2	Two Model Exam	20
3	Record Submission	5
4	Final Assessment	40
CIA Total Marks		100

11.3 ASSESSMENT FOR LAB EMBEDDED THEORY COURSES:

The assessment for the embedded theory shall be as that of the theory (vide clause 11.1) and the assessment for the embedded lab shall be as that of the lab (vide clause 11.2). The weightage of first assessment shall be 40 % and the second assessment shall be 60 %. The weighted average of these two assessments shall be converted into 50 marks and rounded to the nearest integer.

Assessment I (40% weightage) (Theory Component)		Assessment II (60% weightage) (Laboratory Component)		Total Marks
Individual Assignment / Case Study / Seminar / Mini Project	End Semester Examination	Evaluation of Laboratory Observation, Record	Final assessment	
40	60	60	40	200

11.4 ASSESSMENT FOR PROJECT WORK:**i) Project Work - Phase I**

It shall be evaluated for a maximum of 100 by Continuous Internal Assessment. Project work may be assigned to a single student or to a group of students not exceeding four in a group.

There shall be **three assessments** (each 25 marks) during the semester by a review committee. The student shall make presentation on the progress made, before the committee. The Head of the Department shall constitute a review committee for each programme. There shall be a minimum of three members in the review committee. The project **Guide** will be one of the members of the Review Committee. The total marks obtained in the three Reviews shall be 75 marks. The student(s) is expected to submit the project report on or before the last working day of the semester.

Details of the break-up of marks for the Continuous Assessment for Project Work – Phase I are indicated below:

Continuous Assessment (100 Marks)						
Review I		Review II		Review III		Report Evaluation
Marks awarded by Review Committee (excluding guide)	Marks awarded by Guide	Marks awarded by Review Committee (excluding guide)	Marks awarded by Guide	Marks awarded by Review Committee (excluding guide)	Marks awarded by Guide	Marks awarded by Guide
10	10	10	10	10	10	25 Marks
Attendance 5 Marks		Attendance 5 Marks		Attendance 5 Marks		
25 Marks		25 Marks		25 Marks		

ii) Project Work - Phase II

For Project work –Phase II is out of 100 marks, the maximum marks for Continuous Assessment is fixed as 40 and the End Semester Examination (project report evaluation and viva-voce examination) carries 60 marks. Project work may be assigned to a single student or to a group of students not exceeding four in a group.

There shall be **three assessments** (each 100 marks) during the semester by a review committee. The student shall make presentation on the progress made, before the committee. The Head of the Department shall constitute a review committee for each programme. There shall be a minimum of three members in the review committee. The project **Guide** will be one of the members of the Review Committee. The total marks obtained in the three Reviews shall be converted into 40 marks.

The student(s) is expected to submit the project report on or before the last working day of the semester. The End Semester Examination for project work shall consist of evaluation of the final project report by an external examiner followed by a viva-voce examination conducted separately for each batch by the committee consisting of the external examiner, the guide and an internal examiner. The Controller of Examinations shall appoint the Internal and External Examiners for the End Semester Examination.

Details of the break-up of marks for the Continuous Assessment and End Semester Examination for Project Work – Phase II are indicated below:

Continuous Assessment						End Semester Examination				
Review I (05 Marks)		Review II (15 Marks)		Review III (20 Marks)		Report Evaluation (20 Marks)		Viva – Voce (40 Marks)		
Marks awarded by Review Committee (excluding guide)	Marks awarded by Guide	Marks awarded by Review Committee (excluding guide)	Marks awarded by Guide	Marks awarded by Review Committee (excluding guide)	Marks awarded by Guide	External Examiner	Internal Examiner	External Examiner	Internal Examiner	Marks awarded by Guide
03	02	10	05	10	10	10	10	20	10	10
40 Marks						60 Marks				

11.4.1 If the project report is not submitted on or before the specified deadline then the student(s) is deemed to have failed in the Project Work. The failed student(s) shall register for the same in the subsequent semester and repeat the project work.

11.5 ASSESSMENT FOR PROJECT EMBEDDED THEORY COURSES:

The assessment for the Project embedded theory shall be as that of the theory (vide clause 11.1) and the assessment for the embedded project shall be as that of the project (vide clause 11.4) and the cumulative mark will be calculated based on the performance in both the theory and project component of course giving equal weightage.

11.6 ASSESSMENT FOR SEMINAR/PROFESSIONAL PRACTICES/CASE STUDY:

The Seminar / Case study shall carry 100 marks and shall be evaluated through Continuous Assessment only. Every student is expected to

present a minimum of two seminars per semester before the evaluation committee and for each seminar, marks can be equally apportioned. The three member committee appointed by Head of the Department will evaluate the seminar and at the end of the semester the marks can be consolidated and taken as the final mark. The evaluation shall be based on the seminar paper / report (40%), presentation (40%) and response to the questions asked during presentation (20%).

11.7 ASSESSMENT FOR INDUSTRIAL / PRACTICAL TRAINING / INTERNSHIP / SUMMER PROJECT/LIVE IN LAB

The Industrial/Practical Training shall carry 100 marks and shall be evaluated continuously. At the end of Industrial/Practical training/ internship/Summer Project/Live in Lab, the student shall submit a report on the training undergone and a certificate from the organization. The evaluation will be made based on the report and Viva-Voce Examination, conducted internally by a three member Committee constituted by the Head of the Department in adherence to the AICTE guidelines. Certificates (issued by the Organization) submitted by the student shall be attached to the mark list and sent to Controller of Examinations by the Head of the Department.

11.8 ASSESSMENT FOR ONLINE COURSE

Students may be permitted to earn credit from online courses (which are provided with certificate through **proctored examination**) with the approval of Department Consultative Committee and the Dean/Academics, subject to a maximum of **NINE** credits. The redundancy of the courses/contents shall be avoided. The credits earned shall be transferred and marks earned shall be converted into grades. The details regarding online courses taken up by the student and marks/credits earned should be sent to the Controller of Examinations in the subsequent semester(s) to replace the professional elective(s)/open elective(s) as per the regulations prescribed for the same.

11.9 ASSESSMENT FOR SELF STUDY COURSE

The Faculty member appointed by the Head of the Department shall be responsible for periodic monitoring and evaluation of the course. The course shall be evaluated through Continuous Assessments (as decided by the Department Consultative Committee) and End Semester Examination. The evaluation methodology shall be the same as that of a

theory course. (vide clause 11.1) A committee consisting of the Head of the Department, the Faculty Member and another Senior Faculty member nominated by the Head of the Department shall assign grade to the students based on the performance.

12. PASSING REQUIREMENTS

12.1 The Passing requirement for a student in a course is that the student should have obtained minimum of 45% marks in the End Semester Examination and should fulfill 50% of the total by adding both the Continuous Assessments and End Semester Examinations.

The Internal mark is valid for two attempts. However from the third attempt the student shall be declared to be passed if he/she secures minimum of 50% marks prescribed in the End semester examination.

12.1.1 If a student fails in a professional elective or an open elective, the student may be permitted to register for the same course as arrear or opt for new registration to any other professional elective or open elective course respectively in the subsequent semesters. Registering for a new course will require fulfillment of attendance vide clause 8.

12.2 The passing requirement for the courses which are assessed only through continuous assessment (EEC courses except project work), shall be determined based on the marks obtained in continuous assessment tests.

12.3 Examination Wrapper and Revaluation: One week after the publication of results, there shall be an examination wrapper day for the theory courses. On this day, the students can view their end semester answer scripts in the presence of course expert appointed by CoE. In cases of dispute, when the student is not satisfied with the clarifications/corrections the student can apply for revaluation. A student can apply for revaluation of the student's semester examination answer paper in a theory course, within two weeks from the declaration of results, on payment of a prescribed fee along with prescribed application to the Controller of Examinations (CoE) through the Head of Department. The CoE will arrange for the revaluation and the results will be intimated to the student concerned through the Head of the Department. Revaluation is not permitted for laboratory courses and project work.

13 AWARD OF LETTER GRADES

13.1. The performance of a student will be reported using letter grades decided by the relative grading, each carrying certain points as detailed below:

Letter Grade	Grade Points
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Average)	6
C (Satisfactory)	5
U (Fail)	0
U* (Absent)	-
SA (Shortage of Attendance)	-
W (Withdrawn)	-
WH (Withheld)	-

Note: 'RA' denotes fail in that course, U* denotes absent for ESE, 'SA' denotes shortage of attendance (as per Clause 8) and hence prevented from writing End Semester Examinations.

13.2 For the extracurricular activities such as National Service Scheme (NSS)/sports/YRC, a satisfactory/not satisfactory grading will appear in the mark sheet. Every student shall put in a minimum of 75% attendance in the training and attend the camp compulsorily. The training and camp shall be completed during the first year of the programme. However, for valid reasons, the Head of the Institution may permit a student to complete this requirement in the second year. **A satisfactory grade in the above extracurricular activities is compulsory for the award of degree.**

14. GPA AND CGPA CALCULATION

14.1 The CoE shall convene a meeting of the result passing board after the End Semester Examinations and with the approval of the board will declare the results. After results are declared, Grade Sheets will be issued to each student which will contain the following details:

- the list of courses registered during the semester and respective grade earned
- the Grade Point Average (GPA) for the semester and
- the Cumulative Grade Point Average (CGPA) of all the courses from the first semester to the current one.

GPA is the ratio of the sum of the products of the number of credits of courses registered and the grade points corresponding to the grades

scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses registered in the semester.

$$GPA/CGPA = \frac{\sum_{i=1}^n C_i g_i}{\sum_{i=1}^n C_i}$$

where, C_i - is the Credits assigned to the course

g_i - is the grade point corresponding to the letter grade obtained for each course.

n - is number of all Courses successfully cleared during the particular semester in the case of GPA and during all the semesters in the case of CGPA.

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. U, U* and "SA" grades will be excluded for calculating GPA and CGPA.

14.2 In the case of a student registered for more number of electives (PE/OE) than required as per the requirements in the curriculum, the courses with higher grades alone will be considered for calculation of CGPA.

15. ELIGIBILITY FOR THE AWARD OF DEGREE

15.1. A student shall be declared eligible for the award of the BE / B.Tech. Degree provided the student has

- i. Scored the required number of credits specified in the curriculum (minimum of 165 credits for regular students and minimum of 124 credits for lateral entry students) within the stipulated time (vide Clause 6.1).
- ii. Successfully completed the course requirements, appeared for the End Semester Examinations and passed all the courses within a maximum period as prescribed in clause 6.1.
- iii. Passed in the additional courses prescribed by the Dean/Academics whenever readmitted under regulations other than R2023, if applicable.
- iv. A satisfactory grade in NSS/Sports/YRC requirements and other Mandatory non-credit courses.
- v. No disciplinary action pending against the student.

15.2 CLASSIFICATION OF THE DEGREE AWARDED

15.2.1 BE./B.TECH. HONOURS (SPECILISATION IN THE SAME DISCIPLINE):

- The student should have earned additionally a minimum of 18 credits from a vertical of the same programme.
- Should have passed all the courses in the first attempt.
- Should have earned a minimum CGPA of 7.50

15.2.2 BE./B.TECH. HONOURS

- The student should have earned additionally a minimum of 18 credits from more than one vertical of the same programme.
- Should have passed all the courses in the first attempt.
- Should have earned a minimum CGPA of 7.50

15.2.3 BE./B.TECH. (MINOR IN OTHER SPECIALISATION):

The student should have earned additionally a minimum of 18 credits in any one of the verticals of other BE/B.Tech programmes as approved by the BoS concerned or from any one of the following verticals

Vertical I	: Fintech and Blockchain
Vertical II	: Entrepreneurship
Vertical III	: Public Administration
Vertical IV	: Business Data Analytics
Vertical V	: Environment and Sustainability

- The degree given in 15.2.1, 15.2.2 and 15.2.3 will be optional for students
- For the categories 15.2.1, 15.2.2 and 15.2.3, the students will be permitted to register the courses from 5th semester onwards provided the CGPA earned by the students till 3rd semester is greater than or equal to 7.5 and cleared all the courses in the first attempt.
- If a student decides not to opt for honours after completing certain number of additional courses, the additional courses shall be considered instead of Professional Electives. If the students has studied more number of such courses than the required professional electives, the courses with higher grades shall be considered for calculation of CGPA. Remaining courses shall be printed in the grade sheet as additional credits earned during the programme.

15.2.4 FIRST CLASS WITH DISTINCTION:

A student who satisfies the following conditions shall be declared to have passed the Programme of study in **First class with Distinction**:

- Should have passed in all the courses of all the eight semesters in the student's First Appearance within **FIVE** years for HSC students and **FOUR** years for lateral entry students, which includes authorized break of study of **ONE** year. Withdrawal from examination (vide Clause 16) will not be treated as appearance.
- Should have secured a CGPA ≥ 8.50
- Should NOT have missed appearance from end semester examination due to lack of attendance in any of the courses.

15.2.5 FIRST CLASS:

A student who satisfies the following conditions shall be declared to have passed the examination in **First class**:

- Should have passed the courses of all eight semesters **within a span of FIVE years**, which includes **ONE** year of authorized break of study (if availed) or non appearance from writing the End Semester Examination due to lack of attendance (if applicable).
- Should have secured a CGPA ≥ 6.50

15.2.6 SECOND CLASS:

All other students (not covered in clauses 15.2.1 to 15.2.5) who qualify for the award of the degree (vide Clause 15.1) shall be declared to have passed the examination in **Second Class**.

15.2.7 A student who is absent in End Semester Examination of a course/ project work after having registered for the same shall be considered to have appeared in that examination (except approved withdrawal from end semester examinations as per clause 16) for the purpose of classification.

16. PROVISION FOR WITHDRAWAL FROM EXAMINATION

16.1 A student may, for valid reasons, (medically unfit/family situations/Natural disaster/Participation in sports) be granted permission to withdraw from appearing for the End Semester Examination in any course or courses in **ANY ONE** of the semester examinations during the entire duration of the degree programme. The application shall be sent to

the Dean/Academics through Head of the Department with necessary evidence.

16.2 Withdrawal application shall be considered only if the student is otherwise eligible to write the examination (Clause 8) and if it is made within **TEN** working days before the commencement of the End Semester Examination in that course or courses and also be recommended by Head of the Department.

16.3 Notwithstanding the requirement of the mandatory **TEN** working days notice, applications for withdrawal under extraordinary conditions will be considered on the merit of the case.

16.4 Withdrawal is permitted for the End Semester Examinations during final semester if the period of study of the student does not exceed 5 years as per clause 15.2.1.

17. BREAK OF STUDY FROM A PROGRAMME

17.1 A student is permitted to go on break of study for a maximum period of one year either as two breaks of one semester each or a single break of one year.

a. For a break of study, the student shall apply to the Dean/Academics in advance, in any case, not later than the last date of the first assessment period. The application duly filled by the student shall be submitted through the Head of the Department. In the case of short term employment/ training/ internship, the application for break of study shall be approved and forwarded by the Department Consultative Committee to the Dean/Academics.

b. A student, permitted to rejoin the programme after a break of study/ prevention due to lack of attendance, shall be governed by the Curriculum and Regulations in force at the time of rejoining. The students rejoining in new Regulations shall apply to the Dean/Academics in the prescribed format through Head of the Department at the beginning of semester rejoining for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.

17.2 The total period for completion of the programme reckoned from, commencement of the first semester to which the student was admitted

shall not exceed the maximum period specified in clause 6.1 irrespective of the period of break of study in order to be eligible for the award of the degree (vide clause 15).

- 17.3** In case there is any period of break of study more than the permitted duration of break of study, the student shall be permitted to continue the programme only if the approval is obtained from the Dean/Academics through the concerned HoD before the end of the semester in which the student has taken break of study.
- 17.4** If a student is absent from his studies a period of two consecutive semesters without any intimation, the name of the student shall be deleted permanently from enrollment. Such a student is not entitled to seek readmission under any circumstances.
- 17.5** **DISCIPLINE:** Every student is required to observe discipline and decorum both inside and outside the institute and are expected not to indulge in any activity which will tend to bring down the honour of the institute. If a student indulges in malpractice in any of the theory/ practical examination, continuous assessment examinations, he/she shall be liable for punitive action as prescribed by the College from time to time in addition to Anna University regulations.

18. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The College may from time to time revise, amend or change the Regulations, Curriculum, Syllabus and the Scheme of examinations through the Academic Council with the approval of the Chairman of Academic council.

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B.Tech (Information Technology) - Curriculum**Minimum Credits to be Earned: 160**

SEMESTER - I								
S. No	Course Code	Course	Category	Contact Hours	Instruction Hours / Week			C
					L	T	P	
THEORY								
1	23SEN101	Heritage of Tamils	HS	1	1	0	0	1
2	23SEN103	Technical English - I	HS	4	3	1	0	4
3	23SMA101	Matrices and Calculus	BS	4	3	1	0	4
4	23SCH115	Environmental Science for Engineers	BS	3	3	0	0	3
5	23CSR101	Computer Fundamentals and Communication	ES	4	3	1	0	4
6	23CSR102	C Programming	ES	3	3	0	0	3
LABORATORY								
7	23CSR104	C Programming Laboratory	ES	2	0	0	2	1
Total Credits				21	16	3	2	20

SEMESTER - II								
S. No	Course Code	Course	Category	Contact Hours	Instruction Hours / Week			C
					L	T	P	
THEORY								
1	23SEN202	Tamils and Technology	HS	1	1	0	0	1
2	23SEN205	Technical English - II	HS	3	3	0	0	3
3	23SMA202	Graph Theory	BS	4	3	1	0	4
4	23SPH214	Physics for Computing Sciences	BS	3	3	0	0	3
5	23ITR201	Fundamentals of Web Design	ES	3	3	0	0	3
6	23CSR203	Data Structures and Algorithms	ES	3	3	0	0	3
LABORATORY								
7	23SEN217	Communication Skills Laboratory	HS	2	0	0	2	1
8	23SPH122	Physical Sciences Laboratory	BS	2	0	0	2	1
9	23ITR203	Web Design Laboratory	ES	2	0	0	2	1
10	23CSR205	Data Structures and Algorithms Laboratory	ES	2	0	0	2	1
Total Credits				25	16	1	8	21

SEMESTER - III								
S. No	Course Code	Course	Category	Contact Hours	Instruction Hours / Week			C
					L	T	P	
1	23SMA305	Discrete Mathematics and Stochastic Process	BS	4	3	1	0	4
2	23CSR305	Computer Architecture	ES	3	3	0	0	3
3	23CSR306	Java Programming	ES	5	3	0	2	4
4	23CSR302	Database Management Systems	PC	5	3	0	2	4
5	23CSR304	Design and Analysis of Algorithms	PC	5	3	0	2	4
6	23ITR301	Operating Systems	PC	5	3	0	2	4
7	23EXC201	Application Development - I	EEC	2	0	0	2	1
8	23EXC204	Life Skills - I	EEC	2	0	0	2	1
9	23MXC301	Indian Constitution	MC	1	1	0	0	-
Total Credits				32	19	1	12	25

SEMESTER - IV								
S. No	Course Code	Course	Category	Contact Hours	Instruction Hours / Week			C
					L	T	P	
1	23SMA409	Probability and Statistics	BS	4	3	1	0	4
2	23ECR101	Digital Logic Circuits	ES	5	3	0	2	4
3	23ADR304	Artificial Intelligence	PC	5	3	0	2	4
4	23CSR405	Advanced Algorithms	PC	5	3	0	2	4
5	23ITR402	Communication and Networks	PC	5	3	0	2	4
6	23ITR403	Web Application Development	PC	5	3	0	2	4
7	23XXPXXX	Professional Elective - I	PE	4	2	0	2	3
8	23MXC402	Essence of Indian Traditional Knowledge	MC	1	1	0	0	-
Total Credits				34	21	1	12	27

SEMESTER - V								
S. No	Course Code	Course	Category	Contact Hours	Instruction Hours / Week			C
					L	T	P	
1	23ADR405	Machine Learning Techniques	PC	5	3	0	2	4
2	23ITR505	Data Analytics and Visualization	PC	5	3	0	2	4
3	23CTR501	Cloud Computing	PC	5	3	0	2	4
4	23XXPXXX	Professional Elective - II	PE	4	2	0	2	3
5	23XXPXXX	Professional Elective - III	PE	4	2	0	2	3
6	23XXOXXX	Open Elective - I	OE	3	3	0	0	3
7	23EXC305	Life Skills - II	EEC	2	0	0	2	1
8	23EXCXXX	Internship - I / Mini Project - I	EEC	2	0	0	2	1
9	23EXC511	Design Thinking	EEC	1	1	0	0	1
Total Credits				31	7	0	4	24

SEMESTER - VI								
S. No	Course Code	Course	Category	Contact Hours	Instruction Hours / Week			C
					L	T	P	
1	23ITR606	Cryptography and Network Security	PC	4	3	1	0	4
2	23CDR607	Application System Design with UML	PC	5	3	0	2	4
3	23CSR507	Theory of Computation	PC	3	3	0	0	3
4	23XXPXXX	Professional Elective - IV	PE	4	2	0	2	3
5	23XXPXXX	Professional Elective - V	PE	4	2	0	2	3
6	23XXOXXX	Open Elective - II	OE	3	3	0	0	3
7	23EXC506	Life Skills - III	EEC	2	0	0	2	1
8	23CSR510	Open Source Software Laboratory	PC	4	0	0	4	2
Total Credits				29	16	1	12	23

SEMESTER - VII								
S. No	Course Code	Course	Category	Contact Hours	Instruction Hours / Week			C
					L	T	P	
1	23SGE713	Principles of Management and Engineering Ethics	HS	3	3	0	0	3
2	23ITR708	Internet of Things	PC	3	3	0	0	3
3	23XXPXXX	Professional Elective - VI	PE	4	2	0	2	3
4	23XXOXXX	Open Elective - III	OE	3	3	0	0	3
5	23EXC713	Project Work Phase I	EEC	8	0	0	8	4
Total Credits				21	11	0	10	16

SEMESTER - VIII								
S. No	Course Code	Course	Category	Contact Hours	Instruction Hours / Week			C
					L	T	P	
1	23EXC814	Project Work Phase II	EEC	16	0	0	16	8
Total Credits				16	0	0	16	8

Overall Credits	164
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GROUPING OF COURSES**1. Humanities and Social Sciences (HS)**

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	23SEN101	Heritage of Tamils	HS	1	1	0	0	1
2	23SEN202	Tamils and Technology	HS	1	1	0	0	1
3	23SEN103	Technical English – I	HS	4	3	1	0	4
4	23SEN104	Business English – I	HS	4	4	0	0	4
5	23SEN205	Technical English – II	HS	3	3	0	0	3
6	23SEN206	Business English – II	HS	4	4	0	0	4
7	23SEN307	Basics of French	HS	4	3	1	0	4
8	23SEN408	Functional French	HS	4	3	1	0	4
9	23SEN309	Basics of German	HS	4	3	1	0	4
10	23SEN410	Functional German	HS	4	3	1	0	4
11	23SEN311	Basics of Japanese	HS	4	3	1	0	4
12	23SEN412	Functional Japanese	HS	4	3	1	0	4
13	23SGE713	Principles of Management and Engineering Ethics	HS	3	3	0	0	3
14	23SGE714	Professional Practice, Law and Ethics	HS	3	3	0	0	3
15	23SGE815	Organizational Behaviour	HS	3	3	0	0	3
16	23SGE816	Finance and Accounting	HS	3	3	0	0	3
17	23SEN217	Communication Skills Laboratory	HS	2	0	0	2	1

2. Basic Sciences (BS)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	23SMA101	Matrices and Calculus	BS	4	3	1	0	4
2	23SMA202	Graph Theory	BS	4	3	1	0	4
3	23SMA203	Computational Methods for Engineers	BS	4	3	1	0	4
4	23SMA204	Transforms and its Applications	BS	4	3	1	0	4
5	23SMA305	Discrete Mathematics and Stochastic Process	BS	4	3	1	0	4

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
6	23SMA306	Numerical Linear Algebra	BS	4	3	1	0	4
7	23SMA307	Numerical Methods	BS	4	3	1	0	4
8	23SMA408	Statistics and Optimization Techniques	BS	4	3	1	0	4
9	23SMA409	Probability and Statistics	BS	4	3	1	0	4
10	23SPH110	Engineering Physics	BS	5	3	0	2	4
11	23SPH111	Physics for Civil Engineers	BS	3	3	0	0	3
12	23SPH112	Physics for Mechanical Sciences	BS	3	3	0	0	3
13	23SPH113	Physics for Electrical Sciences	BS	3	3	0	0	3
14	23SPH214	Physics for Computing Sciences	BS	3	3	0	0	3
15	23SCH115	Environmental Science for Engineers	BS	3	3	0	0	3
16	23SCH116	Chemistry for Computing Sciences	BS	3	3	0	0	3
17	23SCH217	Chemistry for Electrical Sciences	BS	3	3	0	0	3
18	23SCH218	Chemistry for Mechanical Sciences	BS	3	3	0	0	3
19	23SCH219	Chemistry for Civil Engineers	BS	3	3	0	0	3
20	23SMA423	Probability and Random Process	BS	4	3	1	0	4
21	23SPH124	Physics for Computing Engineers	BS	5	3	0	2	4
22	23SPH125	Semiconductor Physics	BS	5	3	0	2	4
23	23SPH226	Physics for Mechanical Engineers	BS	3	3	0	0	3
24	23SCH127	Environmental Chemistry	BS	5	3	0	2	4
25	23SCH128	Environmental Studies	BS	3	3	0	0	3
26	23SCH229	Engineering Chemistry	BS	5	3	0	2	4
27	23SPH120	Engineering Physics Laboratory	BS	2	0	0	2	1
28	23SCH121	Chemistry Laboratory	BS	2	0	0	2	1
29	23SPH122	Physical Sciences Laboratory	BS	2	0	0	2	1

3. Engineering Sciences (ES)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction			C
					L	T	P	
1	23ADR101	Object Oriented Programming	ES	3	3	0	0	3
2	23CSR101	Computer Fundamentals and	ES	4	3	1	0	4

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
3	23CSR102	C Programming	ES	3	3	0	0	3
4	23ITR201	Fundamentals of Web Design	ES	3	3	0	0	3
5	23CSR203	Data Structures and Algorithms	ES	3	3	0	0	3
6	23ADR104	Object Oriented Programming using Python Laboratory	ES	2	0	0	2	1
7	23CSR104	C Programming Laboratory	ES	2	0	0	2	1
8	23ITR203	Web Design Laboratory	ES	2	0	0	2	1
9	23CSR205	Data Structures and Algorithms Laboratory	ES	2	0	0	2	1
10	23CSR103	Programming in C	ES	5	3	0	2	4
11	23ECR101	Digital Logic Circuits	ES	5	3	0	2	4
12	23ITR202	Web Technology	ES	5	3	0	2	4
13	23CSR305	Computer Architecture	ES	3	3	0	0	3
14	23CSR306	Java Programming	ES	5	3	0	2	4

4. Professional Core (PC)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	23ADR103	Python Programming	PC	5	3	0	2	4
2	23CSR201	Data Structures	PC	5	3	0	2	4
3	23ADR304	Artificial Intelligence	PC	5	3	0	2	4
4	23CSR302	Database Management Systems	PC	5	3	0	2	4
5	23CSR304	Design and Analysis of Algorithms	PC	5	3	0	2	4
6	23ITR301	Operating Systems	PC	5	3	0	2	4
7	23CSR405	Advanced Algorithms	PC	5	3	0	2	4
8	23ADR405	Machine Learning Techniques	PC	5	3	0	2	4
9	23ITR402	Communication and Networks	PC	5	3	0	2	4
10	23ITR403	Web Application Development	PC	5	3	0	2	4
11	23ITR404	Low Code Application Development	PC	5	3	0	2	4

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
12	23CSR507	Theory of Computation	PC	3	3	0	0	3
13	23CTR501	Cloud Computing	PC	5	3	0	2	4
14	23ITR505	Data Analytics and Visualization	PC	5	3	0	2	4
15	23ITR606	Cryptography and Network Security	PC	4	3	1	0	4
16	23CDR607	Application System Design with UML	PC	5	3	0	2	4
17	23ITR708	Internet of Things	PC	3	3	0	0	3
18	23CSR510	Open Source Software Laboratory	PC	4	0	0	4	2

5. Professional Electives (PE)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
ARTIFICIAL INTELLIGENCE & DATA SCIENCE								
1	23CSP101	Cognitive Science	PE	4	2	0	2	3
2	23CSP102	Business Analytics	PE	4	2	0	2	3
3	23CSP103	Text and Speech Analysis	PE	4	2	0	2	3
4	23ADR506	Deep Learning	PE	5	3	0	2	4
5	23ADR508	Big Data Analytics	PE	5	3	0	2	4
6	23ADR609	Computer Vision	PE	5	3	0	2	4
NEXT – GEN COMPUTING								
1	23ITP201	Parallel and Distributed Computing	PE	4	2	0	2	3
2	23ITP202	Edge Computing	PE	4	2	0	2	3
3	23CDR502	Human Computer Interaction	PE	5	3	0	2	4
4	23ITP203	Quantum Computing	PE	4	2	0	2	3
5	23CDR607	Virtual Reality and Augmented Reality	PE	5	3	0	2	4
6	23CSR709	Multicore Architecture and Programming	PE	5	3	0	2	4
CYBER SECURITY								
1	23CYP303	Ethical Hacking	PE	4	2	0	2	3
2	23CYP403	Social Network Security	PE	4	2	0	2	3

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
3	23CYP304	Malware Analysis	PE	4	2	0	2	3
4	23CYP305	Engineering Secure Software Systems	PE	4	2	0	2	3
5	23CYP406	Modern Cryptography	PE	4	2	0	2	3
6	23CYR608	Digital and Mobile Forensics	PE	5	3	0	2	4
CLOUD COMPUTING								
S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	23CTP401	DevOps	PE	4	2	0	2	3
2	23CTP402	Virtualization	PE	4	2	0	2	3
3	23CYP402	Security and Privacy in Cloud	PE	4	2	0	2	3
4	23CTP403	Cloud Services Management	PE	4	2	0	2	3
5	23CTP404	Storage Technologies	PE	4	2	0	2	3
6	23CTP405	Software Defined Networks	PE	4	2	0	2	3
FULL STACK DEVELOPMENT								
1	23CSP501	Mern Stack Development	PE	4	2	0	2	3
2	23CYP302	Web Application Security	PE	4	2	0	2	3
3	23CSP502	Mobile Application Development	PE	4	2	0	2	3
4	23CSP503	C# and .Net Programming	PE	5	3	0	2	4
5	23CSP504	Software Testing and Automation	PE	4	2	0	2	3
6	23CDR605	UI/UX Design	PE	5	3	0	2	4
EMERGING TECHNOLOGIES								
1	23ADP601	Digital Marketing	PE	4	2	0	2	3
2	23CSP601	Game Theory	PE	4	2	0	2	3
3	23CTP601	Robotic Process Automation	PE	4	2	0	2	3
4	23CSP602	3D Printing and Design	PE	4	2	0	2	3
5	23ADP202	Generative AI	PE	4	2	0	2	3
6	23CYP404	Cryptocurrency and Blockchain Technologies	PE	4	2	0	2	3

6. Employability Enhancement Courses (EEC)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	23EXC201	Application Development - I	EEC	2	0	0	2	1
2	23EXC302	Application Development - II	EEC	2	0	0	2	1
3	23EXC403	Application Development - III	EEC	2	0	0	2	1
4	23EXC204	Life Skills - I	EEC	2	0	0	2	1
5	23EXC305	Life Skills - II	EEC	2	0	0	2	1
6	23EXC506	Life Skills - III	EEC	2	0	0	2	1
7	23EXC407	Internship – I	EEC	2	0	0	2	1
8	23EXC508	Internship - II	EEC	2	0	0	2	1
9	23EXC409	Mini Project - I	EEC	2	0	0	2	1
10	23EXC510	Mini Project - II	EEC	2	0	0	2	1
11	23EXC511	Design Thinking	EEC	1	1	0	0	1
12	23EXC712	Comprehension	EEC	-	-	-	-	-
13	23EXC713	Project Work Phase I	EEC	8	0	0	8	4
14	23EXC814	Project Work Phase II	EEC	16	0	0	16	8

7. Mandatory Courses (MC)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	23MXC301	Indian Constitution	MC	1	1	0	0	-
2	23MXC402	Essence of Indian Traditional Knowledge	MC	1	1	0	0	-

8. Open Electives (OE)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1	23ITO101	Fundamentals of Communication and IoT	OE	3	3	0	0	3
2	23ITO102	Introduction to Operating System	OE	3	3	0	0	3
3	23ITO103	Fundamentals of Data Storage Technologies	OE	3	3	0	0	3
4	23ITO104	Introduction to Open Source Technologies	OE	3	3	0	0	3

5	23ITO105	Fundamentals of Mobile Application Development	OE	3	3	0	0	3
6	23ITO106	Foundation of Blockchain Technology	OE	3	3	0	0	3
7	23ITO107	Fundamentals of Computer Networks	OE	3	3	0	0	3
8	23ITO108	Introduction to XML and Web services	OE	3	3	0	0	3

SEMESTER III**23SMA305 DISCRETE MATHEMATICS AND STOCHASTIC PROCESS**

(Common to all Branches)

L	T	P	C
3	1	0	4

PRE-REQUISITES: Graph Theory**OBJECTIVES:**

- To acquire the knowledge of number theory
- To understand the concept of mathematical logic
- To apply the knowledge of theoretical distributions, correlation and spectral densities

OUTCOMES:

Learners will be able to

- | | |
|--|-----------|
| CO1 : apply the concepts of divisibility, prime number, congruence and number theorem | K3 |
| CO2 : solve a given problem using propositional logic | K3 |
| CO3 : utilize the concept of Mathematical induction and Combinatorics | K3 |
| CO4 : make use of concept of moment generating function in probability distributions | K3 |
| CO5 : build power spectral density and Auto correlation function for a given Random process | K3 |

UNIT I NUMBER THEORY 9

Divisibility – Fundamental Properties – Euclidean algorithm – Euclid’s lemma – Fundamental theorem of arithmetic – Congruence – Fermat’s Little theorem (statement only) and the Chinese remainder theorem (statement only).

UNIT II PROPOSITIONAL CALCULUS 9

Propositional Calculus: Propositions – Logical connectives - compound propositions – conditional and biconditional propositions - Truth tables - Tautologies and contradictions – contrapositive – Logical equivalences and implications – Demorgan’s Laws – Normal forms – Principal conjunctive and disjunctive normal forms.

UNIT III COMBINATORICS 9

Mathematical Induction – Permutations and combinations - Recurrence Relation – Formation of Recurrence relation – Solution of recurrence relation by Generating Functions

UNIT IV THEORETICAL DISTRIBUTIONS 9

Concept of Probability – Conditional– Theorem of Total Probability – Baye’s theorem – One dimensional Random Variables – Discrete and Continuous Random variables – Probability distribution function – Probability density function - Mathematical Expectations – Moments –. Mean and Variance – Moment generating function of Binomial, Poisson and Normal distributions

UNIT V STOCHASTIC PROCESS 9

Classification of Random Process – Discrete and Continuous cases — Auto Correlation Functions – Properties – Stationary Random processes – WSS and SSS processes – Power spectral density – properties of power spectral density – Cross-power spectral density and properties – Auto-correlation function and power spectral density of a WSS random sequence

TOTAL: 30 + 15**TEXT BOOKS:**

1. Kenneth H. Rosen and Dr. Kamala Krithivasan , “Discrete Mathematics and Applications”, 8th Edition, Tata Mcgraw Hill Education, 2021.

- Roy D Yates and David J Goodman, "Probability and Stochastic processes", 3rd Edition, Wiley India Pvt Ltd, 2021.

REFERENCE BOOKS:

- Kenneth H Rosen, "Discrete Mathematics and its Applications with Combinatorics and Graph Theory", 7th Revised Edition, Tata McGraw – Hill Pub Co Ltd, 2017.
- Randolph Nelson, "A Brief Journey in Discrete Mathematics", Springer Nature Switzerland AG; 1st Edition, 2020.
- Oscar Levin, "Discrete Mathematics: An Open introduction", 3rd Edition, Create space Independent Pub, 2019.

WEB URLS:

- www.geeksforgeeks.org/proposition-logic/
- www.classcentral.com/subject/number-theory
- www.mathworld.wolfram.com

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	1	-	-	-	-	-	-	-	-	-
CO2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	1	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO	2	1.6	-	-	1	-	-	-	-	-	-	-	-	-

23SMA306 NUMERICAL LINEAR ALGEBRA
(Common to all Branches)

L	T	P	C
3	1	0	4

PRE-REQUISITES: Nil**OBJECTIVES:**

- To acquire the knowledge of solution of algebraic and transcendental equations
- To understand the concepts of algebraic structures
- To apply the knowledge of least square approximation for a given situation

OUTCOMES:

Learners will be able to

CO1 :	solve algebraic equations using direct and indirect methods	K3
CO2 :	make use of the concepts of vector spaces, subspaces and its properties	K3
CO3 :	build the matrix representation of a linear transformation	K3
CO4 :	construct an orthonormal basis for a vector space	K3
CO5 :	utilize least square approximation, singular value decomposition and principal component analysis in vector spaces	K3

UNIT I NUMERICAL SOLUTION OF SYSTEM OF ALGEBRAIC EQUATION**9**

Solving system of equations – Direct methods: Gauss Elimination and Gauss Jordan Methods — Inverse of Matrix by Gauss Jordan method – LU Factorizations – Iterative method: Gauss Seidel method – Power method for finding Eigen values.

UNIT II VECTOR SPACES

9

Algebraic Structures – Binary Operation – Semi Group, Monoid and Group – Subgroups – Rings and Fields (Concept only) – Vector Spaces – Subspaces – Linear Span – Linear Independence and dependence of vectors - Basis and Dimension.

UNIT III LINEAR TRANSFORMATION

9

Linear transformation – Properties of linear transformation – Null space and nullity of a matrix – Rank-Nullity theorem – Range space – Dimension theorem – Matrix representation of linear transformation.

UNIT IV INNER PRODUCT SPACE

9

Inner Products and Norms – Inner Product Spaces – Cauchy-Schwartz inequality – Orthogonal Projection – Projection Theorem - Orthogonal Vectors – Gram- Schmidt Orthogonalization Process – Orthogonal Complement.

UNIT V POSITIVE DEFINITE MATRICES

9

Least Square Approximations – Tests for positive definite, semi definite and indefinite matrices – Positive Definite Matrices – Singular value Decomposition (SVD) – Principal Component Analysis (PCA).

TOTAL: 45 + 15

TEXT BOOKS:

1. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, “Linear Algebra”, Pearson Education, 5th Edition, 2018.
2. Gilbert Strang, “Linear Algebra and Learning from Data”, Cambridge University Press, 1st Edition, 2019.

REFERENCE BOOKS:

1. Kenneth Hoffman and Ray Kunze, “Linear Algebra”, Pearson In, 2nd Edition, 2018.
2. Williams G, “Linear Algebra with Applications”, Jones & Bartlett Learning, 1st Edition, 2019.
3. Sheldon Axler, “Linear Algebra Done Right”, Springer Cham, 3rd Edition, 2015.

WEB URLS:

1. www.classcentral.com/course/swayam-numerical-linear-algebra-9904
2. www.coursera.org/learn/pca-machine-learning
3. www.udemy.com/course/linear-algebra-theory-and-implementation/

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	1	-	-	-	-	-	-	-	-	-
CO2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	1	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	1	-	-	-	-	-	-	-	-	-
CO	2	1.4	-	-	1	-	-	-	-	-	-	-	-	-

23SMA307 NUMERICAL METHODS

(Common to all Branches)

L	T	P	C
3	1	0	4

PRE-REQUISITES: Computational Methods for Engineers, Transforms and its applications**OBJECTIVES:**

- To acquire the basic concepts of solving algebraic and transcendental equations
- To understand the concept of numerical interpolation techniques
- To apply the knowledge of numerical differentiation and integration in solving ordinary differential equations and partial differential equations

OUTCOMES:

Learners will be able to

- CO1:** identify the solution of system of linear equations by iterative methods **K3**
- CO2:** make use of interpolation methods for finding the missing terms **K3**
- CO3:** apply suitable methods of finding differentiation and integration numerically **K3**
- CO4:** solve ordinary differential equations numerically **K3**
- CO5:** utilize implicit and explicit methods in heat and wave equations **K3**

UNIT I SOLUTION OF EQUATIONS**9**

Regula Falsi Method - Newton Raphson method for solving algebraic and transcendental equations -Solution of system of linear equations - Gauss elimination method - Gauss Jordan method -Gauss Seidel method.

UNIT II INTERPOLATION**9**

Interpolations with unequal intervals-Lagrange's interpolation -Newton's divided interpolation - Interpolation with equal intervals-Newton's forward and backward interpolation.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION**9**

Approximation of derivatives using Newton's forward and backward interpolation - Numerical integration using Trapezoidal, Simpson's 1/3 and 3/8 rule

UNIT IV NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS**9**

Single step method- Euler's method-Taylor's series method - Fourth order Runge – Kutta method –Multi step method-Milne's predictor corrector method

UNIT V NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS**9**

Solutions of one-dimensional heat equation by Bender-Schmidt and Crank Nicholson methods – Numerical solutions of one-dimensional wave equation by explicit method

TOTAL: 45+15**TEXT BOOKS:**

1. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers", 8th Edition, Tata McGraw Hill, 2021.
2. Curtis P Gerald and Patrick O. Wheatley, Applied Numerical Analysis, Addison Wesley, 13th Edition, 2004.

REFERENCE BOOKS:

1. Richard L. Burden and J. Douglas Faires, "Numerical Methods", 4th Edition, Brooks/Cole, 2012.
2. Boyce, Di Prima and Meade, "Elementary Differential Equations and Boundary Value Problems", 12th Edition, John Wiley & Sons, 2021.
3. Steven Chapra, "Applied Numerical Methods with MATLAB", 5th Edition, Mcgraw-Hill Education, 2022.

WEB URLs:

1. www.classcentral.com/course/numerical-methods-engineers-32822
2. www.infocobuild.com/education/audio-video-courses/mathematics/numerical-analysis-iitmadras.html
3. www.infocobuild.com/education/audio-video-courses/mathematics/NumericalMethodsFiniteDifference-IIT-Roorkee/lecture-06.html

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	1	-	-	-	-	-	-	-	-	-
CO2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	1	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO	2	1.6	-	-	1	-	-	-	-	-	-	-	-	-

23CSR305 COMPUTER ARCHITECTURE

(Common to CS/CT/CY/IT)

L	T	P	C
3	0	0	3

PREREQUISITES: Computer Fundamentals and Communication**OBJECTIVES:**

- To acquire the knowledge in familiarity with fundamentals of computer system
- To understand the concepts of RISC, CISC instructions and pipelining
- To apply the binary arithmetic operations and memory management systems

OUTCOMES:

Learners will be able to

CO1:	infer the instruction sets and memory operations to understand their fundamentals	K2
CO2:	interpret the basic organization, design, and specification of computer operations	K2
CO3:	solve the design issues related to clock periods, performance, and instruction throughput for processors to optimize the processing efficiency	K3
CO4:	develop an arithmetic processing unit with pipelining and memory management to enhance computational capabilities and system performance.	K3
CO5:	make use of memory hierarchy design and performance improvement techniques for sophisticated computer architecture.	K3

UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM**9**

Functional units – Basic operational concepts – Number representation and arithmetic and operations – Character representation – Performance – Historical perspective – The assembly process – Linker – Compiler – Debugger – Operating System.

UNIT II ARITHMETIC FOR COMPUTERS**9**

Addition and subtraction of signed numbers – Design of fast adders – Multiplication of unsigned numbers – Multiplication of signed numbers – Fast Multiplication – Integer division – Floating point numbers and operations.

UNIT III BASIC PROCESSING UNIT AND PIPELINING**9**

Basic Processing units – Fundamentals concepts – Instruction execution – Hardware components – Instruction fetch and execution steps – Control Signals – Hardware Control – CISC instruction sets – RISC and CISC styles – processors – Basic concepts of Pipelining – Pipeline Organization – Pipelining issues – Data Dependencies – Pipelining in CISC Processor.

UNIT IV MEMORY AND I/O

9

Memory locations and addresses – Memory operations – Instruction and instruction sequencing – Addressing modes – Assembly language – Stacks-Subroutines – Additional instructions – Dealing with 32-Bit immediate values –Memory System – Basic concepts – Semiconductor Ram memories – Direct memory access – Memory hierarchy –Cache memories –Virtual Memory – Memory Management requirements – Secondary storage.

UNIT V ADVANCED COMPUTER ARCHITECTURE

9

RAID architecture – Storage systems – Parallel processing – Hardware multithreading – Vector (SIMD) processing –Shared-Memory multiprocessors – Cache coherence– Message-passing multicomputer – Introduction to Graphics Processing Units – Clusters and Warehouse scale computers – Introduction to Multiprocessor network topologies.

TOTAL: 45

TEXT BOOKS:

1. Jim Ledin, “Modern Computer Architecture and Organization - Learn x86, ARM, and RISC-Architectures and the design of smartphones, PCs, and cloud servers”, 2nd Edition, Kindle, 2022.
2. Smruti R Sarangi, “Advanced Computer Architecture”, 1st Edition, McGraw Hill Education, 2021.

REFERENCE BOOKS:

1. David A Patterson and John L Hennessy, “Computer Organization and Design: The Hardware Software Interface, 6th Edition, Morgan Kaufmann Publishers In, 2020.
2. John Aravindhar D, Veena S and Mohandas R, “Computer Architecture and Organization”, 1st Edition, Notion Press, 2022.

WEB URLS:

1. https://www.csie.nuk.edu.tw/~kcf/course/96_Spring/Architecture/Arch Chapter I.pdf
2. <https://www.phy.ornl.gov/csep/ca/node2.html>
3. <https://www.nptel.ac.in/courses/106103068/5>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	2	-	1
CO2	2	2	1	1	-	-	-	-	-	-	-	2	-	2
CO3	3	2	1	-	-	-	-	-	-	-	-	2	2	2
CO4	3	2	2	2	-	-	-	-	-	-	-	2	1	1
CO5	2	2	2	2	-	-	-	-	-	-	-	2	-	2
CO	2.4	2	1.4	1.5	-	-	-	-	-	-	-	2	1.5	1.6

23CSR306 JAVA PROGRAMMING
(Common to AD/CD/CS/CT/CY/EC/EE/ET/IT)

L	T	P	C
3	0	2	4

PREREQUISITES: C Programming

OBJECTIVES:

- To acquire the knowledge of the fundamental concepts of Java programming
- To understand the knowledge of inheritance, abstraction, exception and package in Java
- To apply Java Collection API, Multithreading, JDBC and Lambda expression for application development

OUTCOMES:

Learners will be able to

- | | |
|--|-----------|
| CO1: infer the fundamental concepts, architecture, and features of Java Programming | K2 |
| CO2: solve programming challenges using object-oriented paradigms | K3 |
| CO3: build applications using multi-tasking mechanisms, and exception handling strategies | K3 |
| CO4: construct robust and efficient Java applications using JDBC, lambda expressions and Interface | K3 |
| CO5: develop Java applications by amalgamating object-oriented design, collection usage and advanced data manipulation. | K3 |

UNIT I INTRODUCTION TO JAVA 9

History of Java – Features of Java – Java Architecture – Comments – Data Types – Variables – Operators – Type Conversion and Casting – Flow Control Statements – Reading Input from keyboard – Command Line Arguments – Using Scanner Class – Arrays – Classes and Objects – UML Class diagram – Methods – Constructors – static variables and Methods – this Keyword – Encapsulation – Concept of Access Control.

UNIT II INHERITANCE 9

Inheritance – Types of Inheritance – Super and Sub Classes – super keyword – final class and methods – Object class – Polymorphism – Types of polymorphism – Method Overloading – Constructor Overloading – Method Overriding – Dynamic Method Dispatching – garbage collection – String class –String Buffer class –String Builder class.

UNIT III DATA ABSTRACTION 9

Packages – Introduction to Packages – User Defined Packages – Accessing Packages – Abstract classes and Methods – Interface – Defining an interface – implementing interfaces – extending interfaces – Multiple Inheritance Using Interface – Exception Handling – Errors vs Exceptions – Exception hierarchy – usage of try – catch – throw – throws and finally – built in exceptions – user defined exceptions.

UNIT IV COLLECTION API AND LAMBDA 9

Introduction to wrapper classes – Predefined wrapper classes – Conversion of types – Concept of Auto boxing and unboxing – Java Collections API – Introduction to Collection – Generics – List implementations – Set implementations – Map implementations – Functional Interfaces – Lambda Expressions – Accessing local variables – Accessing class variables – Predicates – Functions – Suppliers – Consumers – Stream API – Filter – Sorted – Map – Reduce – Count – Parallel Streams.

UNIT V JDBC AND MULTITHREADING 9

JDBC – Introduction to JDBC – Establishing connection – Executing query – Processing results – Prepared Statement – Callable Statement – Transactions – Meta Data objects – Multithreading: Introduction to

Multithreading – Process Vs Thread – Thread life cycle – Thread class – Runnable Interface – Thread creation – Thread control and priorities – Thread synchronization.

TOTAL: 45

LIST OF EXPERIMENTS:

1. Develop programs using flow control statements and arrays to manage execution flow and data organization effectively.
2. Implement programs using inheritance and polymorphism to promote code reusability and dynamic method binding.
3. Develop programs incorporating packages, abstract classes, and interfaces to structure code modularly and enforce abstraction.
4. Implement programs using exception handling mechanisms to ensure robust error detection and graceful recovery.
5. Create programs using the Collection API to manage groups of objects with flexibility and high performance.
6. Implement programs using JDBC to establish and manage database connections for data persistence and retrieval.
7. Develop programs using multithreading to achieve concurrent execution and improve application performance.

TOTAL: 30

TEXT BOOKS:

1. Herbert Scheldt, "Java: The Complete Reference", 12th Edition, Tata McGraw-Hill, 2022.
2. Cay S Horstmann and Gary Cornell, "Core Java: Volume I – Fundamentals", 12th Edition, Prentice Hall, 2021.

REFERENCE BOOKS:

1. David Flanagan and Benjamin Evans, "Java in Nutshell", 8th Edition, O'Reilly Media, 2022.
2. Kathy Sierra, Bert Bates, Trisha Gee, "Head First Java ", 3rd Edition, O'Reilly Media, Inc, 2022.
3. Joshua Bloch, "Effective Java", 3rd Edition, Addison-Wesley Professional, 2018.

WEB URLS:

1. [www.https://docs.oracle.com/javase/tutorial/java/nutsandbolts](https://docs.oracle.com/javase/tutorial/java/nutsandbolts)
2. [www.https://javabeginner.com/learn-java](https://javabeginner.com/learn-java)
3. [www.https://dev.java/learn](https://dev.java/learn)

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	2	1	-	1	2	2
CO2	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO3	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO4	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO5	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO	2.8	1.8	1	-	2	-	-	-	2	1	-	1	2	2

23CSR302 DATABASE MANAGEMENT SYSTEM

(Common to AD/CD/CS/CT/CY/EC/EE/ET/IT)

L	T	P	C
3	0	2	4

PREREQUISITES: Nil**OBJECTIVES:**

- To acquire the knowledge in data models, conceptualize and design a database system using E-R diagrams
- To understand the design principles of a relational database system, SQL and Indexing
- To apply knowledge in transaction processing, concurrency control and recovery techniques

OUTCOMES:

Learners will be able to

- CO1:** illustrate the fundamental principles of database management systems and sketch an ER model for a real-world context **K2**
- CO2:** construct queries in SQL or Relational algebra, relational calculus for providing query based solutions **K3**
- CO3:** design databases with designed structures and enforce normalization principles in relational databases to eliminate anomalies **K3**
- CO4:** build database storage and access techniques for file organization, indexing methods and query processing **K3**
- CO5:** interpret the basic issues of transaction processing, concurrency control, deadlock and its recovery schemes and security schemes **K3**

UNIT I INTRODUCTION 9

Introduction: Database Architecture – Database design and ER model: Overview of the design process–The ER Model – Constraints – Removing redundant attributes in Entity Sets–ER Diagram – Reduction to Relational Schemas – ER Design Issues. Introduction to Relational Model – Formal Relational Query Languages: Relational Algebra, Relational Calculus: Tuple and Domain Relational Calculus.

UNIT II DATABASE DESIGN & NORMAL FORMS 9

Introduction to SQL: DDL, DML, TCL, DCL– Basic structure of SQL Queries – Set operations – Aggregate functions Nested subqueries – Intermediate SQL: Joins–Views – Integrity Constraints – Functional dependencies – Normal forms based on primary keys – General Definition of Second and Third Normal Form – Boyce Codd Normal Form – Multi valued dependencies and Fourth Normal Form.

UNIT III DATA STORAGE AND INDEXING 9

Data Storage & Indexing: File Organizations Organization of Records in Files Indexing Structures Primary & Secondary Indexes Tree – structured Indexes – Multidimensional Indexes –Hashing – Static hashing – Dynamic hashing – Query Processing and Optimization: Heuristic optimization – Cost based optimization.

UNIT IV TRANSACTION AND RECOVERY 9

Transactions: Transaction concept –Transaction Atomicity and Durability – Transaction Isolation – Serializability –Transaction Isolation and Atomicity– Transaction Isolation levels –Implementation of Isolation Levels –Concurrency Control: Lock based protocols – Deadlock handling –Timestamp based protocols – Recovery system: Failure classification – Storage - Recovery and atomicity.

UNIT V DATABASE SECURITY AND RECENT DBMS 9

Database Security: Common Threats and Challenges – Access Control – DAC, MAC and RBAC models – Intrusion Detection – SQL Injection – Recent DBMS: In-memory databases – Graph database – Open-source DBMS– Databases as a service.

TOTAL: 45

LIST OF EXPERIMENTS

1. Design E-R Diagram for the relational database.
2. Write a SQL Queries to implement Data Definition Language commands.
3. Write a SQL Queries to implement Data Manipulation Language (DML).
4. Write a SQL Queries to implement Data Control Language (DCL) and TCL commands.
5. Implement Nested Queries and Joins.
6. Querying using Aggregate Functions (COUNT, SUM, AVG, MAX and MIN)
7. Create and manage views and integrity constraints.

TOTAL: 30

TEXT BOOKS:

1. Silberschatz A, Korth H F and Sudarshan S, “Database System Concepts”, 6th Edition, Tata Mc-Graw Hill, 2022.
2. Date C J, “Database Design and Relational Theory”, 2nd Edition, A press Berkeley, CA, 2019.

REFERENCE BOOKS:

1. Ramakrishna R. & Gehrke J, “Database Management Systems”, 3rd Edition, Mc-Graw Hill, 2022.
2. Ramez Elmasri and Shamkant B Navathe, “Fundamental Database Systems”, 7th Edition, Pearson Education, 2021.
3. Robinson, I, Webber, J, & Eifrem E, “Graph Databases”, 3rd Edition, O’Reilly, 2019.

WEB URLS:

1. www.geeksforgeeks.org/dbms/
2. www.guru99.com/dbms-tutorial.html
3. www.javatpoint.com/dbms-tutorial

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	1	-	-	-	-	-	-	-	1	1
CO2	3	2	1	-	1	-	-	-	-	-	-	-	2	1
CO3	3	2	-	-	-	-	-	-	-	-	-	1	2	1
CO4	3	2	-	-	-	-	-	-	-	-	-	1	1	1
CO5	3	2	2	-	-	-	-	-	-	-	-	1	1	1
CO	3	2	1.3	-	1	-	-	-	-	-	-	1	1.4	1

23CSR201 DATA STRUCTURES (Common to AD/CD/CS/CT/CY/EC/EE/ET/IT)

L	T	P	C
3	0	2	4

PRE-REQUISITES: Programming in C

OBJECTIVES:

- To acquire the knowledge of fundamental data structures and algorithms

- To understand efficient data structures and algorithms for solving problems
- To apply the appropriate data structure and algorithm design method for a specified application

OUTCOMES:

Learners should be able to

CO1: interpret the concepts of linear and non-linear data structures	K2
CO2: identify appropriate data structure for solving problems	K3
CO3: implement linear and non-linear data structure operations for efficient storage and retrieval	K3
CO4: develop the application using suitable data structures	K3
CO5: compare the efficiency of algorithms to explore the performance	K3

UNIT I LISTS 9

Abstract Data Types (ADTs) – Elementary Data types – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Doubly-linked lists – Circularly linked lists –Applications of lists – Polynomial ADT – Multilists – Sparse Matrices.

UNIT II STACKS AND QUEUES 9

Stack ADT – Operations – Applications – Balancing symbols – Evaluating arithmetic expressions – Infix to Postfix conversion – Function calls – Queue ADT – Operations – Circular queue – Deque – Applications of queues.

UNIT III TREES 9

Tree ADT – Tree traversals – Binary tree ADT – Expression trees – Binary search tree ADT– AVL Trees – Red-Black trees – Priority queue (Heaps) – Binary heap.

UNIT IV MULTIWAY SEARCH TREES AND GRAPHS 9

B-Tree – B+ Tree – Tries – Graph definition – Representation of graphs – Types of graphs – Breadth-first traversal – Depth-first traversal – Bi-connectivity – Euler circuits – Topological sort – Dijkstra's algorithm – Minimum spanning tree – Prim's algorithm – Kruskal's algorithm

UNIT V	SEARCHING, SORTING AND HASHING TECHNIQUES	9
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Searching – Linear search – Binary search – Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Quick sort – Merge sort – Heap sort – Radix sort – Hashing – Hash functions – Separate chaining – Open addressing – Rehashing – Extendible hashing.

TOTAL: 45

LIST OF EXPERIMENTS

1. Implement array implementation of Stack, Queue, and Circular Queue ADTs.
2. Implement a singly linked list and its operation.
3. Implement stack and linear queue ADTs using linked list.
4. Implement the evaluation of postfix expressions and infix to postfix conversion.
5. Develop the code to implement binary search trees and AVL Trees.
6. Implement insertion sort, merge sort and quick sort.
7. Implement open addressing collision resolution technique.

TOTAL: 30

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition (Fortieth Impression), Pearson Education, 2014.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 4th Edition, MIT Press, 2022.

REFERENCE BOOKS:

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy", 5th Edition, Career monk Publications, 2023.
2. Langsam, Augenstein and Tanenbaum, "Data Structures Using C and C++", 2nd Edition, Pearson Education, 2020.
3. Jan Wengrow, "A Common-Sense Guide to Data Structures and Algorithm", 2nd Edition, O'Reilly Publications, 2020.
4. Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB publications, 2022.

WEB URLS:

1. [www.https://nptel.ac.in/courses/106106145](https://nptel.ac.in/courses/106106145)
2. [www.https://coursera.org/learn/data-structures](https://coursera.org/learn/data-structures)
3. [www.https://cs.usfca.edu/~galles/visualization/Algorithms.html](https://cs.usfca.edu/~galles/visualization/Algorithms.html)

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	-	-	1	1	-	-	1	2
CO2	2	2	2	1	1	-	-	-	1	1	-	-	1	2
CO3	2	2	2	2	1	-	-	-	1	1	-	1	1	2
CO4	3	2	2	2	1	-	-	-	1	1	-	1	1	2
CO5	3	3	3	2	1	-	-	-	1	1	-	1	2	2
CO	2.4	2.2	2	1.6	1	-	-	-	1	1	-	0.6	1.2	2

23CSR304**DESIGN AND ANALYSIS OF ALGORITHMS**

(Common to AD/CD/CS/CT/CY/EC/EE/ET/IT)

L	T	P	C
3	0	2	4

PREREQUISITES: Data Structures**OBJECTIVES:**

- To acquire the knowledge on various algorithm analysis techniques.
- To understand the design techniques and time efficiency of various algorithms.
- To apply various problem solving techniques and solve computational problems.

OUTCOMES:

Learners will be able to

CO1:	explain the fundamentals of algorithm design and asymptotic notations.	K2
CO2:	implement time-efficient solutions using problem solving techniques.	K3
CO3:	construct optimal solutions for real-world problems by exploring the time complexity.	K3
CO4:	develop solutions for constraint satisfaction and optimization problems.	K3
CO5:	categorize the performance of various advanced computational techniques.	K4

UNIT I INTRODUCTION**9**

Algorithm analysis: Time and space complexity – Asymptotic Notations and its properties – Best case – Worst case and average case analysis – Mathematical analysis of non-recursive and recursive algorithms – Recurrence relation: substitution method – Masters theorem Sorting – Analysis of Insertion sort and heap sort.

UNIT II BRUTE FORCE APPROACH AND DIVIDE AND CONQUER 9

Searching: linear search – binary search – interpolation Search – Pattern search: The naive string-matching algorithm – Rabin – Karp algorithm – Knuth–Morris – Pratt algorithm. Divide and Conquer methodology: Finding maximum and minimum – Merge sort – Quick sort – Strassen matrix multiplication.

UNIT III GREEDY AND DYNAMIC PROGRAMMING 9

Greedy Technique: Activity-selection problem – Fractional knapsack problem – Huffman Trees – Minimum spanning tree: Kruskal's and Prim's algorithm – Shortest path – Dijkstra's algorithm – Dynamic programming: Longest common subsequence – Matrix-chain multiplication – All pair shortest path – Floyd's algorithm – Optimal Binary Search Trees.

UNIT IV STATE SPACE SEARCH ALGORITHMS 9

Backtracking: n – Queens problem – Hamiltonian Circuit Problem – Subset Sum Problem – Graph colouring problem Branch and Bound: Solving 15-Puzzle problem – Assignment problem – Knapsack Problem – Travelling Salesman Problem.

UNIT V NP-COMPLETE AND APPROXIMATION ALGORITHM 9

Tractable and intractable problems: Polynomial time algorithms – Venn diagram representation – NP algorithms – NP-hardness – NP-completeness – Bin Packing problem – Problem reduction: TSP – 3CNF problem – Approximation Algorithms: TSP – Randomized Algorithms: concept and application – primarily testing – randomized quick sort – Finding k^{th} smallest number.

TOTAL: 45

LIST OF EXPERIMENTS

1. Analyze Linear Search and Binary Search algorithms with Complexity Analysis
2. Create implementations of Pattern Matching algorithms
3. Develop Dijkstra's algorithm for shortest path
4. Implement dynamic programming solution to find the length of longest common subsequence
5. Create N Queens problem solution using Backtracking
6. Implement backtracking solution for Subset Sum Problem
7. Develop solution for Traveling Salesperson problem

TOTAL: 30

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 4th Edition, Mcgraw Hill/ MIT Press, 2022.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2019.

REFERENCE BOOKS:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Computer Algorithms /C++", 2nd Edition, Orient Blackswan, 2019.
2. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy: Data Structures and Algorithmic puzzles", 1st Edition, Career Monk Publications, 2023.
3. S. Sridhar, "Design and Analysis of Algorithms", 2nd Edition, Oxford university Press, 2023.

WEB URLS:

1. [www.https://nptel.ac.in/courses/106106131](https://nptel.ac.in/courses/106106131)
2. [www.https://geeksforgeeks.org/dynamic-programming-vs-divide-and-conquer/](https://geeksforgeeks.org/dynamic-programming-vs-divide-and-conquer/)
3. www.javatpoint.com/

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	-	-	2	1	-	-	1	1
CO2	3	2	2	1	1	-	-	-	2	1	-	-	2	2
CO3	3	3	3	2	2	-	-	-	2	1	-	1	2	2
CO4	3	3	3	2	2	-	-	-	2	1	-	1	2	2
CO5	3	3	3	2	2	-	-	-	2	1	-	1	2	2
CO	2.8	2.6	2.4	1.6	1.6	-	-	-	2	1	-	0.6	1.8	1.8

23ITR301 OPERATING SYSTEM

(Common to AD/CD/CS/CT/IT)

L	T	P	C
3	0	2	4

PRE-REQUISITES: Computer Architecture**OBJECTIVES:**

- To acquire the basic knowledge on operating system structures and functions
- To understand various approaches of memory, file, interrupt and process management
- To apply solutions for various problems related to system operations and managements

OUTCOMES:

Learners will be able to

- CO1:** interpret the functionality of the Operating Systems to monitor, access and control the hardware for the user applications **K2**
- CO2:** solve the conflict of resource access by processes using process synchronization and deadlock handling techniques **K3**
- CO3:** build scheduling algorithms to utilize the resources of the system efficiently **K3**
- CO4:** analyze the allocation and access strategy of memory for the processes to achieve high performance **K3**
- CO5:** apply Virtualization approach to achieve portability with appropriate File System **K3**

UNIT I BASICS OF OPERATING SYSTEMS AND PROCESS MANAGEMENT 9

Basics of operating systems: Generations – Types – Structure – Services - System Calls - System Boot - System Programs - Protection and Security - Process management: Process Concepts - Process States, Process Control Block –Operation on Process - Scheduling-Criteria - Scheduling Algorithms and their Evaluation – Threads - Threading Issues.

UNIT II PROCESS SYNCHRONIZATION AND DEADLOCK 9

Process synchronization: Background - Critical-Section Problem - Peterson's Solution - Synchronization Hardware – Semaphores - Classic Problems of Synchronization - Monitors. Deadlock: System Model - Deadlock Characterization - Deadlock Prevention - Detection and Avoidance - Recovery form Deadlock.

UNIT III MEMORY MANAGEMENT 9

Main Memory - Swapping - Contiguous Memory Allocation - Paging - Structure of Page Table - Segmentation - Virtual Memory - Demand Paging - Page Replacement Algorithms - Allocation of Frames - Thrashing.

UNIT IV STORAGE MANAGEMENT AND SYSTEM PROTECTION 9

Disk structure and attachment – Disk scheduling algorithms (seek time, rotational latency based)- System threats and security – Policy vs mechanism - Access vs authentication - System protection: Access matrix – Access Control - Capability based systems - OS: performance, scaling, future directions in mobile OS.

UNIT V VIRTUALIZATION AND FILE SYSTEM MANAGEMENT 9

Virtual Machines - Virtualization (Hardware/Software, Server, Service, Network - Hypervisors - Container virtualization - Cost of virtualization - File system interface (access methods, directory structures) - File system implementation (directory implementation, file allocation methods) - File system recovery - Journaling - Soft updates - Log-structured file system - Distributed file system.

TOTAL: 45**LIST OF EXPERIMENTS**

1. Practice UNIX and Shell commands, develop shell scripts and simulate a shell
2. Implement any two CPU scheduling algorithms, simulate and record the process state using SOsim
 - a. FCFS
 - b. SJF
 - c. Priority
 - d. Round Robin
3. Implement Bankers Algorithm for Dead Lock Avoidance
4. Implement Semaphore for Producer Consumer Problem
5. Implement any two of the following page replacement algorithms
 - a. FIFO
 - b. LRU
 - c. LFU
6. Implement any two of the following file organization Techniques
 - a. Single level directory structure
 - b. Two level directory structure
 - c. Tree structure
 - d. Acyclic graph structure
7. Implement a few Disks Scheduling Algorithms

TOTAL: 30**TEXT BOOKS:**

1. William Stallings, “Operating Systems: Internals and Design Principles”, 10th Edition, Pearson Education, 2021.
2. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, “Operating System Concepts”, 10th Edition, Wiley, 2021.

REFERENCE BOOKS:

1. Charles Crowley, “Operating Systems: A Design-Oriented Approach”, 1st Edition, CRC Press, 2020.
2. Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau, “Operating Systems: Three Easy Pieces”, 2nd Edition, Arpaci-Dusseau Books, 2018.
3. Andrew S. Tanenbaum, Herbert Bos, “Modern Operating Systems”, 5th Edition, Pearson Education, 2022.

WEB URLS:

1. <https://www.coursera.org/courses?query=operating%20system>
2. https://www.tutorialspoint.com/operating_system/index.htm
3. <https://www.edu.gcfglobal.org/en/computerbasics/understanding-operating-systems/1/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO4	2	1	-	1	-	-	-	-	-	1	-	1	1	-
CO5	1	1	1	-	1	-	-	-	-	1	-	1	-	1
CO	2.0	1.4	1	1	1	-	-	-	-	2.0	-	2.0	1.5	1

23EXC204 LIFE SKILLS - I

(Common to all branches)

L	T	P	C
0	0	2	1

OBJECTIVES:

- To acquire the knowledge on Quantitative aptitude
- To understand the importance of Quantitative aptitude
- To apply the concept of Quants to solve real world problems

OUTCOMES:

Learners should be able to

- CO1:** explain fundamental concepts of quantitative aptitude and their applications in solving numerical problems. **K2**
- CO2:** utilize numerical techniques and ratios to solve real-world problems involving proportional relationships. **K3**
- CO3:** implement mathematical operations and methods to address practical challenges in areas like interest calculations, profit and loss, and time and work. **K3**
- CO4:** examine and evaluate mathematical models used in solving complex problems such as probability, permutations, and combinations, highlighting their limitations. **K4**
- CO5:** investigate data sets to assess probabilities and make logical conclusions based on quantitative information. **K4**

TOPICS:

Number Systems, Problems on Numbers, Simplification, Average, Ratio and Proportion, Problems on Ages, Percentage, Profit and Loss, Logarithms, Mixture and Allegation, Interest Calculation, Time, Speed Distance, Problems on Trains, Boats and Streams, Time and Work, Pipes and Cisterns, Permutation and Combination, Probability, Data Interpretation, Mensuration 2D, Mensuration 3D, Cryptarithmic Series

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	1	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	1	1	-	-
CO	2.8	1.8	-	-	-	-	-	-	-	-	1.0	0.2		

23MXC301 INDIAN CONSTITUTION

(Common to all branches)

L	T	P	C
1	0	0	-

PRE-REQUISITES: Nil**OBJECTIVES:**

- To acquire the knowledge about the constitutional amendments and the rights of women and children in Indian Society
- To understand the historical context behind the creation of India's constitution
- To impart the powers and functions of the union government and the state governments in India, and how they interact and cooperate with each other

OUTCOMES:

Learners will be able to

- CO1:** recall the historical and philosophical foundations of the Indian Constitution and its key features **K1**
- CO2:** understand the structure and functions of the three branches of government and the role of the judiciary in constitutional interpretation and review **K1**
- CO3:** identify the structure and functions of the Union and State government **K1**
- CO4:** recognize the federal system and the center-state relations in India with other countries **K1**
- CO5:** explain the constitutional amendments and reforms that have shaped the Indian polity and society **K2**

CONCEPT AND CONVENTIONS (Not for Examinations)

Origin and history of East India Company – Reservation system in India

UNIT I HISTORY AND INTRODUCTION TO CONSTITUTION OF INDIA 3

Historical Background – Constituent Assembly of India – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.

UNIT II POWERS AND FUNCTION OF UNION GOVERNMENT 3

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India.

UNIT III POWERS AND FUNCTIONS OF STATE GOVERNMENT 3

State Government – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT IV CONSTITUTIONAL AUTHORITIES, FUNCTIONS AND RESPONSIBILITIES 3

Indian Federal System – Center - State Relations – President's Rule – Constitutional Amendments – Assessment of working of the Parliamentary System in India – Political Parties.

UNIT V CONSTITUTIONAL PROVISIONS 3

Pressure Groups – Judicial Review – Indian Social Structure; Caste, Religion, Language in India – Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

TOTAL: 15**TEXT BOOKS:**

1. Durga Das Basu, "Introduction to the Constitution of India", 24th Edition, Lexis Nexis Publishers, 2019.
2. Agarwal R C, "Indian Political System", 1st Edition, S.Chand and Company, 2002.

REFERENCE BOOKS:

1. Sharma and Kishore and Brijji, "Introduction to the Constitution of India", 7th Edition, Prentice Hall of India, 2014.
2. Gahai U R, "Indian Political System", 1st Edition, New Academic Publishing House, 2011.

3. Sharma R N, “Indian Social Problems”, 1st Edition, Media Promoters and Publishers, 2009.

WEB URLS:

1. www.importantindia.com/2030/right-to-constitutional-remedies-indian-constitution/
2. www.lawteacher.net/free-law-essays/international-law/an-understanding-of-the-indian-legal-system-international-law-essay.php
3. www.blog.ipleaders.in/courts-justice-system-india/

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	3	-	-	-	-	-	-
CO2	-	-	-	-	-	2	2	2	-	-	-	-	-	-
CO3	-	-	-	-	-	2	2	2	-	-	-	-	-	-
CO4	-	-	-	-	-	2	2	2	-	-	-	-	-	-
CO5	-	-	-	-	-	2	2	2	-	-	-	-	-	-
CO	-	-	-	-	-	2.2	2.2	2.2	-	-	-	-	-	-

SEMESTER IV**23SMA408 STATISTICS AND OPTIMIZATION TECHNIQUES**

(Common to all Branches)

L	T	P	C
3	1	0	4

PRE-REQUISITES: Discrete Mathematics and Stochastic Process**OBJECTIVES:**

- To acquire the knowledge of statistical measures for a data
- To understand the concept of networking models and game theory
- To apply the knowledge of linear programming problem in transportation and assignment models

OUTCOMES:

Learners will be able to

CO1: utilize the concept of measures of central tendency and measures of dispersion	K3
CO2: identify suitable sampling test for a given data	K3
CO3: build feasible optimum solution for a given linear programming problem	K3
CO4: develop optimum solution for transportation and assignment problems	K3
CO5: solve the network models and problems in games	K3

UNIT I DESCRIPTIVE STATISTICS**9**

Measures of central tendency – Mean, median, mode, geometric mean and harmonic mean – Dispersions – Range, mean deviation, variance, standard deviation, coefficient of variation – Relative measures – Coefficient of correlation – Pearson’s correlation coefficient – Lines of regression.

UNIT II TESTING OF HYPOTHESIS**9**

Test of hypothesis – Large sample tests based on normal distribution – Test for single mean – Difference between means – Proportion – Difference between proportion – Small sample test – Student-t test – Test for single mean – Difference between means – Snedecor’s F test – Chi-square test for goodness of fit, independence of attributes.

UNIT III LINEAR PROGRAMMING PROBLEM**9**

Advantages and disadvantages of LP - Formulation of LP - Algebraic solution of a LP - Graphical method - The simplex method - Principle of duality - Dual and primal problems - Dual simplex method.

UNIT IV TRANSPORTATION AND ASSIGNMENT MODELS**9**

Initial basic feasible solution - North west corner rule, row-minima, column minima, matrix minima and Vogel's approximation methods - MODI method for finding optimum solution - Unbalanced transportation problems - Assignment Model - Initial basic feasible solution - Hungarian algorithm - Unbalanced Assignment Problem - Maximization in assignment problems.

UNIT V NETWORK MODELS AND GAME THEORY**9**

CPM & PERT techniques - Critical path method - PERT approach - Expected length of a project - Probability of project completion by due date - Game theory - Pay-off matrix - Pure strategies: Games with saddle point - The rules of dominance - mixed strategies: Games without saddle point - Solution of 2xn and mx2 games.

TOTAL: 45+15**TEXT BOOKS:**

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, "Introduction to Mathematical Statistics", 18th Edition, Pearson Education Limited, 2019.
2. Geoffrey, Grimmett and David Stirzaker, "Probability and Random Processes", 4th Edition, Oxford University Press, 2020.

REFERENCE BOOKS:

1. Gupta S. C, Kapoor V. K, "Fundamentals of Mathematical Statistics", 12th Edition, Sultan Chand & Sons, 2020.
2. Frederick S. Hillier, Gerald J. Lieberman, Bodhibrata Nag and Preetam Basu, "Introduction to Operations Research", 10th Edition, McGraw Hill Education, 2017.
3. Ronald L Rardin, "Optimization in Operations Research", 2nd Edition, Pearson, 2017.

WEB URLs:

1. www.classcentral.com/course/udacity-intro-to-descriptive-statistics-2309
2. www.classcentral.com/course/open-edatpsu-stat-506-sampling-theory-and-methods-116656
3. www.classcentral.com/course/swayam-operations-research-14219

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	1	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	1	-	-	-	-	-	-	-	-	-
CO	2	1.6	-	-	1	-	-	-	-	-	-	-	-	-

23SMA409 PROBABILITY AND STATISTICS
(Common to all Branches)

L	T	P	C
3	1	0	4

PRE-REQUISITES: Numerical Methods**OBJECTIVES:**

- To acquire the basic knowledge of probability, random variables and distributions

- To understand the concepts of statistical measures of a data
- To apply the knowledge of hypothesis testing using small and large samples

OUTCOMES:

Learners will be able to

CO1:	identify concepts of probability and random variables	K3
CO2:	make use of concepts of moment generating function in probability distribution	K3
CO3:	apply the measures of central tendency and measures of dispersion for a statistical data	K3
CO4:	utilize the concept of correlation and regression to interpret the data	K3
CO5:	construct small and large sample tests in testing of hypothesis	K3

UNIT I PROBABILITY AND RANDOM VARIABLES**9**

Concept of Probability – Addition and multiplication laws – Conditional probability – Total Probability – Baye's theorem and its applications – One dimensional Random Variables (Discrete and Continuous) – Mathematical Expectation.

UNIT II THEORETICAL DISTRIBUTIONS**9**

Discrete distributions – Binomial, Poisson, Geometric Distributions – Continuous distributions – Uniform, Exponential and Normal Distributions.

UNIT III DESCRIPTIVE STATISTICS**9**

Measures of Central Tendency – Mean, Median, Mode – Measures of Dispersion – Mean deviation – Standard deviation – Coefficient of variation

UNIT IV CORRELATION AND REGRESSION**9**

Correlation – Pearson's Correlation coefficient – Spearman's Rank correlation coefficient – Regression – Regression lines- Linear, Multiple Regression- Logistic Regression - Polynomial Regression.

UNIT V TESTING OF HYPOTHESIS**9**

Large sample tests based on normal distribution – Test for single mean – Difference between means – Proportion – Difference between proportions – Small sample test – Student-t test – Test for single mean – Difference between means – Snedecor's F test – Chi-square test for goodness of fit, independence of attributes.

TOTAL : 45+15**TEXT BOOKS:**

1. Geoffrey Grimmett and David Stirzaker, "Probability and Random Processes", Oxford University Press, 4th Edition, 2020.
2. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, "Introduction to Mathematical Statistics", Pearson, 8th Edition, 2019.

REFERENCE BOOKS:

1. Sheldon M Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, 6th Edition, 2021.
2. Douglas C. Montgomery & George C. Runger, "Applied Statistics and Probability for Engineers", John Wiley, 7th Edition, 2019.
3. Allen Craig Robert V Hogg, Joseph W McKean, "Introduction to Mathematical Statistics", Pearson, 8th Edition, 2021.

WEB URLs:

1. www.britannica.com/science/probability
2. www.britannica.com/science/density-function
3. www.khanacademy.org/math/statistics-probability

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	1	-	-	-	-	-	-	-	-	-
CO2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	1	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO	2	1.6	-	-	1	-	-	-	-	-	-	-	-	-

23ECR101 DIGITAL LOGIC CIRCUITS
(Common to AD/CS/CT/CY/IT)

L	T	P	C
3	0	2	4

PRE-REQUISITES: Nil

COURSE OBJECTIVES

- To acquire knowledge on different number systems, Boolean Algebra and logic gates
- To understand the minimization techniques and various functionalities of combinational and sequential circuits
- To apply the programmable logic in building memory devices.

COURSE OUTCOMES

Lerner should be able to

- | | | |
|-------------|--|-----------|
| CO1: | utilize the tenets of Number Systems, Arithmetic Operations, Boolean Algebra and Digital Logic Gates. | K3 |
| CO2: | make use of various Boolean function simplification procedures for construction of digital circuits | K3 |
| CO3: | implement the design procedure of combinational circuits and sequential circuits | K3 |
| CO4: | build digital circuits with memory elements grounded on programmable logic. | K3 |
| CO5: | conduct experiments to verify the Boolean logic and demonstrate the implementation of digital circuits | K3 |

UNIT I DIGITAL FUNDAMENTALS**9**

Number Systems – Decimal, Binary, Octal, Hexadecimal, number base conversions, 1,s and 2,s complements, Arithmetic Operations, Binary codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes. Boolean Algebra - Basic definitions, basic theorems and properties of Boolean algebra, Boolean functions, Sum of products and product of sums, Min terms and Maxterms, Canonical form, conversion between canonical forms, Digital logic gates, Universal gates.

UNIT II GATE LEVEL MINIMIZATION**9**

The K-map method- two-variable map, three-variable map and four-variable map, Sum of products and product of sums, simplification, don't-care conditions, determination and selection of Prime Implicants, Essential and Non-essential prime Implicants, Implementation of logic functions using gates, multilevel gate implementation, NAND and NOR implementation.

UNIT III COMBINATIONAL LOGIC CIRCUITS 9

Design procedure, Design of Half and Full Adders, Half and Full Subtractors, 4-bit Binary Parallel Adder, 4-bit Binary Parallel Adder/subtractor, 2 bit Magnitude Comparator, 3- to- 8 - line Decoders, 8- to- 3- line conventional Encoders, 4- to- 2- line Priority Encoder, 8x1 Multiplexer, and 1x8 De-multiplexers.

UNIT IV SYNCHRONOUS LOGIC CIRCUITS 9

Sequential circuits, latches, Flip flops – SR, JK, T, D, Flip Flop conversions, analysis of clocked sequential circuits- Moore/Mealy models, state minimization, state assignment, state diagram. Registers, shift registers, Universal Shift Register, ripple counters, synchronous counters - Modulo counters.

UNIT V MEMORY AND PROGRAMMABLE LOGIC 9

Classification of memories- Random access memory - Static and dynamic RAM, memory decoding, Read only memory- PROM - EPROM – EEPROM, programmable logic array, programmable array logic, Field Programmable Gate Arrays, Implementation of combinational logic circuits using PLA, PAL.

TOTAL: 45**LIST OF EXPERIMENTS**

1. Verification of Boolean theorems using logic gates
2. Realization of Universal gates.
3. Implementation of full adder and full subtractor
4. Implementation of encoder and decoder circuits
5. Implementation of Synchronous Decade counter using T flip-flops
6. Implementation of a Shift left register and shift right register

TOTAL: 30**TEXT BOOKS**

1. M. Morris Mano and Michael D. Ciletti, “Digital Design”, 6th Edition, 2018.
2. S. Salivahanan and S. Arivazhagan, “Digital Circuits and Design”, 5th Edition, Oxford university press, 2018

REFERENCE BOOKS

1. R.P. Jain and Kishor Sarawadekar, “Modern Digital Electronics”, 5th Edition, Tata McGraw Hill, 2022
2. Thomas .L. Floyd, “Digital Fundamentals”, 11th Edition, Pearson Education Inc, 2017
3. Kate Timberlake, “Digital Electronics –A practical Approach”, 1st Edition, Thomson, 2022

Web URL's

1. <https://www.tutorialspoint.com/digital-electronics/logic-gates.html>
2. <https://www.geeksforgeeks.org/logic-gates/>
3. https://profile.iiita.ac.in/bibhas.ghoshal/COA_2020/Lectures/LogicDesign_part1.pdf

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO3	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO5	3	2	2	-	3	-	-	-	-	-	-	1	1	-
CO	3	2	1.2	-	3	-	-	-	-	-	-	1	1	-

(Common to AD/CD/CS/CT/IT)

L	T	P	C
3	0	2	4

PREREQUISITES: Python Programming

OBJECTIVES:

- To acquire knowledge about Artificial Intelligence.
- To understand the main abstractions and reasoning for intelligent systems.
- To apply the basic principles of Artificial Intelligence in various applications

OUTCOMES:

Learners will be able to

CO1: interpret the structures of Learning concepts and use of Prolog in AI.	K2
CO2: apply the AI intelligent agents to a given real time dataset	K3
CO3: make use of the search strategies and its types	K4
CO4: examine the structures and algorithms selection in Artificial Intelligence techniques related to knowledge representation and reasoning	K4
CO5: compare AI with human intelligence and traditional information processing to complex and human - centered problems	K4

UNIT I INTRODUCTION TO AI 9

Introduction - Definition - Characteristics of Intelligent Agents - Typical Intelligent Agents - Problem Solving Approach to Typical AI problems, History of Artificial Intelligence, The State of the Art, Future of Artificial Intelligence, Risks and Benefits of AI.

UNIT II INTELLIGENT AGENTS 9

Agents and Environment, The Concept of Rationality: Performance measures, Rationality, Omniscience, learning, and autonomy, Agent architectures (e.g., reactive, layered, cognitive), The Nature of Environments: Specifying the task environment, Properties of task environments, The Structure of Agents.

UNIT III PROBLEM - SOLVING 9

Solving Problems by Searching: Problem-Solving Agents, Search problems and solutions, formulating problems, Search Algorithms, Breadth-first search, Depth-first search, A* search, the effect of heuristic accuracy on performance, Generating heuristics from relaxed problems. Local Search and Optimization Problem, Hill-climbing search, Constraint Satisfaction Problem, Variations on the CSP formalism.

UNIT IV	KNOWLEDGE AND REASONING	9
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Logical Agents: Knowledge-Based Agents, Logic, Propositional Logic: A Very Simple Logic, Syntax, Semantics, A simple knowledge base, A simple inference procedure, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Conjunctive normal form, A resolution algorithm, Completeness of resolution, Forward and backward chaining.

UNIT V ADVERSARIAL SEARCH AND GAMES 9

Game theory, classification of games, game playing strategies, prisoner's Dilemma, Game playing techniques, minimax procedure, alpha-beta cut-offs, Complexity of alpha-beta search, Limitations of game search algorithms.

TOTAL: 45

LIST OF EXPERIMENTS:

1. Installation and working on various AI tools viz Scikit Learn, Tensorflow, Keras, CNTK.
2. Data pre-processing and annotation and creation of datasets.
3. Implementation of Breadth First and Depth First searching techniques.
4. Implementation of Hill climbing algorithm.
5. Implementation of A* Algorithm.
6. Designing a Chat bot application.
7. Write a program for problem solving methods.

TOTAL: 30**TEXT BOOKS:**

1. S.Russell and P.Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 4th Edition, 2021.
2. Bratko, Prolog: Programming for Artificial Intelligence, 4th Edition, Addison-Wesley Educational Publishers Inc, 2011

REFERENCE BOOKS:

1. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2023.
2. Deepak Khemani, Artificial Intelligence, Tata McGraw Hill Education 2013.
3. Mishra R B, Artificial Intelligence, PHI Learning Pvt. Ltd., New Delhi, 2013.

WEB URLS:

1. <https://plato.stanford.edu/entries/artificial-intelligence/>
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/>
3. <https://oli.cmu.edu/learn-with-oli/see-all-oli-courses/>
4. <https://aitopics.org>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	3	3	-
CO2	3	2	1	-	-	-	-	-	2	2	-	3	3	-
CO3	3	3	2	1	-	-	-	-	2	2	-	3	3	-
CO4	3	3	2	1	-	-	-	-	2	2	-	3	3	-
CO5	3	3	2	1	-	-	-	-	2	2	-	3	3	-
CO	2.8	2.4	1.8	1	-	-	-	-	2	2	-	2	2	-

23CSR405 ADVANCED ALGORITHMS

(Common to CD/CS/CT/CY/EC/EE/ET/IT)

L	T	P	C
3	0	2	4

PREREQUISITES: Design and analysis of algorithms**OBJECTIVES:**

- To acquire the mathematical knowledge for designing the algorithms.
- To understand the methods of analysing the algorithms.
- To apply the principles of algorithm design and solve various problems.

OUTCOMES:

Learners will be able to

CO1: outline the mathematical properties involved in algorithmic design	K2
CO2: apply the number theory approaches for advanced algorithms	K3
CO3: identify the role of efficient problem solving techniques	K3
CO4: construct optimal algorithms used in competitive programming	K3
CO5: examine the performance of advanced algorithms to solve real time problems.	K4

UNIT I INTRODUCTION 9

Programming Language Backgrounds: STL in C++ – Data Structure support in python – Mathematical Backgrounds – Logarithmic Exponentiation – Efficient Prime Factorization – Combinatorics – Sieve of Eratosthenes – Geometry – Co-ordinate Compression Binomial Coefficients – Euclid's extended Algorithm – Line intersections.

UNIT II MATHEMATICAL APPROACHES 9

Probability – Modular Multiplicative inverse – Matrix Exponentiation – Miller rabin Primality Test – Heavy light Decomposition – Convex hull – Hungarian Algorithm – Sweep line Algorithm – Gaussian Algorithm – Pollard Rho Factorization – Euler's Totient Function – Burnside lemma.

UNIT III ADVANCED ALGORITHM DESIGN TECHNIQUES 9

Recursion – Dynamic Programming – Backtracking – Branch and Bound – Suffix Automata – Game Theory – Meet in the middle – arbitrary precision integer – Square root decomposition. Knapsack problem – Stable Marriage Problem – N-Queen Problems – Tug of wars – Sudoku problem – Advanced Trees: Binary Indexed Tree – Segment Tree – Lowest common ancestors – Counting Inversions – Suffix Tree – Interval Tree – Sparse table – k-d tree – Treap – Link/cut tree.

UNIT IV ADVANCED GRAPH ALGORITHMS 9

Advanced Graph Algorithms: Z-algorithm – Union find/Disjoint Set – Cycle Detection – Bellman Ford – Maxflow – Ford – Fulkerson Min cut – min cost flow – Dinic's Algorithm – Edmonds Karp algorithm – Maximum Bipartite Matching – Topological Sorting – Eulerian & Hamiltonian Paths – Graph Coloring – Blossom's Algorithm – Jarvis algorithm – Graham Scan – Johnson's Algorithm.

UNIT V PATTERN MATCHING AND SEARCHING 9

Searching and Pattern Matching: Rabin-Karp Algorithm – Aho-Corasick String Matching Algorithm – Manacher's Algorithm – Kasai's Algorithm – Levenshtein distance – Sorting – Quick Select.

TOTAL: 45

LIST OF EXPERIMENTS:

1. Implement algorithms to solve geometric problems.
2. Develop solutions using dynamic programming.
3. Implement algorithms using backtracking methods.
4. Detect cycles in a graph using appropriate algorithms.
5. Develop algorithms for topological sorting.
6. Implement graph colouring algorithms.
7. Implement pattern matching algorithms.

TOTAL: 30

TEXT BOOKS:

1. Cormen T H, Leiserson C E, Rivest RL, Stein C, "Introduction to Algorithms", 4th Edition, MIT Press, 2022.

- Yonghui Wu, Jiande Wang, "Data structure Practice for Collegiate Programming Contests and Education", 1st Edition, CRC Press, 2020.

REFERENCE BOOKS:

- Steven S. Skiena "The Algorithm Design Manual", 3rd Edition, Springer, 2020.
- Michael T. Goodrich, Roberto Tamassia, "Design and Analysis of Algorithms, An Indian Adaptation", 1st Edition, Wiley, 2021.
- Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2019.

WEB URLS:

- [www.https://freecodecamp.org/news/demystifying-dynamic-programming-24fbdb831d3a/](https://freecodecamp.org/news/demystifying-dynamic-programming-24fbdb831d3a/)
- [www.https://geeksforgeeks.org/rabin-karp-algorithm-for-pattern-searching/](https://geeksforgeeks.org/rabin-karp-algorithm-for-pattern-searching/)
- [www.https://crypto.stanford.edu/pbc/notes/numbertheory/millerrabin.html](https://crypto.stanford.edu/pbc/notes/numbertheory/millerrabin.html)

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	-	-	2	1	-	-	2	2
CO2	3	3	2	1	1	-	-	-	2	1	-	-	2	2
CO3	3	3	3	2	2	-	-	-	2	1	-	-	2	2
CO4	3	3	3	2	2	-	-	-	2	1	-	1	2	2
CO5	3	3	3	3	2	-	-	-	2	1	-	2	2	2
CO	2.8	2.8	2.4	1.8	1.6	-	-	-	2	1	-	0.6	2	2

23ITR402

COMMUNICATION AND NETWORKS

L	T	P	C
3	0	2	4

PREREQUISITE: C Programming, Operating System**OBJECTIVES:**

- To acquire the knowledge of communication networks.
- To understand the end-to-end flow of information and the functions of network layer, transport layer, application layer and the various routing protocols
- To apply various network topologies and protocols to design and configure small to medium-sized communication networks and security

OUTCOMES:

Learners will be able to

- | | | |
|-------------|--|-----------|
| CO1: | explain the basic layers and its functions in communication networks | K2 |
| CO2: | utilize the fundamental principles of data flow, including the mechanisms and protocols through which data is transmitted from one node to another within a network. | K3 |
| CO3: | examine different routing algorithms, taking into account their efficiency, scalability, and applicability to various network scenarios. | K3 |
| CO4: | make use of protocols for various functions in the network and analyze the working of various application layer protocols. | K3 |
| CO5: | make use of fundamentals of networks security and understand techniques in communication networks | K3 |

UNIT I INTRODUCTION TO COMMUNICATION NETWORKS 7

Overview and importance of communication networks, Types of networks (LAN, MAN, WAN, PAN; wired vs. wireless), Network topologies (bus, star, ring, mesh), OSI and TCP/IP models, Basic network devices (routers, switches, hubs)

UNIT II DATA TRANSMISSION AND PHYSICAL LAYER 8

Analog vs. digital transmission, bandwidth, latency, Transmission media (twisted pair, coaxial, fiber optics, radio waves), Digital encoding schemes (NRZ, Manchester), Multiplexing (FDM, TDM), Physical layer standards (Ethernet, Wi-Fi)

UNIT III DATA LINK LAYER AND NETWORK LAYER 10

Data Link Layer: Framing, error detection (parity, CRC), Flow control, MAC addressing, Protocols (HDLC, PPP, Ethernet, Wi-Fi), Switching techniques (circuit, packet, message). **Network Layer:** Logical addressing, routing, forwarding, IP addressing (IPv4, IPv6, subnetting, CIDR, DHCP), Routing algorithms (distance vector, link state), Protocols (ICMP, ARP, OSPF, BGP)

UNIT IV TRANSPORT LAYER AND APPLICATION LAYER 10

Transport Layer: Segmentation, reassembly, flow control, error control, Protocols (TCP, UDP), Congestion control mechanisms (AIMD, slow start). **Application Layer:** Network applications and protocols (HTTP, HTTPS, FTP, SMTP, DNS), Web services (REST, SOAP)

UNIT V NETWORK SECURITY AND EMERGING TECHNIQUES IN COMMUNICATION NETWORKS 10

Network Security: Security principles (confidentiality, integrity, availability), Cryptography (symmetric, asymmetric encryption, hash functions), Security protocols (SSL/TLS, IPsec, VPN). **Emerging Techniques in Communication Networks** - Wireless and mobile networks, Ad hoc networks, Software-Defined Networking (SDN), Internet of Things (IoT), Network Virtualization (VLANs, VPNs)

TOTAL: 45**LIST OF EXPERIMENTS:**

1. Design and implement different network topologies (star, bus, ring) using network simulation software (e.g., Cisco Packet Tracer, GNS3).
2. Implement and analyze different digital encoding schemes (NRZ, Manchester) and observe their impact on data transmission.
3. Implement error detection techniques (parity checks, CRC) and error correction methods (Hamming code).
4. Analyze the performance of MAC protocols (CSMA/CD for Ethernet, CSMA/CA for Wi-Fi) under different network conditions.
5. Implement and compare routing protocols (RIP, OSPF, BGP) in a simulated network environment.
6. Simulate TCP congestion control algorithms (slow start, AIMD) and analyze their impact on network performance.
7. Use network security tools (firewalls, IDS/IPS) to secure a network and analyze attack traffic.

TOTAL: 30**TEXT BOOKS:**

1. "Data and Computer Communications", William Stallings, 10th Edition, Pearson Education, 2017
2. "Computer Networking: A Top-Down Approach", James F. Kurose and Keith W. Ross, 7th Edition, Pearson Education, 2017

REFERENCE BOOKS:

1. "Communication Networks – Fundamental Concept and Key Architecture", Alberto Leon-Garcia and Indra Widjaja, 2nd Edition, Tata McGraw Hill Education, 2017
2. "Computer Networks", Andrew S. Tanenbaum and David J. Wetherall, 5th Edition, Prentice Hall, 2011

WEB URLS:

1. [https:// www.archive.nptel.ac.in/courses/106/105/106105183/](https://www.archive.nptel.ac.in/courses/106/105/106105183/).
2. <http://www.digimat.in/nptel/courses/video/106105081/L25.html>.
3. https://onlinecourses.nptel.ac.in/noc23_cs35/

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	1	1	1	-	2	2	2
CO2	3	2	2	-	-	-	-	1	1	1	-	2	2	2
CO3	3	2	2	-	-	-	-	1	1	1	-	2	2	2
CO4	3	2	2	2	-	-	-	1	1	1	-	2	2	2
CO5	3	2	2	1	-	-	-	1	1	1	-	2	2	2
CO	3	2	1.8	1.5	-	-	-	1	1	1	-	2	2	2

23ITR403**WEB APPLICATION DEVELOPMENT**

(Common to AD/CD/CS/CT/CY/EC/EE/ET/IT)

L	T	P	C
3	0	2	4

PREREQUISITES: Java Programming**OBJECTIVES:**

- To acquire the concepts of Servlet API and JSP
- To understand the knowledge of Hibernate for interacting with database
- To apply the concepts of Spring and Spring Boot

OUTCOMES:

Learners will be able to

- CO1:** outline web application architecture using Servlets, JSP, and Hibernate for building dynamic and data-driven web applications. **K3**
- CO2:** illustrate the integration of JSP with ORM concepts and database interactions to ensure data consistency in web applications **K3**
- CO3:** construct robust web applications with database integration and Spring MVC, focusing on modularity and scalability **K3**
- CO4:** develop comprehensive web solutions using Spring Boot, integrating advanced features to address real-world challenges in web development **K3**
- CO5:** integrate advanced web technologies across different layers of the web stack to design high-performance and scalable web applications. **K4**

UNIT I SERVLET API**9**

Introduction to MVC - Features - Components. Servlet: Life Cycle – Types - Servlet Configuration - ServletContext - ServletConfig - Request Dispatcher - sendRedirect - Session Tracking: Cookies – HTTP Session - Servlet with JDBC

UNIT II JSP API 9

JSP: Comparison with Servlet – Architecture - Life Cycle - Scripting Elements – Directives - Action Tags - Implicit Objects - Java Beans in JSP - Expression Language (EL) - JSTL Core Tags - Session Management - Exception Handling – JSP with JDBC.

UNIT III HIBERNATE API 9

Hibernate: Architecture - Object Relation Mapping – Annotation – Querying: Hibernate Query Language - Criteria Queries - Native SQL - Basic O/R Mapping - Collection Mapping - Association Mappings.

UNIT IV SPRING MVC 9

Spring: Introduction – Architecture - Spring MVC Module - Life Cycle of Bean Factory - Constructor Injection - Dependency Injection - Inner Beans - Aliases in Bean - Bean Scopes - Spring Annotations - Spring AOP Module, Spring DAO - Database Transaction Management - Build Tools: Maven - Gradle.

UNIT V SPRING BOOT 9

Introduction to Spring Boot - Spring Vs. Spring Boot - Internals - Auto Configuration - Annotations - Spring Data - Crud Repository - JPA Repository - Custom Queries in JPA - Spring Boot Profiles - Spring Web MVC - Thymeleaf – Spring boot with ORM.

TOTAL: 45

LIST OF EXPERIMENTS:

1. Implement a web application using Servlets to handle HTTP requests and responses.
2. Develop dynamic web pages using JavaServer Pages (JSP).
3. Develop application features using Hibernate Collection Mapping and Association Mapping to manage relationships between entities.
4. Create web applications using the Spring MVC framework.
5. Develop Spring MVC applications integrated with a backend database.
6. Develop Spring applications integrated with JPA.
7. Implement RESTful APIs and microservices using Spring Boot.

TOTAL: 30

TEXT BOOKS:

1. Mayur Ramgir, "Full Stack Java Development with Spring MVC, Hibernate, jQuery, and Bootstrap", Wiley, 2020.
2. Shagun Bakliwal, "Hands-on Application Development using Spring Boot", BPB Publications, 2021.

REFERENCE BOOKS:

1. Christian Ullenboom, "Spring Boot 3 and Spring Framework 6", Shroff/Rheinwerk Computing, 2023.
2. Catalin Tudose, "Java Persistence with Spring Data and Hibernate", Manning Publications, March 2023.
3. Sarika Agarwal, Vivek Gupta, "Java for Web Development", BPB Publications, 2022.

WEB URLS:

1. <https://hibernate.org/orm/documentation/6.6/>
2. <https://www.docs.spring.io/spring-framework/docs/3.2.x/spring-framework-reference/html/mvc.html>
3. <https://www.docs.spring.io/spring-boot/docs/current/reference/htmlsingle/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	3	-	-	-	2	1	1	2	3	2
CO2	3	2	1	-	3	-	-	-	2	1	1	2	3	2
CO3	3	2	1	-	3	-	-	-	2	1	1	2	3	2
CO4	3	2	1	-	3	-	-	-	2	1	1	2	3	2
CO5	3	3	2	1	3	-	-	-	2	1	1	2	3	2
CO	2.8	2	1.25	1	3	-	-	-	2	1	1	2	3	2

23ITR404 LOW CODE APPLICATION DEVELOPMENT

(Common to AD/CD/CS/CT/CY/EC/EE/ET/IT)

L	T	P	C
3	0	2	4

PREREQUISITES: Nil

OBJECTIVES:

- To acquire low-code development components and their functionalities.
- To understand proficiency in using low-code platforms/tools for app creation, automation, and publication.
- To apply machine learning tools for data analysis and present actionable insights.

OUTCOMES:

Learners will be able to

- CO1:** interpret the functionality and application of low code tools for web scraping, API integration, automation, and UI/UX design **K2**
- CO2:** infer low code platforms like Zapier, Voice Flow, and Figma for effective publishing of Applications **K2**
- CO3:** utilize data scraping, API manipulation, and data analysis using machine learning tools. **K3**
- CO4:** build voice applications and bots, integrating services like Giphy and Twitter **K3**
- CO5:** develop user interfaces and experiences with basic UI/UX principles using low code Solutions **K3**

UNIT I WEB SCRAPING AND API PARABOLA WITH LOW CODE 9

NoCode Stacks - NoCode Fundamentals. Web Scraping: Scrape Data from WEB URLs:- Initial Scraper Setup- Defining our data- Using our Scraped Data. APIs: Filtering Data- Numerical Formatting - Exporting - Publishing data.

UNIT II BUILD AUTOMATIONS AND CREATE BOTS WITH LOW CODE 9

Automations using Zapier: Introduction - Connecting Google sheets - Connecting twitter- Publishing Zapier Automation. Bots: Configuring Slack - Creating First bot using slack - Including conditional and helper functions - Connecting Giphy -Connecting slack to bot - Publishing our bot.

UNIT III DATA SCIENCE 9

Introduction - Data flow- Machine learning. Obviously AI: Introduction- Sourcing -Upload -Analyze- Publish using Obviously AI.

UNIT IV VOICE APP

9

Introduction-VoiceFlow-Initial setup- launch sequence -Querying the user-Calling API for data-Returning Data to the user-Testing the application-Publish the voice app.

UNIT V UI / UX DESIGN FOR APPLICATION

9

Introduction-Business Use case-Tools. Figma: Introduction-File setup - Placing Images - Frame- Building Forms- Profile Image- Proportions- Project.

TOTAL: 45

LIST OF EXPERIMENTS:

1. Set up an automation in Parabola to integrate data from a public API (eg, weather or news API) and format it for easy analysis
2. Configure a Zapier automation that connects Google Sheets with Slack, automatically posting updates or notifications
3. Build a Slack bot using Zapier that respond to user queries with relevant information sourced from an external API (eg., Giphy)
4. Upload a dataset to Obviously AI, analyse it using machine learning models and generate predictive insights without coding
5. Develop a VoiceFlow application that interacts with users to provide real-time information (eg., weather forecasts) via voice commands
6. Design a mobile app interface prototype in Figma, focusing on intuitive navigation and user-friendly interactions
7. Create an interactive dashboard prototype in Figma that visualizes data insights and allows for customizable widgets and filters

TEXT BOOKS:

1. David Wilson, " Low-Code Application Development: A Practical Guide ", 1st Edition, ABC Press, 2021
2. Paul E Love, " Mastering No-Code: Create Professional Quality Apps Without Coding (Vol. 1) ", 1st Edition, Independent Publication, 2021.

REFERENCE BOOKS:

1. Mittal Akhil, "Getting Started with Chatbots ", 1st Edition, BPB Publications, 2019.
2. Fabio staiano, "Designing and Prototyping Interfaces with Figma ", 1st Edition, Packt Publishing, 2022.
3. Mikhail Zhilkin, " Data Science Without Makeup", 1st Edition, CRC Press, 2021.

WEB URLS:

1. <https://learn.microsoft.com/en-us/training/modules/understanding-low-code-as-a-traditional-developer/>
2. <https://www.udemy.com/course/creatio-low-code-app-development/>
3. <https://www.nocode.tech/academy>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	3	-	-	-	1	1	-	1	1	1

CO2	3	2	1	-	3	-	-	-	1	1	-	1	1	1
CO3	3	2	1	-	3	-	-	-	1	1	-	1	1	1
CO4	3	2	1	-	3	-	-	-	1	1	-	1	1	1
CO5	3	2	1	-	3	-	-	-	1	1	-	1	1	1
CO	3	2	1	-	3	-	-	-	1	1	-	1	1	1

23MXC402 ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE
(Common to all branches)

L	T	P	C
1	0	0	-

PRE-REQUISITES: Nil

OBJECTIVES:

- To acquire the diverse facets of ancient Indian culture, such as its scientific breakthroughs, inventions, innovations, including ayurvedic, agriculture and commerce activities that impact the world
- To understand the basics of Indian culture, religions and philosophies of India
- To impart the knowledge in cultural heritage of India through its languages, literatures and performing arts

OUTCOMES:

Learners will be able to

- CO1:** recall the concept, nature, scope and importance of Indian traditional knowledge and its relation influenced by various philosophies and religions **K1**
- CO2:** identify the diverse and rich sources of Indian traditional knowledge, such as Vedas, Upanishads, Puranas, Ayurveda, Yoga, etc **K1**
- CO3:** recite the styles, influences and characteristic of the major schools of architecture and fine arts in India based on the wisdom of Indian traditional knowledge **K1**
- CO4:** understand the principles and methods of Indian traditional knowledge to various domains of life, such as health, education, environment, ethics, etc **K1**
- CO5:** explain the significance of Indian traditional knowledge with the modern scientific knowledge and explore the possibilities of integration and synergy **K2**

UNIT I INDIAN CULTURE, RELIGION AND PHILOSOPHY 3
An Introduction to Indian Culture – Religion and Philosophy in India – Ancient Period: Pre-Vedic and Vedic religion – Buddhism and Jainism – Indian Philosophy – Vedanta and Mimamsa school of Philosophy.

UNIT II INDIAN LANGUAGES AND LITERATURE 3
Indian Languages and Literature – The Vedas, Upanishads and Sutras – Epics: Ramayana -Mahabharata and Puranas.

UNIT III SCHOOLS OF ARCHITECTURE AND FINE ARTS IN INDIA 3
Indian Arts and Architecture – Gandhara School and Mathura School of Art – Hindu Temple Architecture – Buddhist Architecture – Medieval and Colonial Architecture – Indian Painting Tradition – Performing Arts- Divisions of Indian classical music – Dances of India.

UNIT IV TRADITIONAL KNOWLEDGE ON SCIENCE IN INDIA 3
Ancient India's contribution to science and technology – Historical evolution of medicinal traditions in ancient India.

UNIT V MEDICINAL SCIENCE, TECHNOLOGY AND SPACE SCIENCE IN INDIA 3

Ayurveda for life – Ayurveda and medicinal plants – Conventional, non-conventional and clean energy sources of India – Science and its various branches – Indigenous agriculture, Biotechnology and Nano-technology – India in Space.

TOTAL: 15**TEXT BOOKS:**

1. Radhahrishnan Sarvepalli and Moore Charles A, “A Source book in India Philosophy”, 1st Edition, Princeton University Press, 1967.
2. Bharati Vijnana, “Indian Contribution to Science”, 2nd Edition, Vijnana Bharati, 2017.

REFERENCE BOOKS:

1. Dasgupta and Surendaranath, “A History of Indian Philosophy (5 Vols.)”, 1st Edition, Cambridge University Press, 1922-1955.
2. Subbarayappa B V, “Chemistry and Chemical in India, Project of history of Indian Science”, 1st Edition, Philosophy and culture and center for studies in civilizations Vol. IV (part-1), 1999.

WEB URLs:

1. www.insightsonindia.com/2013/08/07/study-material-for-indian-culture-art-architecture-and-literature/
2. www.indianculture.gov.in/ebooks/study-material-culture
3. www.sistk.org/DOWNLOADS/MATERIALS/ECE-notes/EITK%20COURSE%20MATERIAL.PDF

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	3	-	-	-	-	-	-
CO2	-	-	-	-	-	2	2	2	-	-	-	-	-	-
CO3	-	-	-	-	-	2	2	2	-	-	-	-	-	-
CO4	-	-	-	-	-	2	2	2	-	-	-	-	-	-
CO5	-	-	-	-	-	2	2	2	-	-	-	-	-	-
CO	-	-	-	-	-	2.2	2.2	2.2	-	-	-	-	-	-

SEMESTER - V
23ADR405 MACHINE LEARNING TECHNIQUES
 (Common to AD/CS/CT/IT)

L	T	P	C
3	0	2	4

PRE-REQUISITES: Artificial Intelligence, Python Programming

OBJECTIVES:

- To acquire the fundamental concepts of data pre-processing, supervised, unsupervised, and reinforcement learning.
- To understand tools and techniques for regression and classification models.
- To apply contemporary K-Means Hierarchical Clustering and neural networks.

OUTCOMES:

Learner should be able to

- CO1:** explain the fundamental concepts of supervised, unsupervised, reinforcement learning and pre-processing techniques **K2**
- CO2:** compare the performance of various regression models. **K2**
- CO3:** utilize classification and clustering algorithms to frame ML models **K3**
- CO4:** build a single layer neural network and a multilayer perceptron **K3**
- CO5:** analyze machine learning techniques to solve complex problems **K4**

UNIT I INTRODUCTION AND DATA PRE-PROCESSING 9

Machine learning – Introduction – Supervised learning – Unsupervised learning – Reinforcement learning – Machine learning lifecycle – Data Preprocessing – Importing the libraries – Importing the dataset – Handling missing data – Outlier detection and removal – Handling Imbalance class - Encoding categorical data – Splitting the dataset – Feature scaling.

UNIT II REGRESSION 9

Regression – Simple linear regression – Multiple linear regression – Polynomial regression – Support vector regression – Decision tree regression – Random Forest regression – Evaluating regression models – Regression model selection.

UNIT III CLASSIFICATION 9

Classification – Logistic regression – K-Nearest neighbor – Support vector machine – Kernel SVM – Naive Bayes – Decision tree classification – Random Forest classification – XGBoost – Classification model selection – evaluating classification models.

UNIT IV CLUSTERING, ASSOCIATION, REINFORCEMENT LEARNING 9

Clustering – K-Means clustering – Hierarchical clustering. Association – Apriori – Eclat algorithm. Dimensionality reduction – PCA – LDA – Kernel PCA. Reinforcement learning – Multi armed bandit problem – Upper confidence bound – Thompson sampling. Model selection – K-fold cross validation – Grid search.

UNIT V NEURAL NETWORKS 9

Basics of Neural Networks - MP neurons - perceptron - weight - bias - activation - loss function - optimizer; Artificial Neural Networks - Single Layer Neural Network - Multilayer Perceptron.

TOTAL: 45

LIST OF EXPERIMENTS:

1. Implementation of regression algorithms for sentimental analysis.
2. Decision Tree for various Diagnosis.

3. Random Forest for prediction analysis.
4. Implementation of Support Vector Machine and K-Mean Clustering.
5. Association Rule Mining for decision making analysis.
6. Implementation of Principal Component Analysis and Linear Discriminant Analysis.
7. Multi-layer perceptron for feature extraction methods.

TOTAL: 30**TEXT BOOKS:**

1. Pratheerth Padman, "Learn Data Science from Scratch: Mastering ML and NLP with Python in a step-by-step approach", BPB Publications, 1st edition, 2024.
2. Peter Wlodarczak, "Machine Learning and its Applications", John Wiley, 1st edition, 2020.

REFERENCE BOOKS:

1. Wei-Meng, "Python Machine Learning", John Wiley, 1st edition, 2019.
2. Wei-Meng, "Python Machine Learning", John Wiley, 1st edition, 2019.
3. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", O'Reilly Media, 3rd edition, 2022.

WEB URLS:

1. <https://www.machinelearningmastery.com/>
2. <https://www.geeksforgeeks.org/machine-learning/>
3. <https://www.javatpoint.com/machine-learning>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	-	2	2	2	-	-	3
CO2	2	1	-	-	1	-	-	-	2	2	2	-	-	3
CO3	3	2	1	-	1	-	-	-	2	2	2	-	-	3
CO4	3	2	1	-	1	-	-	-	2	2	2	-	-	3
CO5	3	3	2	1	1	-	-	-	2	2	2	-	-	3
CO	2.6	1.8	1.3	1	1	-	-	-	2	2	2	-	-	3

23ITR505**DATA ANALYTICS AND VISUALIZATION**
(Common to AD/CS/CY/IT)

L	T	P	C
3	0	2	4

PRE-REQUISITES: NIL**OBJECTIVES:**

- To acquire the basics of data science and statistical inference.
- To understand the concept of data pre-processing and feature selection algorithms.
- To apply the processed data using visualization techniques.

OUTCOMES:

Learner should be able to

CO1:	interpret data science basics, exploratory data analysis and its tools	K2
CO2:	demonstrate the usage of statistical inference and regression models	K2
CO3:	make use of the linear and non-linear ways of Data visualization.	K3
CO4:	visualize the graphs for discrete and continuous probability distributions.	K3

CO5: explore the data visualization using R language

K4

UNIT I INTRODUCTION

9

Data Science – Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications

UNIT II DESCRIBING DATA

9

Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs – averages – mode – median – mean – averages for qualitative and ranked data – describing variability – range – variance – standard deviation – degrees of freedom – interquartile range – variability for qualitative and ranked data

UNIT III BASICS OF DATA VISUALIZATION

9

The Seven Stages of Visualizing Data - Getting Started with Processing - Mapping - Time Series - Connections and Correlations - Scatterplot Maps - Trees, Hierarchies, and Recursion - Networks and Graphs – Acquiring Data – Parsing Data.

UNIT IV MISCELLANEOUS GRAPH

9

Basics of Histogram, Making Multiple Histograms from Grouped Data – Basics of Density Curve, Making Multiple Density Curves from Grouped Data – Frequency Polygon – Box Plot – Violin Plot – Multiple Dot Plots for Grouped Data – Density Plot of Two-Dimensional Data – Correlation Matrix – Network Graph – Heat Map – Three-Dimensional Scatter Plot – Dendrogram – QQ Plot an Empirical Cumulative Distribution Function – Mosaic Plot – MAP.

UNIT V TECHNIQUES AND APPLICATIONS OF DATA EXPLORATION AND VISUALIZATION IN R

9

Introduction to R and RStudio - The Basics of Data Exploration - Loading Data into R - Transforming Data - Creating Tidy Data – Basic Data Exploration Techniques - Basic Data Visualization Techniques - Visualizing Geographic Data with ggmap - R Markdown - Case Study – Wildfire Activity in the Western United States - Case Study – Single Family Residential Home and Rental Values.

TOTAL: 45

LIST OF EXPERIMENTS:

1. Learn the basics of functions in R and implement with examples.
2. Implement data frames in R. Write a program to join columns and rows in a data frame using c bind () and r bind () in R.
3. Implement different String Manipulation functions in R.
4. Implement different data structures in R(Vectors ,Lists ,Data Frames)
5. Write a program to read acsv file and analyze the data in the file in R
6. Create pie charts and bar charts using R.
7. Create a data set and do statistical analysis on the data using R.

TOTAL: 30

TEXT BOOKS:

1. David Cielen, Arno D B Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2020.
2. Robert S Witte and John S Witte, “Statistics”, Wiley Publications, 11th edition, 2017.
3. Bendat, J S and A G Piersol. “Random Data: Analysis and Measurement Procedures”, John Wiley & Sons, Inc.,NY, USA, 4th edition., 2010

REFERENCE BOOKS:

1. Montgomery D C and Runger G C. "Applied Statistics and Probability for Engineers", John Wiley & Sons, Inc., NY, USA, 5th edition, 2011
2. David G Luenberger . "Optimization by Vector Space Methods", John Wiley & Sons (NY), 1969
3. Cathy O'Neil and Rachel Schutt, "Doing Data Science", O'Reilly Media, 2013

WEB URLS:

1. https://onlinecourses.nptel.ac.in/noc21_cs69/preview
2. <https://www.udemy.com/topic/data-science/>
3. <https://www.udemy.com/topic/data-visualization/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	-	-	-	2	2	-	-	2	1
CO2	2	1	1	-	-	-	-	-	2	2	-	-	2	1
CO3	3	1	-	-	-	-	-	-	2	2	-	-	2	1
CO4	3	1	1	1	-	-	-	-	2	2	-	-	2	1
CO5	3	2	1	1	-	-	-	-	2	2	-	-	2	1
CO	2.6	1.2	1	1	-	-	-	-	2	2	-	-	2	1

23CTR501 CLOUD COMPUTING

(Common to AD/CS/CT/IT)

L	T	P	C
3	0	2	4

PRE-REQUISITES: Computer Networks**OBJECTIVES:**

- To acquire knowledge of cloud computing concepts, models, and applications
- To understand the various cloud platforms, especially AWS, and their use in cloud computing
- To apply cloud computing techniques and tools like Docker and DevOps to develop and deploy scalable applications

OUTCOMES:

Learners should be able to

CO1:	explain cloud computing concepts, its characteristics and various service models	K2
CO2:	analyze the architecture and functionality of cloud platforms like AWS	K4
CO3:	design applications using AWS services and virtualization techniques	K6
CO4:	apply Docker for containerization and integrate it with cloud platforms like AWS	K3
CO5:	develop cloud based application using various platforms	K6

UNIT I CLOUD INTRODUCTION**9**

Cloud Introduction – Characteristics – Models – Applications – Comparison on Premise and cloud platform
 – Key elements of CDC – Compute, Storage and network on business continuity – CDC Management.

UNIT II	VIRTUALIZATION	9
Data center Management - Application – Virtualized Data Center(VDC) – Virtualization: Compute, Storage, Network virtualization techniques – Virtual Provisioning – Block and file level Storage Virtualization.		
UNIT III	AWS	9
AWS Introduction – AWS EC2 – AWS VPC – AWS Storage types and its benefits – AWS security – identity and compliance – AWS Networking and content Delivery.		
UNIT IV	DOCKER	9
Docker: Containers –terminology – Docker Run Static sites – Docker Images – Docker File – Docker on AWS – Docker Network – Docker Compose – Development workflow – AWS EC Services		
UNIT V	DEVOPS	9
DevOps: Introduction – Test Driven Development – Continuous Integration – Code Coverage – Best Practices – Virtual Machines vs Containers – Rolling Deployments – Continuous Deployment – Auto scaling		

TOTAL: 45

LIST OF EXPERIMENTS:

1. Install a C compiler in the virtual machine created using a virtual box and execute simple programs.
2. Install Google App Engine. Create hello world app and other simple web applications using python / java.
3. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
4. Find a procedure to transfer the files from one virtual machine to another virtual machine.
5. Install Hadoop single node cluster and run simple applications like word count.
6. Creating and Executing your First Container using Docker.
7. Run a container from Docker Hub.

TEXT BOOKS:

1. Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi, "Mastering Cloud Computing," McGraw- Hill.
2. Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra, "Distributed and Cloud Computing," Morgan Kaufmann.

REFERENCE BOOKS:

1. Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture," Prentice Hall.
2. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach," McGraw-Hill.
3. Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-on Approach," CreateSpace Independent Publishing.
4. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy," O'Reilly.

WEB URL's:

1. <https://aws.amazon.com>
2. <https://cloud.google.com>
3. <https://azure.microsoft.com>
4. <https://www.ibm.com/cloud>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	1	-	-	-	-	-	-	-	1	1
CO2	2	2	-	-	1	-	-	-	-	-	-	-	1	1
CO3	3	2	1	1	1	-	-	-	-	1	1	-	1	1
CO4	3	2	1	-	1	-	-	-	1	1	-	-	1	1
CO5	3	1	1	-	1	-	-	-	1	1	1	-	1	1
CO	2.4	1.6	1	1	1	-	-	-	1	1	1	-	1	1

SEMESTER – VI**23ITR606****CRYPTOGRAPHY AND NETWORK SECURITY**

(Common to AD/CS/CT/IT)

L	T	P	C
3	1	0	4

PRE-REQUISITES: Computer Networks**OBJECTIVES:**

- To acquire the basic knowledge about number theory and classical encryption techniques.
- To understand the concepts and functions of encryption and decryption algorithms.
- To apply the functions with working procedures for network security algorithms.

OUTCOMES:

Learner should be able to

- CO1:** interpret OSI security services, security attacks and security mechanism. **K2**
- CO2:** apply symmetric key cryptography algorithms for encryption and decryption process. **K3**
- CO3:** build public key cryptography algorithms for encryption and decryption process. **K3**
- CO4:** make use of digital signature and authentication protocols for message authentication and integrity. **K3**
- CO5:** analyze security solutions for Electronic Mail Security, IP security, and web security. **K4**

UNIT I OSI SECURITY ARCHITECTURE 9

Overview – OSI security architecture – Attacks and services – Security mechanism – Classical encryption techniques – Basic concepts in number theory and finite fields – Prime numbers – Fermat and Euler's theorem – Primality testing.

UNIT II SYMMETRIC KEY CRYPTOGRAPHY 9

Data Encryption Standard – Block cipher design principles – DES example – The Strength of DES – Triple DES – AES – Modes of operation.

UNIT III PUBLIC KEY CRYPTOGRAPHY 9

RSA – Attacks – Diffie-hellman key exchange – Elliptic curve arithmetic – Elliptic curve cryptography – ElGamal Public key cryptosystems.

UNIT IV MESSAGE AUTHENTICATION AND INTEGRITY 9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA – Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords - Authentication applications – Kerberos.

UNIT V SECURITY PRACTICE AND SYSTEM SECURITY 9

Electronic Mail security – PGP, S/MIME – IP security – Web Security – System Security: Intruders – Malicious software – viruses – Firewalls.

TOTAL: 45**TEXT BOOKS:**

1. William Stallings, "Cryptography and Network Security Principles and Practices", Pearson/PHI, 9th edition, 2020.
2. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", Pearson Education, 2021.

REFERENCE BOOKS:

1. Mao W, "Modern Cryptography – Theory and Practice", Pearson Education, 3rd edition, 2018.

2. Charles P Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", Prentice Hall of India, 5th edition, 2018.

WEBSITES:

1. https://www.onlinecourses.nptel.ac.in/noc22_cs03.
2. <https://www.geeksforgeeks.org/>
3. <https://www.scaler.com/topics/computer-network/cryptography-and-network-security>.

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	-	-	-	-	-	3	1
CO2	3	2	1	1	1	-	-	-	-	-	-	-	2	1
CO3	3	2	2	1	1	-	-	-	-	-	-	-	3	1
CO4	2	1	1	1	1	-	-	-	-	-	-	-	3	1
CO5	3	2	1	1	1	-	-	-	-	-	-	-	3	1
CO	2.6	1.6	1.2	1	1	-	-	-	-	-	-	-	2.8	1

23CSR507 THEORY OF COMPUTATION

(Common to CD/CS/CT/CY/IT)

L	T	P	C
3	0	0	3

PREREQUISITES: Discrete Mathematics and stochastic Process**OBJECTIVES:**

- To acquire the basic knowledge of Finite Automata and its equivalence regular expressions
- To understand the grammar and the language with their relationships equating it to develop the compiler
- To apply the intermediate codes and perform optimization on the code generated

OUTCOMES:

Learners should be able to

- CO1:** interpret mathematical foundations of computation and construction of abstract machines using finite automata **K2**
- CO2:** construct finite automata for Regular Expression and languages **K3**
- CO3:** construct context free grammar for regular languages **K3**
- CO4:** build a Turing machine from their associated languages and grammars **K3**
- CO5:** analysis the complexity and computability of Undecidable and NP class problems **K3**

UNIT I FINITE AUTOMATA& REGULAR EXPRESSION**10**

Introduction to Turing Machine & FA - DFA – NFA –Epsilon NFA – Equivalence of Deterministic and Nondeterministic Finite Automata - Epsilon NFA conversions - Eliminating Epsilon transitions - DFA Minimization - Regular Expressions – Applications of FA and RE.

UNIT II COMPILER & GRAMMAR**10**

Structure of Compilers –Lexical Analyzer - Specification and Recognition of tokens – Lexical analyzer generator - LEX tool – CFG: Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG's, Minimization of CFG's, CNF, GNF, Pumping Lemma for CFL's, Enumeration of Properties of CFL – the Chomsky hierarchy

UNIT III SYNTAX ANALYSIS**10**

Top-down Parsing: Recursive Descent Parsing – First and Follow – Predictive parsing – Non recursive predictive parsing – Bottom-up parsing: Reduction - SR Parsing – LR Parsing: LR (0) Automation– SLR parsing – CLR and LALR parsers –YACC.

UNIT IV INTERMEDIATE CODE GENERATION**8**

Syntax Directed Definition – Evaluation orders: Dependency graph –L and S attributed definitions –Applications – Intermediate Code Generation – Three Address Code – Type expression and equivalence – Type declaration - Expression translation – Type Checking – Back Patching – Run Time environments – Storage Organization.

UNIT V CODE GENERATION, OPTIMIZATION, TURING MACHINE**7**

Code generation: issues in the code generator – Address in the target code - DAG– Basic blocks in flow graphs – Simple code generator – Code optimization: Peephole optimization –The Principal sources of optimization – P, NP Problems – NP complete – NP Hard problems.

TOTAL: 45**TEXT BOOKS:**

1. Keith Cooper D, Linda Torczon, "Engineering a Compiler", 3rd Edition, 2022.
2. Douglas Thain, "Introduction to Compilers and Language Design", 2nd Edition, Springer, 2020.

REFERENCE BOOKS:

1. Micheal Sipser, "Introduction to the Theory of Computation", 3rd Edition, Cengage Learning, 2021.
2. Prem Nath, Patel RB "Theory of Computation (With Formal Languages)", 2nd Edition, Khanna Publishing House, 2025.
3. Alfred Aho, Monica Lam, Ravi Sethi, and Jeffrey Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education, 3rd Edition, 2016.
4. Anuradha A Puntambekar, "Theory of Computation", 1st Edition, Technical Publications, 2022.

WEB URLS:

1. <https://www.nptel.ac.in/courses/106104028/>
2. <https://www.geeksforgeeks.org/introduction-of-finite-automata/>
3. <https://www.gate.cse.in/category/compiler-design/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO5	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO	2.4	1.4	1	-	-	-	-	-	-	-	-	1	1	-

23CSR510**OPEN SOURCE SOFTWARE LABORATORY**

(Common to CD/CS/CT/IT)

L	T	P	C
0	0	4	2

PREREQUISITES: Nil**OBJECTIVES:**

- To acquire the basic knowledge FOSS environment and introduce them to use open-source packages in open-source platform
- To understand the knowledge of shell programming and version control system setup using GIT
- To apply the Common Unix Printing System (CUPS), samba and share files to windows

OUTCOMES:

Learners should be able to

- | | | |
|-------------|---|-----------|
| CO1: | apply Linux commands and shell scripts for system configuration | K3 |
| CO2: | develop shell scripts and GUI for specific needs | K3 |
| CO3: | make use of GIT tools for version control system setup | K3 |
| CO4: | identify and Install software packages, Common Unix Printing System (CUPS), samba and share files to windows. | K3 |
| CO5: | inference server packages over http or ftp | K4 |

LIST OF EXPERIMENTS

1. Shell Programming: Write shell script to show various system configuration like
 - Currently logged user and his log name
 - Your current shell
 - Your home directory
 - Your operating system type
 - Your current path setting
 - Your current working directory
 - Show Currently logged number of users
2. Write shell script to show various system configuration like
 - About your OS and version, release number, kernel version
 - Show all available shells
 - Show mouse settings
 - Show computer CPU information like processor type, speed etc
 - Show memory information
 - Show hard disk information like size of hard-disk, cache memory, model etc
 - File system (Mounted)
3. Shell script program for scientific calculator.
4. Write a script called add names that is to be called as follows, where class list is the name of the class list file, and username is a particular student' username. /add names class list username.
The script should,
 - Check that the correct number of arguments was received and print an usage message if not,
 - Check whether the classlist file exists and print an error message if not,
 - Check whether the username is already in the file, and then either
 - Print a message stating that the name already existed, or

- Add the name to the end of the list.
5. Version Control System setup and usage using GIT.
 - Creating a repository
 - Checking out a repository
 - Adding content to the repository
 - Committing the data to a repository
 - Updating the local copy
 - Comparing different revisions
 - Revert
 - Conflicts and solving a conflict
 6. GUI programming: Create scientific calculator – using Gambas or try using GTK or QT
 7. Kernel configuration, compilation and installation: Download / access the latest kernel source code from kernel.org, compile the kernel and install it in the local system. Try to view the source code of the kernel
 8. Virtualization environment (e.g., xen, qemu, virtualbox or lguest) to test an applications, new kernels and isolate applications. It could also be used to expose students to other alternate OSs like BSD
 9. Compiling from source: learn about the various build systems used like the auto* family, cmake, ant etc. instead of just running the commands. This could involve the full process like fetching from a cvs and also include autoconf, automake etc.,
 10. Introduction to packet management system: Given a set of RPM or DEB, how to build and maintain, serve packages over http or ftp. and also how do you configure client systems to access the package repository.
 11. Installing various software packages. Either the package is yet to be installed or an older version is existing. The student can practice installing the latest version. Of course, this might need Internet access.
 - Install samba and share files to windows
 - Install Common Unix Printing System (CUPS)

PROJECT MODULE

12. Deploy Frappe erpnext in local environment and Setup Workspace
13. Customize client-side scripting for your own requirements
14. Customize server-side scripting for your own requirements
15. Write Reports for your own requirements

TOTAL: 60

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	1	-	-	-	1	-	-	-	1	1

CO2	2	1	1	1	1	-	-	-	1	-	-	-	1	1
CO3	3	2	1	-	2	-	-	-	2	-	-	-	1	1
CO4	3	2	1	-	1	-	-	-	1	1	-	-	1	1
CO5	3	2	1	-	1	-	-	-	1	1	-	-	1	1
CO	2.4	1.8	1	1	1.2	-	-	-	1.2	1	-	-	1	1

SEMESTER – VII
23SGE713 PRINCIPLES OF MANAGEMENT AND ENGINEERING ETHICS
 (Common to AD/CD/CS/CT/ CY/EC/EE/ET/ ME/IT)

L	T	P	C
3	0	0	3

PRE-REQUISITES: Nil

OBJECTIVES:

- To understand the foundations of business and management.
- To acquire knowledge in various verticals of management.
- To apply ethics in engineering practices

OUTCOMES:

Learners should be able to

CO1 : outline the basic management principles and business organization practices	K2
CO2 : interpret the business management process in organizations	K2
CO3 : demonstrate the leadership qualities in an organization	K2
CO4 : relate the importance of interpersonal ethical relations in an organization	K2
CO5 : explain the significance of ethical codes for sustainable development	K2

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Management – Science or art – Manager Vs entrepreneur – Managerial roles, skills and styles – Evolution of management thought – Types of business organization – Current trends and issues in management.

UNIT II PLANNING AND ORGANISING 9

Planning – Nature and purpose of planning – Planning process – Types of planning – Strategic management – MBO – Decision making process – Organizing – Nature and purpose of organizing – Formal and informal organization – Organization chart – Organization structure – Line and staff Authority – Centralization and decentralization – HRM – Career planning.

UNIT III DIRECTING AND CONTROLLING 9

Directing – Nature and purpose of directing – Motivation – Motivation theories – Job satisfaction – Job enrichment – leadership – Communication – Process and barrier of communication – Controlling – System and process of controlling – Budgetary and non-budgetary control techniques – Control performance – Direct and preventive control – Reporting

UNIT IV ENGINEERING ETHICS 9

Engineering ethics – Why engineering ethics – Personal Vs professional ethics – Code of ethics – Analysis of issues in ethical problems – Ethical problem solving techniques – Risk – Safety – Accidents – Professional responsibilities of engineers – Professional rights and whistle – Blowing.

UNIT V GLOBAL ETHICAL ISSUES 9

Ethical issues in engineering practices – Environmental ethics – Sustainable development – Environmental leadership – Global issues – Code of ethics of professional engineering societies – IEEE, NSPE, ASME, ASCE, AICHE, Japan society of civil engineers.

TOTAL: 45

TEXT BOOKS:

1. Harold Koontz and Heinz Welhrich, “Essentials of Management an International, Innovation and Leadership Perspective”, 11th Edition, McGraw Hill, 2020.

- Charles B Fleddermann, "Engineering Ethics", 4th Edition, Prentice Hall, 2016.

REFERENCE BOOKS:

- Stephen P Robbins and Mary A Coulter, "Management", 14th Edition, Pearson Education, 2017.
- Tripathi P C and Reddy P N, "Principles of Management", 7th Edition, Tata McGraw Hill, 2021.
- Christopher P Neck, Jeffery D Houghton, Emma Murray and Charles L Lattimer, "Management", 2nd Edition, Wiley, 2017.
- Ibo van de Poel and Lamber Royakkers Ethics, Technology, and Engineering: An Introduction, 2nd Edition, Wiley-Blackwell, 2023.

WEB URLS:

- www.open.lib.umn.edu/principlesmanagement/
- www.ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-805-ethics-and-the-law-on-the-electronic-frontier-fall-2005/
- www.nptel.ac.in/courses/122108038/

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	2	-	1	-	-	3	-	-
CO2	-	-	-	-	-	2	2	-	1	-	-	3	-	-
CO3	-	-	-	-	-	2	2	-	1	-	-	3	-	-
CO4	-	-	-	-	-	-	2	3	1	-	-	3	-	-
CO5	-	-	-	-	-	-	2	3	1	-	-	3	-	-
CO	-	-	-	-	-	2	2	3	1	-	-	3	-	-

23ITR708 INTERNET OF THINGS
(Common to AD/CD/CS/CT/ CY/IT)

L	T	P	C
3	0	2	4

PRE-REQUISITES: Computer Architecture**OBJECTIVES:**

- To acquire knowledge of embedded processor architecture and its programming features
- To understand IoT communication models, open platforms, and protocols for real-world connectivity
- To apply embedded programming and IoT tools to design and implement smart applications

OUTCOMES:

Learners should be able to

CO1 : interpret the architecture and instruction set of 8-bit embedded processors	K2
CO2 : develop embedded C programs for microcontroller-based systems	K3
CO3 : design IoT devices using Arduino and other open-source platforms	K3
CO4 : use appropriate IoT communication protocols and models for real-world applications	K3
CO5 : build end-to-end IoT applications using Arduino/Raspberry Pi.	K3

UNIT I 8-BIT EMBEDDED PROCESSOR**9**

8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers and Serial Port – Interrupt Handling.

UNIT II EMBEDDED C PROGRAMMING**9**

Memory And I/O Devices Interfacing – Programming Embedded Systems in C – Need For RTOS – Multiple Tasks and Processes.

UNIT III IOT AND ARDUINO PROGRAMMING**9**

Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches.

UNIT IV IOT COMMUNICATION AND OPEN PLATFORMS**9**

IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee –GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Connecting to the Cloud.

UNIT V APPLICATIONS DEVELOPMENT**9**

Development of IoT Applications – Smart Agriculture – Smart Cities – Smart Healthcare.

TOTAL: 45**LIST OF EXPERIMENTS:**

1. Write 8051 Assembly Language experiments using simulator.
2. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth)
3. Interfacing sensors with Raspberry PI
4. Communicate between Arduino and Raspberry PI using any wireless medium
5. Log Data using Raspberry PI and upload to the cloud platform
6. Design an IOT based system

TOTAL: 30**TEXT BOOKS:**

1. Raj Kamal, "Internet of Things: Architecture and Design", 2nd Edition, McGraw Hill, 2021.
2. Olivier Hersent, "The Internet of Things: Key Applications and Protocols", 3rd Edition, Wiley, 2021.

REFERENCE BOOKS:

1. Ying Bai, "IoT and Sensor Networks Using Arduino and Raspberry Pi", 1st Edition, CRC Press, 2020.
2. Pethuru Raj & Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", 1st Edition, CRC Press, 2021.
3. Manisha Dubey, "Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed", 1st Edition, CRC Press, 2022.

WEB URLs:

1. <https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot/>
2. <https://www.javatpoint.com/iot-internet-of-things>
3. https://www.tutorialspoint.com/internet_of_things/index.htm

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	-	1	-	-	-	1	-
CO2	2	2	2	-	2	-	-	-	1	-	-	-	1	1

CO3	3	3	2	-	2	-	-	-	1	-	-	-	2	1
CO4	3	3	2	2	2	-	-	-	1	-	-	-	2	2
CO5	3	3	3	3	2	-	-	-	1	-	-	-	2	2
CO	2.6	2.4	2.25	2.5	1.8	-	-	-	1	-	-	-	1.6	1.5

PROFESSIONAL ELECTIVE – I**ARTIFICIAL INTELLIGENCE AND DATA SCIENCE****23CSP101 COGNITIVE SCIENCE**

(Common to CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PRE-REQUISITES: Artificial Intelligence**OBJECTIVES:**

- To understand the theoretical background of cognition
- To acquire the knowledge between cognition and computational intelligence
- To apply probabilistic programming language

OUTCOMES:

Learners will be able to:

- | | | |
|-------------|--|-----------|
| CO1: | interpret the fundamental of cognitive science concepts and AI applications. | K2 |
| CO2: | solve planning and learning methods in cognitive systems. | K3 |
| CO3: | make use of computational intelligence techniques for reasoning and problem-solving. | K3 |
| CO4: | develop cognitive models for memory and language. | K3 |
| CO5: | analyze the models for cognitive processes and their development | K4 |

UNIT I INTRODUCTION TO COGNITIVE SCIENCE 6

Fundamental Concepts of cognitive science – Computers in Cognitive Science – Applied Cognitive Science – The Interdisciplinary Nature of Cognitive Science – Artificial Intelligence: Knowledge representation, semantic networks, frames, conceptual dependency, scripts, Ontology- Understanding, Common Sense Reasoning.

UNIT II PLANNING AND LEARNING METHODS 6

Planning – Situation Logic- Learning in Cognitive Systems- Rote Learning – Learning by Examples - Incremental Concept Learning – Inductive Learning – Classification Techniques – Statistical Reasoning- Bayesian Classification- Bayesian Networks- Concept Learning- Version Spaces - Discrimination Trees.

UNIT III COMPUTATIONAL INTELLIGENCE 6

Reasoning by analogy – Explanation based reasoning – Case based reasoning- Constraint Satisfaction- Constraint Propagation- Temporal reasoning – Temporal Constraint Networks- Spatial reasoning- Visual Spatial reasoning- Meta reasoning – Learning by correcting mistakes in AI ethics

UNIT IV COGNITIVE MODELING 6

Declarative/ logic-based computational cognitive modelling - connectionist models of cognition – Bayesian models of cognition - Cognitive Models of Memory and Language - Computational models of episodic and semantic memory - modelling psycholinguistics (with emphasis on lexical semantics) - towards deep understanding - modelling the interaction of language, memory and learning.

UNIT V LEARNING MODELS OF COGNITION 6

Modelling Select Aspects of Cognition Classical models of rationality - symbolic reasoning and decision making under uncertainty - Formal models of inductive generalization causality - Categorization and similarity analysis - Cognitive Development - Child concept acquisition - Child language learning - Acquisition of arithmetic skills – Distributed Cognition and Learning- Simple and Complex Decision Making – Reasoning Under Uncertainty – Natural Language Understanding – Natural Language Processing.

TOTAL: 30

LIST OF EXPERIMENTS:

1. Demonstration of Mathematical functions using WebPPL.
2. Implementation of reasoning algorithms.
3. Developing an application system using generative model.
4. Developing an application using conditional inference learning model.
5. Application development using hierarchical model.
6. Application development using Mixture model.

TOTAL: 30**TEXT BOOKS:**

1. Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020
2. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, "Probabilistic Models of Cognition", 2nd Edition, 2016

REFERENCE BOOKS:

1. Vijay V Raghavan, Venkat N. Gudivada, Venu Govindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016
2. Mallick, Pradeep Kumar, Borah, Samarjeet, "Emerging Trends and Applications in Cognitive Computing", IGI Global Publishers, 2019.
3. Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence", 3rd Edition, TMS, third Edition.

WEB URLS:

1. www.geeksforgeeks.org/cognitive-computing/
2. ocw.mit.edu/courses/9-66j-computational-cognitive-science-fall-2004
3. elsevier.com/books/cognitive-computing-theory-and-applications/

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	2		-	-	1	1	2	2	1	2
CO2	2	2	1	1	2	-	-	-	3	2	3	1	2	3
CO3	1	3	1	3	3	-	-	-	1	3	1	3	3	1
CO4	2	1	1	2	3	-	-	-	1	2	3	1	3	3
CO5	1	2	3	2	2	-	-	-	1	2	2	2	2	2
CO	1.8	1.8	1.8	2	2.4				1.4	2	2.2	1.8	2.2	2.2

23CSP102 BUSINESS ANALYTICS
(Common to CD/CS/CT/IT)

L	T	P	C
2	0	2	3

PRE-REQUISITES: Nil**OBJECTIVES:**

- To acquire the Analytics Life Cycle and types of analytics for Business Forecasting.

- To understand Comprehend the process of acquiring Business Intelligence
- To apply analytics for different functions of a business

OUTCOMES:

Learners should be able to

CO1:	interpret the real-world business problems and model with analytical solutions.	K2
CO2:	identify the business processes for extracting Business Intelligence	K3
CO3:	build predictive analytics for business fore-casting.	K3
CO4:	utilize the analytics for supply chain and logistics management.	K3
CO5:	make use of analytics for marketing and sales.	K3

UNIT I INTRODUCTION TO BUSINESS ANALYTICS 6

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition- Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation- Interpretation – Deployment and Iteration

UNIT II BUSINESS INTELLIGENCE 6

Data Warehouse and DataMart – Knowledge Management – Types of Decisions – Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions

UNIT III BUSINESS FORECASTING 6

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models –Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.

UNIT IV HR AND SUPPLY CHAIN ANALYTICS 6

Human Resources – Planning and Recruitment – Training and Development - Supply chain network Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain Applying HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT V MARKETING & SALES ANALYTICS 6

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales.

TOTAL: 30

LIST OF EXPERIMENTS**MS-Excel**

1. Perform Z-test, T-test & ANOVA
2. Perform data pre-processing operations i) Handling Missing data ii) Normalization
3. Perform bivariate and multivariate analysis on the dataset.

Power BI Desktop

4. Explore the features of Power BI Desktop
5. Prepare, Load and prepare report for the given data
6. Perform DAX calculations

TOTAL: 30

TEXT BOOKS:

1. G. Somasundaram, Alok Shrivastava, “Information Storage and Management”, EMC Corporation, 2ND Edition, Wiley, 2012.
2. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, “Introduction to Storage Area Networks”, 9th Edition, IBM - Redbooks, 2017.

3. Ulf Tropsen, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein, “Storage Networks Explained”, 2nd Edition, Wiley, 2009.

REFERENCE BOOKS:

1. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2023.

WEB URLS:

1. www.coursera.org/specializations/business-analytics
2. www.onlinecourses.nptel.ac.in/noc23_mg104/preview
3. www.ibm.com/topics/business-analytics

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	-	1	1	-	-	2	2
CO2	2	2	1	1	-	-	-	-	1	1	-	-	2	2
CO3	1	1	2	2	2	-	-	-	1	1	-	2	2	2
CO4	1	2	2	2	2	-	-	-	1	1	-	3	2	2
CO5	1	1	1	1	2	-	-	-	1	1	-	2	2	2
CO	1.2	1.5	1.5	1.5	2	-	-	-	1	1	-	2.3	2	2

23CSP103 TEXT AND SPEECH ANALYSIS

(Common to CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PRE-REQUISITES: Python, Basics of Deep learning, Artificial Intelligence, Machine learning**OBJECTIVES:**

- To acquire the basics of natural language processing
- To understand knowledge on classification algorithms to text documents
- To apply speech recognition system and speech synthesizer

OUTCOMES:

Learners should be able to

- CO1:** interpret existing and emerging deep learning architectures for text and speech processing **K2**
- CO2:** construct deep learning techniques for NLP tasks, language modelling and machine translation **K3**
- CO3:** infer coreference and coherence for text processing **K2**
- CO4:** build deep learning models for speech recognition and text-to-speech systems **K3**
- CO5:** relate the speech recognition techniques **K2**

UNIT I NATURAL LANGUAGE BASICS**6**

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

UNIT II TEXT CLASSIFICATION**6**

Vector Semantics and Embeddings -Word Embeddings – Word2Vec model – Glove model -Fast Text model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models

UNIT III SPEECH ANALYSIS**6**

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

UNIT IV AUTOMATIC SPEECH RECOGNITION**6**

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models n– grams, context dependent sub-word units; Applications and present status.

UNIT V SPEECH SYNTHESIS**6**

Concatenative and waveform synthesis methods, sub word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

TOTAL: 30**LIST OF EXPERIMENTS:**

1. Create Regular expressions in Python for detecting word patterns and tokenizing text
2. Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams
3. Accessing Text Corpora using NLTK in Python
4. Write a function that finds the 50 most frequently occurring words of a text that are not stop words.
5. Implement the Word2Vec model
6. Use a transformer for implementing classification
7. Design a chatbot with a simple dialog system

TOTAL: 30**TEXT BOOKS:**

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, 3rd Edition, Pearson education, 2022.

REFERENCE BOOKS:

1. Muskan Garg, Sandeep Kumar, Abdul Khader Jilani Saudagar, “Natural Language Processing and Information Retrieval: Principles and Applications” 1st Edition, CRC Press, 2024.
2. Dipanjan Sarkar, “Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data”, 1st Edition, APress, 2018.
3. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, “Fundamentals of Speech Recognition” 1st Edition, Pearson, 2009.

WEB URLs:

1. <https://www.classcentral.com/subject/text-to-speech>
2. <https://www.coursera.org/courses?query=speech%20recognition>
3. <https://www.datatrained.com/speech-to-text-conversion-using-python>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	-	1	1	-	1	3	1
CO2	3	2	2	1	1	-	-	-	-	1	-	1	2	1
CO3	3	2	2	1	1	-	-	-	-	1	-	1	3	1
CO4	3	1	1	1	1	-	-	-	1	1	-	-	3	1
CO5	3	3	2	2	1	-	-	-	1	1	-	1	3	1
CO	3	2	1.8	1.2	1	-	-	-	1	1	-	1	2.8	1

23ADR506 DEEP LEARNING
(Common to AD/CD/CS/CT/CY/IT)

PREREQUISITE: Machine Learning Techniques

L	T	P	C
3	0	2	4

OBJECTIVES:

- To acquire fundamental concepts of Neural Networks fundamentals.
- To understand tools and techniques for optimization techniques and data analysis advanced algorithms.
- To apply Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) for various case studies

OUTCOMES:

Learners should be able to

CO1:	demonstrate proficiency in building and training Neural Networks for various tasks	K2
CO2:	interpret optimization techniques effectively to improve model performance	K3
CO3:	solve advanced algorithms for data analysis and dimensionality reduction	K3
CO4:	develop expertise in Convolutional Neural Networks (CNNs) for image recognition	K3
CO5:	survey the appropriate metrics and validation technique for Recurrent Neural Networks (RNNs)	K3

UNIT I INTRODUCTION TO NEURAL NETWORKS**6**

Introduction to Neural networks – Biological neuron – McCulloch pitts neuron – Perceptron – Error and error surfaces – Perceptron learning algorithm – Linearly separable Boolean functions – Sigmoid neuron- Multilayer network of sigmoid neurons – Feedforward neural networks – Output functions and loss functions – Backpropagation – Activation function – Information content, Entropy, cross entropy

UNIT II OPTIMIZATION TECHNIQUES**6**

Gradient descent – Contour maps – Momentum based gradient descent – Nesterov accelerated gradient descent – Stochastic and mini batch gradient descent – Adjusting learning rate and momentum – Adaptive learning rate – Bias correction in Adam.

UNIT III DEEP DIVE INTO VARIOUS ALGORITHMS**6**

Eigen value decomposition - Principal component analysis – Singular value decomposition. Autoencoders – Introduction – Regularization – Denoising autoencoders – Sparse autoencoders -Contractive autoencoders.

Ensemble methods – dropout – unsupervised pretraining – better activation functions – Initialization strategies – Batch normalization.

UNIT IV CONVOLUTIONAL NEURAL NETWORKS

6

Convolutional neural networks – Input layers – Convolution layers – Pooling layers – Dense layers – LeNet – AlexNet – VGG16 – ResNet – Transfer learning with image data – Oxford VGG Model – Google Inception model – R-CNN – Fast R-CNN – Faster R-CNN – Mask R-CNN – YOLO.

UNIT V NATURAL LANGUAGE PROCESSING USING RNN

6

Language modelling – Vector space model – Continuous Bag of words – Skip gram model. RNN: Introduction – Bidirectional RNN – Artificial Neural Network (ANN) – Large Language Model (LLM) - Long Short Term Memory – Bidirectional LSTM – Sequence to sequence models – Gated recurrent unit.

TOTAL: 30

LIST OF EXPERIMENTS

1. Simulate the functioning of McCulloch Pitts neurons in a programming environment.
2. Implement the Perceptron learning algorithm to classify linearly separable Boolean functions.
3. Construct and train a multilayer feedforward neural network for pattern recognition tasks.
4. Implement various gradient descent optimization algorithms.
5. Implement auto encoders and explore regularization techniques.
6. Construct and train CNNs with different architectures for image classification.
7. Implement recurrent neural networks (RNNs) for sequence modeling tasks.

TOTAL: 30

TEXT BOOKS:

1. Francois Collet, Adam Gibson, “Deep Learning with Python”, 2nd Edition, Manning Publication, 2021.
2. Magnus Ekman, “Learning Deep Learning: Theory and Practice of Neural Networks, Computer Vision, Natural Language Processing and Transformers using TensorFlow”, 1st Edition, Addison-Wesley Professional, 2021

REFERENCE BOOKS:

1. Vinita Silaparasetty, “Deep Learning Projects using Tensorflow”, 2nd Edition, APress, 2020
2. David Foster, “Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play”, 2nd Edition Thomson Learning, 2023

WEB URLS:

1. <https://archive.nptel.ac.in/noc/courses/noc18/SEM2/noc18-cs41/>
2. <https://www.deeplearningcourses.com/>
3. <https://www.coursera.org/learn/neural-networks-deep-learning>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	3	-	3
CO2	3	2	1	-	-	-	-	-	2	2	-	3	-	3
CO3	3	2	1	-	-	-	-	-	2	2	-	3	-	3
CO4	3	2	1	1	1	-	-	-	2	2	-	3	-	3
CO5	3	2	1	1	1	-	-	-	2	2	-	3	1	3
CO	2.8	1.8	1	1	1	-	-	-	2	2	-	3	1	3

23ADR508 BIG DATA ANALYTICS

(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
3	0	2	4

PREREQUISITE: Basics of Programming and Fundamentals of Data Science**OBJECTIVES:**

- To acquire a fundamental concepts of big data
- To understand tools and techniques for big data file systems
- To apply data importing and querying techniques in Hive for effective data management.

OUTCOMES:

Learners should be able to

- CO1:** explain the evolution of Big Data, characteristics of Big Data challenges **K2**
- CO2:** apply non-relational databases techniques for storing and processing large volumes of structured and unstructured data. **K3**
- CO3:** analyse data processing and big data analytics approaches **K4**
- CO4:** examine big data solutions for selecting algorithms and data structures appropriately **K4**
- CO5:** categorize efficient big data solutions for application areas using selected algorithms and data structures. **K4**

UNIT I COMPREHENSIVE GUIDE TO HADOOP 6

Hadoop - cluster architecture - Hadoop cluster modes - Common Hadoop shell commands - Hadoop configuration files - single node cluster - multi node cluster - Hadoop administration -MapReduce - MapReduce Combiner - Demo on de-identifying Health Care Data set, Demo on Weather Data analyzing

UNIT II MASTERING APACHE PIG 6

About Pig - MapReduce Vs Pig - Programming Structure - Pig Running Modes - Pig Components Data Models in Pig - Pig Data Types - Shell and Utility Commands - Pig Latin: Relational Operators, File Loaders - Group Operator - Joins and COGROUP – Union - Diagnostic Operators -Specialized joins in Pig, Load and Store Functions - Math function, String Function, Date Function, Pig Streaming, Pig Demo on Healthcare Data set - Creating jar for assignment

UNIT III UNDERSTANDING APACHE HIVE 6

Hive Background - Hive Vs Pig - Hive Architecture and Components, Metastore in Hive - Limitations of Hive- Comparison with Traditional Database - Hive Data Types and Data Models - Partitions and Buckets,

UNIT IV HIVE & HBASE ESSENTIALS 6

Hive Tables (Managed Tables and External Tables), Importing Data, Querying Data, Managing Outputs, Hive Script, Hive UDF, Retail use case in Hive – HBase - HBase Data Model, HBase Shell, HBase Client API, Data Loading Techniques

UNIT V EXPLORING HBASE ARCHITECTURE 6

HBase. Knowledge of HBase Architecture and its components. Topics – Hbase - Introduction to NoSQL Databases and HBase - HBase v/s RDBMS - HBase Components - HBase Architecture -HBase Cluster deployment.

TOTAL: 30**LIST OF EXPERIMENTS:**

1. Hadoop Shell Commands to Manage HDFS and Linux Basic Commands.
2. Count the number of occurrences of each word in a text file.

- Find out successful students using Pig Latin Script.
- Working with Online Social Networks data.
- Calculating a Stock's Covariance.
- Company working data analysis.
- Government financial dataset analysis.

TOTAL: 30**TEXT BOOKS:**

- Stuart J Russel and Peter Norvig, "Hadoop: The Definitive Guide", O'Reilly Media, 4th Edition, 2015.
- Thangaraj, M., suguna, S., sudha, g, "Big Data Analytics Concepts, Techniques, Tools and Technologies", PHI Learning Pvt. Ltd., 2022.

REFERENCE BOOKS:

- Mounia Khelfaoui, Nadjat Kadi, Soraya Sedkaoui, "Big Data Analytics Harnessing Data for New Business Models", Apple Academic Press, 1st Edition, 2021.
- Naresh Kumar and Prashant Shindgikar, "Modern Big Data Processing with Hadoop", Packt Publishing, 1st Edition, 2018.
- Judith S Hurwitz and Alan F Nugent, "Big Data For Dummies", John Wiley & Sons, Inc, 1st Edition, 2013.

WEB URLS:

- www.courseera.org/learn/big-data-integration-processing?specialization=big-data
- www.edx.org/learn/big-data
- www.ibm.com/analytics/hadoop/big-data-analytics

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	3	-	3
CO2	3	2	1	-	-	-	-	-	2	2	-	3	-	3
CO3	3	2	1	1	1	-	-	-	2	2	-	3	-	3
CO4	3	2	1	1	1	-	-	-	2	2	-	3	-	3
CO5	3	2	1	1	1	-	-	-	2	2	-	3	-	3
CO	2.4	2.2	1	1	1	-	-	-	2	2	-	3	-	3

23ADR609 COMPUTER VISION
(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
3	0	2	4

PRE-REQUISITES: Basics of Programming**OBJECTIVES:**

- To acquire fundamental knowledge of computer vision algorithms, stereoscopic imaging and higher-level image processing operations
- To understand tools and techniques for image processing facilities in Octave and open-source tools like OpenCV
- To apply object detection and tracking algorithms for analyzing industrial applications effectively

OUTCOMES:

Learners should be able to

CO1:	Summarize the basic computer vision algorithms, the proper use of shape and its related cue features for computer vision applications	K2
CO2:	Illustrate object detection methodologies for image processing	K2
CO3:	apply Object detection algorithms used in Computer Vision	K3
CO4:	identify the performance of computer vision algorithms	K3
CO5:	analyse an exemplary application on the real–world computer vision problems	K3

UNIT I IMAGE BASICS 9

Image Formation and Representation – Intensity and Range Images – Camera models – Camera parameters – Light and colour – Color Image Processing - Image Noise – Morphological Image Processing - Image Filtering (spatial domain) – Image Compression - Mask based filtering – Frequency Domain Filtering - Image Smoothing – Image Sharpening.

UNIT II IMAGE DETECTION 9

Point and Line Detection – Hough Transform and Shape detection – Edge Detection – Corner Detection – Harris Detector- Stereopsis – Correspondence Problem –RANSAC and Alignment –Epipolar Geometry.

UNIT III IMAGE FEATURES 9

Image Features – Textures – Deformable Contours – Features Reduction – Principal Component analysis – Feature Descriptors – SIFT and SURF– Motion field of rigid objects – Notation of Optical flow

UNIT IV IMAGE ALGORITHMS 9

Estimation Motion Field – Horn and Schunck Algorithm – Lucas and Kanade Algorithm - Shape from Shading and shape from Texture Model based Vision – Smooth Surfaces and their Outlines–Aspect Graphs and Range Data.

UNIT V MACHINE LEARNING 9

Localization – Classification and Evaluation – AdaBoost – Random Decision Forests – Pedestrian Detection.
Emotion Recognition – Real Time Object Detection – Gesture Recognition – Face Detection.

TOTAL: 30

LIST OF EXPERIMENTS:

1. Implementation of Noise removal algorithms
2. Implementation of Object detection based on Edge detection algorithms
3. Implementation of Perspective projection of the lane borders
4. Implementations of Feature Extraction of an object using SIFT.
5. Implementation of Feature Extraction of an object using SURF
6. Implementation of Emotion Recognition
7. Implementation of Object detection using AdaBoost

TOTAL: 30

TEXT BOOKS:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer International, 1st Edition, 2011.
2. V Kishore Ayyadevara, Yeshwanth Reddy, “Modern Computer Vision with PyTorch”, Springer Publishers, 1st Edition”, Packt Publishing, 2020.

REFERENCE BOOKS:

1. Antonio Torralba, Phillip Isola, William T. Freeman, “Foundations of Computer Vision”, MIT Press 2024.
2. Md Atiqur Rahman Ahad, “Computer Vision and Image Processing: Fundamentals and Applications”, 1st Edition, Routledge, 2021.

3. Vasudev Bhaskaran, Upal Mahbub - Computer Vision: Challenges, Trends, and Opportunities, 1st Edition oreilly, 2022.

WEB URLS:

1. <https://www.nptel.ac.in/courses/106/106/106106224/>
2. <https://www.kaggle.com/learn/computer-vision/>
3. <https://viso.ai/deep-learning/computer-vision-tasks/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	2	-	2
CO2	3	2	1	-	-	-	-	-	2	2	-	2	-	2
CO3	3	2	1	1	1	-	-	-	2	2	-	2	-	2
CO4	3	2	1	1	1	-	-	-	2	2	-	2	-	2
CO5	3	2	1	1	1	-	-	-	2	2	1	2	1	2
CO	2.8	1.8	1	1	1	-	-	-	2	2	1	2	1	2

PROFESSIONAL ELECTIVE – II**NEXT – GEN COMPUTING****23ITP201****PARALLEL AND DISTRIBUTED COMPUTING**

(Common to CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PRE-REQUISITES: Computer Architecture**OBJECTIVES:**

- To acquire foundational knowledge of key concepts and principles related to parallel and distributed computing
- To understand analytical modelling techniques and performance metrics of parallel programs
- To apply CUDA programming to implement parallel and distributed computing techniques

OUTCOMES:**Learners should be able to**

CO1:	outline the basics of parallel and distributed computing platforms	K2
CO2:	identify suitable models and frameworks for different computational workloads	K3
CO3:	solve problems using parallel and distributed computing techniques	K3
CO4:	implement algorithms using CUDA programming for parallel and distributed systems	K3
CO5:	develop analytical models to evaluate the performance of parallel programs	K6

UNIT I INTRODUCTION**6**

Latency vs. Bandwidth - Applications and Challenges - Types of architecture - Flynn's taxonomy, Basic concepts: cores, nodes, threads, processes, speedup, efficiency, overhead - strong and weak scaling Amdahl's law, Gustafson's law - Cache, Principle of Locality - Programming Models.

UNIT II DISTRIBUTED COMPUTING**6**

Distributed Memory - Message Passing Interface - Asynchronous/Synchronous computation/communication - concurrency control - fault tolerance - Distributed Programming with OpenMPI.

UNIT III PARALLEL COMPUTING**6**

Shared memory - data and task parallelism – Synchronization - Concurrent Data Structures - Shared Memory - Programming with available APIs: PThreads, OpenMP, TBB.

UNIT IV CUDA PROGRAMMING**6**

GPU Architecture - Programming Models: CUDA/OpenCL - Basic Concepts: Threads, Blocks, Grids - GPU memory hierarchy - Thread Scheduling, Warps and Control divergence - Memory Coalescing - Programming with CUDA, Using CUDA Libraries: CuBLAS, CuFFT.

UNIT V ANALYTICAL MODELING OF PARALLEL PROGRAMS**6**

Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost Optimal Execution Time.

TOTAL: 30**LIST OF EXPERIMENTS:**

1. Create the shared memory for parallel computing with APIs.

2. Demonstrate Memory Coalescing technique in CUDA.
3. Create analytical model of parallel programs.
4. Implement the Dense Matrix Algorithms using parallel and distributed programming techniques with CUDA programming.
5. Implement Search Algorithms for Discrete Optimization Problem using parallel and distributed programming techniques with CUDA programming.
6. Implement Graph Algorithms for Discrete Optimization Problem using parallel and distributed programming techniques with CUDA programming.

TOTAL: 30**TEXT BOOKS:**

1. Thomas Rauber and Gudula Rünger, "Parallel Programming: for Multicore and Cluster Systems", 2nd Edition, Springer, 2021.
2. Shivaratri, Rajeev, "Fundamentals of Parallel and Distributed Computing", 2nd Edition, McGraw Hill Education, 2022

REFERENCE BOOKS:

1. Benyo and Zoltan, "Introduction to Parallel and Distributed Computing", 1st Edition, Springer Nature Switzerland AG, 2021.
2. Gautam Bhanage, "Parallel and Distributed Computing: A Practical Guide to Algorithms, Programming, and Performance", 1st Edition, CRC Press, 2020.
3. Shivaratri and Rajeev, "Fundamentals of Parallel and Distributed Computing", 2nd Edition, McGraw Hill Education, 2022.
4. David B. Kirk and Wen-mei W. Hwu, "Programming Massively Parallel Processors: A Hands-on Approach", 4th Edition, Morgan Kaufmann (Elsevier), 2022.

WEB URLS:

1. <https://www.geeksforgeeks.org/computer-science-fundamentals/introduction-to-parallel-computing/><https://www.geeksforgeeks.org/introduction-of-finite-automata/>
2. https://www.tutorialspoint.com/parallel_computer_architecture/parallel_computer_architecture_models.htm
3. <https://ulhpc-tutorials.readthedocs.io/en/latest/parallel/basics/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	-	1	-	-	-	1	-
CO2	2	2	2	-	2	-	-	-	1	-	-	-	1	-
CO3	3	3	3	-	3	-	-	-	1	-	-	-	2	1
CO4	3	3	3	2	3	-	-	-	1	-	-	-	2	2
CO5	3	3	3	3	3	-	-	-	1	-	-	-	2	2
CO	2.6	2.4	2.75	2.5	2.4	-	-	-	1	-	-	-	1.6	1.25

23ITP202 EDGE COMPUTING

(Common to CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PRE-REQUISITES: Computer Networks**OBJECTIVES:**

- To acquire foundational knowledge of Edge Computing architectures, models, and platforms.

- To understand resource management, middleware, and optimization techniques in edge environments.
- To apply edge computing solutions to real-world problems and emerging technologies.

OUTCOMES:

Learners will be able to

- CO1:** explain the fundamental principles, architectures, and significance of edge computing in distributed systems. **K2**
- CO2:** construct edge computing systems using appropriate architectures, models, and platforms **K3**
- CO3:** implement resource management strategies using task scheduling, allocation, and load balancing algorithms **K3**
- CO4:** apply performance metrics and optimization techniques for edge computing systems **K3**
- CO5:** develop edge computing applications in emerging domains such as AI, 5G, and smart environments **K6**

UNIT I OVERVIEW OF EDGE COMPUTING 6

Edge computing architectures – models - and platforms. Comparison of edge computing with cloud computing and fog computing - Case studies of edge computing applications

UNIT II RESOURCE MANAGEMENT 6

Resource management techniques for edge computing: Task scheduling algorithms, resource allocation algorithms, and load balancing algorithms. Case studies and applications of resource management in edge computing, such as mobile edge computing, and autonomous vehicles.

UNIT III PERFORMANCE ANALYSIS AND OPTIMIZATION 6

Metrics for measuring performance in edge computing: latency, throughput, and energy efficiency. Case studies of performance analysis and optimization in edge computing, such as edge-based video streaming, smart transportation systems, and healthcare IoT devices.

UNIT IV MIDDLEWARE 6

Need for Middleware, Design goals, State-of-the-Art Middleware Infrastructures, System Model: API Code, Security, Device Discovery, Middleware, Sensor and Actuators.

UNIT V EMERGING TRENDS IN EDGE COMPUTING 6

Edge intelligence, Serverless computing, edge security, Hybrid cloud and edge architectures.

TOTAL: 30

LIST OF EXPERIMENTS:**Capstone Project:**

Use Case with brief description, each batch of students should choose one from the following use case to complete the capstone project in Edge Computing

1. Autonomous Vehicles-Edge computing enables autonomous platooning of truck convoys, potentially eliminating the need for drivers in all trucks except the front one.
2. Remote Monitoring of Oil and Gas Assets- Enables real-time analytics with processing closer to the remote asset, reducing reliance on connectivity to a centralized cloud.
3. Smart Grid- Aids in managing energy consumption by enabling real-time visibility of energy use and analysis of consumption.
4. Predictive Maintenance- Brings processing and storage of data closer to the equipment, allowing for real-time health monitoring and analytics.
5. In-Hospital Patient Monitoring-Edge computing on-site provides data privacy, real-time notifications to practitioners, and comprehensive patient dashboards.
6. Virtualised Radio Networks and 5G (vRAN)-Enables complex processing with low latency for virtualised RAN hardware.

7. Cloud Gaming-Cloud gaming companies are using edge servers to reduce latency and improve the gaming experience.
8. Content Delivery-Improves content delivery by caching content at the edge, significantly reducing latency.
9. Traffic Management-Edge computing allows effective city traffic management, optimizing bus frequency, lane usage, and future autonomous car flows.
10. Smart Homes-Bringing processing and storage closer to the smart home can improve performance and security of smart home IoT devices.

TOTAL: 30**TEXT BOOKS:**

1. Furkan Kocak, "Edge Computing: Models, Technologies and Applications", 1st Edition, Springer, 2022.
2. Mohamed F. Aly, "Edge Computing with Kubernetes", 1st Edition, Packt Publishing, 2021.

REFERENCE BOOKS:

1. Kai Hwang, "Cloud and Edge Computing: Scalable, Efficient and Secure Processing of Distributed Applications", 1st Edition, Wiley, 2022.
2. Pethuru Raj, "Edge Computing: A Primer", 1st Edition, CRC Press, 2021.
3. Amir M. Rahmani, "Guide to Edge Computing: Principles and Applications", 1st Edition, Springer, 2020.

WEB URLS:

1. <https://www.geeksforgeeks.org/what-is-edge-computing/>
2. <https://www.javatpoint.com/edge-computing>
3. <https://developer.ibm.com/articles/edge-computing-explained/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	-	1	-	-	-	1	-
CO2	2	2	2	-	2	-	-	-	1	-	-	-	1	-
CO3	3	3	3	-	3	-	-	-	1	-	-	-	2	1
CO4	3	3	3	2	3	-	-	-	1	-	-	-	2	2
CO5	3	3	3	3	3	-	-	-	1	-	-	-	2	2
CO	2.6	2.4	2.75	2.5	2.4	-	-	-	1	-	-	-	1.6	1.25

23CDR502 HUMAN COMPUTER INTERACTION

(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
3	0	2	4

PRE-REQUISITES: Computer Networks**OBJECTIVES:**

- To acquire the foundations of Human Computer Interaction
- To understand the design, software process, interaction styles, models, web interface and mobile HCI
- To apply an interactive design process and universal design principles in designing HCI systems

OUTCOMES:

Learner should be able to

CO1: outline the fundamentals of Human Computer Interaction**K2**

CO2:	build effective dialog for HCI	K3
CO3:	demonstrate effective HCI for individuals and persons with disabilities	K3
CO4:	interpret the HCI implications for designing multimedia, ecommerce and e-learning Web sites	K2
CO5:	develop web and mobile user interface in HCI	K3

UNIT I FOUNDATION OF HCI 9

The Human: I/O channels – Memory – Reasoning and problem solving - Emotion - The Computer: Devices – Positioning, Pointing and Drawing - Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.

UNIT II DESIGN AND SOFTWARE PROCESS 9

Interactive Design: Basics – process – scenarios – navigation – screen design and layout – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Iterative design and prototyping – design rationale. Design rules: principles, standards, guidelines, rules; Evaluation Techniques.

UNIT III INTERACTION STYLES 9

Interaction Styles- Direct Manipulation and Virtual Environments, Menu Selection, Form Filling and Dialog Boxes, Command and Natural Languages, Interaction Devices, Collaboration.

UNIT IV MODELS AND THEORIES 9

Cognitive models - Socio-Organizational issues and stakeholder requirements – Communication and collaboration models - Task Analysis - Hypertext, Multimedia and WWW.

UNIT V WEB INTERFACE DESIGN AND MOBILE HCI 9

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages. Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture.

TOTAL: 45

LIST OF EXPERIMENTS:

1. Design a system based on a user-centered approach.
2. Design the existing GUI with screen complexity.
3. Design web user interface based on Gestalt theory.
4. Implementation of various kinds of menus.
5. Implementation of various kinds of windows.
6. Implementation of various kinds of icons.

TOTAL: 30

TEXT BOOKS:

1. Alan Dix, Janet Finlay, Gregory Abowd and Russell Beale, “Human Computer Interaction”, 3rd Edition, Pearson Education, 2009.
2. Bill Scott and Theresa, “Neil Designing Web Interfaces”, 1st Edition, O’Reilly Media Inc., 2009.

REFERENCE BOOKS:

1. Dan R Olsen, “Human – Computer Interaction”, 1st Edition, Cengage Learning, 2010.
2. Andrew Sears and Julie A Jackson, “The Handbook of Formal Methods in Human-Computer Interaction”, 2nd Edition, Lawrence Erlbaum Associates, 2017.
3. Naas P, “How to Cheat in Maya 2017: Tools and Techniques for Character Animation”, 1st Edition, CRC Press, 2017.

WEB URLS:

1. <https://www.hcibook.com/e3/plain/resources/>
2. <https://www.hcibib.org/>
3. https://www.tutorialspoint.com/human_computer_interface/human_computer_interface_resources.htm

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	1	1	-	1	-
CO2	3	2	2	-	1	-	-	-	1	1	-	1	1
CO3	3	2	2	-	1	-	-	-	1	1	-	1	1
CO4	2	2	-	-	1	-	-	-	1	1	-	1	1
CO5	3	2	2	2	1	-	-	-	1	1	-	1	1
CO	2.8	2	1.6	0.8	1	0	0	0	1	1	0	1	0.8

23ITP203 QUANTUM COMPUTING
(Common to AD/CD/CS/CT/CY/IT)

PRE-REQUISITES: Cryptography and Network Security

L	T	P	C
3	0	0	3

OBJECTIVES:

- To acquire fundamental knowledge of quantum mechanics essential for quantum computing
- To understand quantum computation models, quantum gates, and essential quantum algorithms
- To apply quantum programming techniques using simulators and real quantum computing platforms for solving computational problems

OUTCOMES:

Learners will be able to

CO1 :	explain the fundamental postulates of quantum mechanics and their relevance to quantum computation	K2
CO2 :	analyze quantum circuits using single and multi-qubit quantum gates	K3
CO3 :	implement quantum algorithms such as Deutsch-Jozsa, Grover's, and Shor's for specific computational problems	K3
CO4 :	use quantum programming frameworks like Qiskit to simulate and execute quantum programs on simulators or real quantum devices.	K3
CO5 :	evaluate the applications of quantum computing in secure communication, data processing, and emerging AI domains.	K4

UNIT I QUANTUM COMPUTING BASIC CONCEPTS**7**

Classical and Quantum Computing – Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits – Super positions - entanglement – interference

UNIT II QUANTUM COMPUTATION MODELS**5**

Quantum bits (qubits) and quantum states- Basic single qubit gates- Multiple qubit gates- Circuit development - Measurement in quantum computing

UNIT III QUANTUM ALGORITHMS**7**

Quantum parallelism - Deutsch's algorithm – The Deutsch – Jozsa algorithm – Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm

UNIT IV QUANTUM INFORMATION THEORY**6**

Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem - Classical information over noisy quantum channels

UNIT V QUANTUM APPLICATIONS**5**

Quantum cryptography and quantum key distribution - Shor's Factoring Algorithm - Quantum machine learning

TOTAL: 30**LIST OF EXPERIMENTS:**

1. Single and multiple qubit gate simulation-Quantum Composer
2. Composing simple quantum circuits with q-gates and measuring the output into classical bits.
3. IBM Qiskit Platform Introduction
4. Implementation of Shor's Algorithms and Grover's Algorithm
5. Implementation of Deutsch's Algorithm and Deutsch - Jozsa's Algorithm
6. QKD Simulation

TOTAL: 30**TEXT BOOKS:**

1. Mingsheng Ying, "Foundations of Quantum Programming", 1st Edition, Morgan Kaufmann (Elsevier), 2021.
2. Jack D. Hidary, "Quantum Computing: An Applied Approach", 2nd Edition, Springer Nature Switzerland AG, 2021.

REFERENCE BOOKS:

1. Thomas G. Wong, "Introduction to Classical and Quantum Computing", 1st Edition, Springer Nature Switzerland AG, 2022.
2. Alastair A. Abbott, "The Quantum Computing Fundamentals", 1st Edition, Cambridge University Press, 2023.
3. Chris Bernhardt, "Quantum Computing for Everyone", 1st Edition, MIT Press, 2019.

WEB URL's:

1. <https://www.geeksforgeeks.org/quantum-computing-the-computing-technology-of-tomorrow>
2. <https://learning.quantum.ibm.com/learning-path/understanding-quantum-information-and-computation>
3. <https://quantum.cern/introduction-quantum-computing>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	2	-	-	-	2	1	-	1	2	1
CO2	3	2	1	-	2	-	-	-	2	1	-	1	2	1
CO3	3	2	1	-	2	-	-	-	2	1	-	1	2	1
CO4	3	2	1	-	2	-	-	-	2	1	-	1	2	1
CO5	3	2	1	-	2	-	-	-	2	1	-	1	2	1
CO	3	2	1	-	2	-	-	-	2	1	-	1	2	1

23CDR607 VIRTUAL REALITY AND AUGMENTED REALITY
(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
3	0	2	4

PRE-REQUISITES: Human Computer Interaction

OBJECTIVES:

- To acquire the fundamental aspects and principles of AR/VR technologies
- To understand the internals of the hardware and software components involved in the development of AR/VR enabled applications
- To apply the graphical processing units and their architectures for AR/VR applications

OUTCOMES:

Learner should be able to

CO1:	illustrate the basic concepts of AR and VR	K3
CO2:	make use of tools and technologies related to AR/VR	K3
CO3:	interpret the working principle of AR/VR related to Sensor devices	K2
CO4:	build real-world asserts using modeling techniques	K3
CO5:	develop AR/VR applications in different domains	K3

UNIT I INTRODUCTION 12

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space – Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR – AR Technologies – Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

UNIT II VR MODELING 10

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants – Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation–Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT III VR PROGRAMMING 7

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D.

UNIT IV APPLICATIONS 10

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications– Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics– Information Visualization – VR in Business – VR in Entertainment – VR in Education.

UNIT V AUGMENTED REALITY 6

Introduction to Augmented Reality – Computer vision for AR-Interaction – Modelling and Annotation – Navigation – Wearable devices.

TOTAL: 45

LIST OF EXPERIMENTS:

1. Use the primitive objects and apply various projection types by handling camera.

2. Model three dimensional objects using various modeling techniques and apply textures over them.
3. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
4. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
5. Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.
6. Develop simple MR enabled gaming applications.

TOTAL: 30**TEXT BOOKS:**

1. Charles Palmer and John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", 1st Edition, Packt Publisher, 2018.
2. Dieter Schmalstieg and Tobias Hollerer, "Augmented Reality: Principles & Practice", 1st Edition, Addison Wesley, 2016.

REFERENCE BOOKS:

1. Sherman, William R, Craig and Alan B, "Understanding Virtual Reality", 1st Edition, Elsevier India Private Limited, Noida, 2018.
2. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", 2nd Edition, Wiley, 2017.
3. John Vince, "Introduction to Virtual Reality", 1st Edition, Springer-Verlag, 2004.

WEB URLS:

1. <https://elearn.nptel.ac.in/shop/iit-workshops/completed/foundation-course-on-virtual-reality-and-augmented-reality/>
2. <https://www.iiitb.ac.in/includefiles/userfiles/images/pdf/IIIT%20Bangalore%20Advanced%20Certification%20In%20UI%20UX%20Design.pdf>
3. <https://www.youtube.com/watch?v=spGDKJNq-EE>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	1	-	-	-	-	-	-	1	-
CO2	3	2	1	1	1	-	-	-	1	1	-	1	1
CO3	2	2	1	-	1	-	-	-	1	1	-	1	1
CO4	2	2	2	1	1	-	-	-	1	1	-	1	1
CO5	3	2	2	2	1	-	-	-	1	1	-	1	1
CO	2.6	2	1.6	0.8	1	-	-	-	0.8	0.8	-	1	0.8

23CSR709**MULTICORE ARCHITECTURE AND PROGRAMMING**

(Common to CD/CS/CT/CY//IT)

L	T	P	C
3	0	2	4

PRE REQUISITES: Computer Architecture**OBJECTIVES:**

- To acquire the basic knowledge in parallel and multithreaded programming and need for multi-core processors, and their architecture
- To understand about the various parallel programming paradigms
- To apply the multicore and design parallel programming to obtain solutions

OUTCOMES:

Learners should be able to

- | | | |
|-------------|---|-----------|
| CO1: | explain the architecture, characteristics, and challenges of multicore processors | K2 |
| CO2: | identify the issues in programming parallel processors and synchronization techniques | K3 |
| CO3: | implement parallel and distributed computing algorithms using OpenMP and MPI | K3 |
| CO4: | design parallel programming solutions for real-world problems | K3 |
| CO5: | analyze the differences between serial and parallel processor | K4 |

UNIT I MULTI-CORE PROCESSORS**9**

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks – Symmetric and Distributed Shared Memory Architectures – Cache coherence – Performance Issues – Parallel program design.

UNIT II PARALLEL PROGRAM CHALLENGES**9**

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and live locks – communication between threads (condition variables, signals, message queues and pipes)

UNIT III SHARED MEMORY PROGRAMMING WITH Open MP**9**

Open MP Execution Model – Memory Model – Open MP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

UNIT IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI**9**

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived data types – Performance evaluation

UNIT V PARALLEL PROGRAM DEVELOPMENT**9**

Case studies – n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

TOTAL: 45**TEXT BOOKS:**

1. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris, Pearson, 2021
2. Michael J Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2020.

REFERENCE BOOKS:

1. Peter S. Pacheco, "An Introduction to Parallel Programming, Morgan-Kaufman/Elsevier, 2021.
2. Victor Alessandrini, Shared Memory Application Programming, 1st Edition, Concepts and Strategies in Multicore Application Programming, Morgan Kaufmann, 2018.
3. Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press, 2019.

WEB URLS:

1. https://www.onlinecourses.nptel.ac.in/noc22_cs21/preview
2. https://www.fmcet.in/CSE/CS6801_uw.pdf
3. https://www.onlinecourses.nptel.ac.in/noc23_cs113/preview

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	-	-	-	1	1	1	-	2	2	2

CO2	3	2	2	2	-	-	-	1	1	1	-	2	2	2
CO3	3	2	2	2	-	-	-	1	1	1	-	2	2	2
CO4	3	2	2	2	-	-	-	1	1	1	-	2	2	2
CO5	3	2	2	2	-	-	-	1	1	1	-	2	2	2
CO	2.8	1.8	1.8	1.8	-	-	-	1	1	1	-	2	2	2

PROFESSIONAL ELECTIVE – III**CYBER SECURITY****23CYP303 ETHICAL HACKING**

(Common to AD/CD/CS/CT/CY/IT)

PRE-REQUISITES: Information Security

L	T	P	C
2	0	2	3

OBJECTIVES:

- To acquire knowledge about the fundamental concepts of Ethical Hacking and Network Security
- To understand the methods of enumeration and vulnerability analysis used in network protection.
- To use techniques and software tools for gathering information and identifying vulnerabilities.

OUTCOMES:

Learners will be able to

- CO1:** explain the attacks that target computer networks and operating systems **K2**
- CO2:** illustrate the phases of ethical hacking and vulnerability analysis related to operating systems **K2**
- CO3:** make use of the tools that can be used to perform information gathering **K3**
- CO4:** apply tools to detect exploits involved in system hacking and wireless environments **K3**
- CO5:** engage in independent study as a member of a team and make an effective report on the real world problems **K3**

UNIT I INTRODUCTION 6

Ethical Hacking Overview – Role of Security and Penetration Testers Penetration-Testing Methodologies- Laws of the Land – Overview of TCP/IP – The Application Layer - The Transport Layer – The Internet Layer - IP Addressing – Network and Computer Attacks – Malware – Protecting Against Malware Attacks.– Intruder Attacks - Addressing Physical Security.

UNIT II FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORK 6

Footprinting Concepts – Footprinting through Search Engines – Web Services – Social Networking Sites – Website – Email – Competitive Intelligence – Footprinting through Social Engineering – Foot printing Tools – Network Scanning Concepts – Port-Scanning Tools – Scanning Techniques – Scanning Beyond IDS.

UNIT III ENUMERATION AND VULNERABILITY ANALYSIS 6

Enumeration Concepts – NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration – Vulnerability Assessment Concepts – Desktop and Server OS Vulnerabilities – Windows OS Vulnerabilities – Tools for Identifying Vulnerabilities in Windows – Linux OS Vulnerabilities – Vulnerabilities of Embedded Oss.

UNIT IV SYSTEM HACKING 6

Hacking Web Servers – Web Application Components- Vulnerabilities – Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking – Tools of the Trade.

UNIT V NETWORK PROTECTION SYSTEMS 6

Access Control Lists – Cisco Adaptive Security Appliance Firewall – Configuration and Risk Analysis Tools for Firewalls and Routers – Intrusion Detection and Prevention Systems – Network- Based and Host – Based IDSs and IPSs – Web Filtering – Security Incident Response Teams – Honeypots.

TOTAL:30**LIST OF EXPERIMENTS:**

1. Install Kali or Backtrack Linux / Metasploitable/ Windows XP
2. Practice the basics of reconnaissance.
3. Using FOCA / Search Diggity tools, extract metadata and expanding the target list.
4. Information gathering using tools like Robtex.
5. Scan the target using tools like Nessus.

TOTAL:30**TEXT BOOKS:**

1. The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
2. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

REFERENCE BOOKS:

1. Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014.

WEB URLS:

1. <https://www.eccouncil.org/>
1. <https://www.offensive-security.com/metasploit-unleashed/penetration-testing-methodologies/>
2. <https://www.hackingtutorials.org/wireless-hacking/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	1	-	1	-	-	-	-	2	-
CO2	3	3	2	1	2	-	-	1	-	1	-	-	3	2
CO3	3	3	3	1	2	-	-	-	-	-	1	-	3	3
CO4	3	3	3	1	2	1	1	1	2	1	-	-	3	3
CO5	3	3	3	1	2	2	2	2	1	-	-	1	3	3
CO	3	2.8	2.7	1	2	1.3	1.5	1.2	1.5	1	1	1	3	3

23CYP304 MALWARE ANALYSIS

(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PRE-REQUISITES: Computer Networks

OBJECTIVES:

- To acquire knowledge on various malware attacks by static analysis and dynamic analysis
- To understand the fundamentals of malware, types and its effects
- To apply malware detection techniques in real-time application

OUTCOMES:

Learners should be able to

CO1:	infer the concepts of malware analysis and their technologies used.	K2
CO2:	utilize the concept of Android malware analysis and their architecture in App development.	K2
CO3:	build malware detection mechanism for a virtual system	K3
CO4:	apply malware analysis to safely analyze, debug, and disassemble any malicious software	K3
CO5:	analyze Android malware case studies to detect typical attack vectors	K3

UNIT I INTRODUCTION AND BASIC ANALYSIS 6

Goals of Malware Analysis – AV Scanning, Hashing – Finding Strings – Packing and Obfuscation – PE file format – Static – Linked Libraries and Functions – Static Analysis tools – Virtual Machines and their usage in malware analysis – Sandboxing – Basic dynamic analysis – Malware execution – Process Monitoring – Viewing processes – Registry snapshots

UNIT II ADVANCED STATIC ANALYSIS 7

The Stack – Conditionals – Branching – Rep Instructions – Disassembly – Global and local variables – Arithmetic operations – Loops – Function Call Conventions – C Main Method and Offsets – Portable Executable File Format – The PE File Headers and Sections – IDA Pro – Function analysis – Graphing – The Structure of a Virtual Machine – Analyzing Windows programs – Anti-static analysis techniques – obfuscation – packing – metamorphism – polymorphism.

UNIT III ADVANCED DYNAMIC ANALYSIS 7

Live malware analysis – dead malware analysis – analyzing traces of malware – system calls – API calls – registries – network activities – Anti-dynamic analysis techniques – VM detection techniques – Evasion techniques – Malware Sandbox, Monitoring with Process Monitor – Packet Sniffing with Wireshark – Kernel vs – User-Mode Debugging – OllyDbg – Breakpoints – Tracing – Exception Handling – Patching.

UNIT IV MALWARE FUNCTIONALITY 5

Downloaders and Launchers – Backdoors – Credential Stealers – Persistence Mechanisms – Handles – Mutexes – Privilege Escalation – Covert malware launching – Launchers – Process Injection – Process Replacement – Hook Injection – Detours – APC injection.

UNIT V ANDROID MALWARE ANALYSIS 5

Android Malware Analysis: Android architecture – App development cycle – APK Tool – APK Inspector – Dex2Jar – JD-GUI – Static and Dynamic Analysis – Case studies.

TOTAL: 30

LIST OF EXPERIMENTS:

1. Experiment on Sandboxing Malware and Gathering Information from Runtime Analysis

2. Experiment on Portable Executable (PE32) File Format /Adobe PDF
3. Experiment on Executable Metadata and Executable Packers
4. Experiment on Malware Self - Defense, Compression, and Obfuscation Techniques
5. Experimentation on Mobile malware analysis
6. Experiment on Packing and Unpacking of malware
7. Experiment on Malware traffic analysis

TOTAL: 30**TEXT BOOKS:**

1. Dylan Barker, "Malware Analysis Techniques", Packt Publishing, 2021.
2. Victor Marak, "Windows Malware Analysis Essentials" Packt Publishing, O'Reilly, 2015.
3. Michael Sikorski and Andrew Honig, "Practical Malware Analysis" by No Starch Press, 2012.

REFERENCE BOOKS:

1. Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, "Android Malware and Analysis", CRC Press, Taylor & Francis Group, 2015.
2. Windows Malware Analysis Essentials by Victor Marak, Packt Publishing, 2015.
3. Bruce Dang, Alexandre Gazet, Elias Bachaalany, Sébastien Josse, "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation", 2014.

WEB URLS:

1. <https://www.geeksforgeeks.org/introduction-to-malware-analysis/>
2. <https://www.udemy.com/course/basic-introduction-to-malware-analysis/>
3. <https://intellipaat.com/blog/malware-analysis/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	3	-	3
CO2	3	2	1	-	-	-	-	-	2	2	-	3	-	3
CO3	3	2	1	1	1	-	-	-	2	2	-	3	-	3
CO4	3	2	1	1	2	-	-	-	2	2	-	3	-	3
CO5	3	2	1	1	2	-	-	-	2	2	1	3	1	3
CO	2.4	2.2	1	1	1.6	-	-	-	2	2	1	3	1	3

23CYP305 ENGINEERING SECURE SOFTWARE SYSTEMS
(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PRE-REQUISITES: computer networks**OBJECTIVES:**

- To acquire knowledge about the principles and necessity of secure software design
- To understand risk management techniques in secure software development
- To apply tools for Software design, testing and project management

OUTCOMES:**Learners should be able to**

CO1:	Identify the vulnerabilities and attacks related to software security	K2
CO2:	Explain the models, processes and frameworks involved in the software design life cycle And project management	K2
CO3:	Interpret the various techniques for applying security principles in software development And project management	K3
CO4:	Make use of the assessment methods and mitigation techniques involved in risk Management and the testing phase of software development	K3
CO5:	Apply tools to ensure software security throughout the different phases of its development	K3

UNIT I NEED OF SOFTWARE SECURITY AND LOW- LEVEL ATTACKS 6

Software Assurance and Software Security - Threats to software security - Sources of software in security – Benefits of Detecting Software Security – Properties of Secure Software – Memory Based Attacks: Low - Level Attacks against Heap and Stack - Defense Against Memory-Based Attacks.

UNIT II SECURE SOFTWARE DESIGN 6

Requirements Engineering for secure software - SQUARE process Model – Requirement elicitation and prioritization- Isolating the Effects of Un trusted Executable Content – Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles.

UNIT III SECURITY RISK MANAGEMENT 6

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management.

UNIT IV SECURITY TESTING 7

Traditional Software Testing – Comparison - Secure Software Development Life Cycle – Risk Based Security Testing – Prioritizing Security Testing with Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client-Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing.

UNIT V SECURE PROJECT MANAGEMENT 5

Governance and security – Adopting an enterprise software security framework – Security and project management - Maturity of Practice.

TOTAL: 30**LIST OF EXPERIMENTS:**

1. Implement the SQL injection attack.
2. Implement the Buffer Over flow attack.
3. Implement Cross Site Scripting and Prevent XSS.
4. Perform Penetration testing on a web application to gather information about the system, then initiate XSS and SQL injection attacks using tools like Kali Linux.
5. Develop and test the secure test cases.
6. Penetration test using kali Linux.

TOTAL: 30

TEXT BOOKS:

1. Erik Fretheim, Marie Deschene, "Secure Software Systems", Jones & Bartlett Learning, 2023.
2. Evan Wheeler, "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up", Syngress Publishing, 2011

REFERENCE BOOKS:

1. Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012
2. Bryan Sullivan and Vincen tLiu, "Web Application Security, A Beginner's Guide", Kindle Edition, Mc Graw Hill, 2012
3. Lee Allen, "Advanced Penetration Testing for Highly Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, Packt Publishing, 2012.

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<https://study.com/academy/lesson/secure-software-definition-characteristics.html>
<https://www.geeksforgeeks.org/what-is-software-security-definition-and-best-practice/>
<https://www.isaca.org/resources/isaca-journal/issues/2020/volume-2/governance-and-security>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	-	1	-	2	2	-
CO2	2	1	-	-	1	-	-	1	-	1	-	2	2	-
CO3	3	2	1	-	1	-	-	1	-	1	-	2	2	2
CO4	3	2	1	-	1	-	-	1	-	1	-	2	2	2
CO5	3	2	1	-	1	1	-	1	1	1	-	2	2	2
CO	2.6	1.6	1	-	1	1	-	1	1	1	-	2	2	2

23CYP305 SOCIAL NETWORK SECURITY
 (Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PRE-REQUISITES: computer networks

OBJECTIVES:

- To acquire the knowledge about semantic web and its measures for network analysis
- To understand Privacy and Security issues in Social Networking
- To apply the techniques and tools to predict human behavior in social communities

OUTCOMES:

Learners should be able to

CO1:	explain the fundamental concepts of social networking, privacy, and security paradigms	K2
CO2:	identify security issues in networks and the effect of context and anonymity on users.	K2
CO3:	Apply extraction and mining techniques for analyzing social networking data	K3
CO4:	make use of security tools and techniques to predict the human behavior in social communities	K3
CO5:	analyze methods for access control, identity management, and user authentication to ensure	K4

security in social networks

UNIT I FUNDAMENTALS OF SOCIAL NETWORKING 6

Introduction to Semantic Web- Limitations of current Web- Development of Semantic Web- Emergence of the Social Web- Social Network analysis- Development of Social Network Analysis- Key concepts and measures in network analysis- Historical overview of privacy and security- Major paradigms for understanding privacy and security.

UNIT II SECURITY ISSUES IN SOCIAL NETWORKS 6

The evolution of privacy and security concerns with networked technologies - Contextual influences on privacy attitudes and behaviors- Anonymity in a networked world.

UNIT III EXTRACTION AND MINING IN SOCIAL NETWORKING DATA 6

Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community- Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Big data and Privacy.

UNIT IV PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES 6

Understanding and predicting human behavior for social communities- User data Management- Inference and Distribution- Enabling new human experiences- Reality mining- Context- Awareness- Privacy in online social networks- Trust in online environment- Neo4j- Nodes- Relationships- Properties.

UNIT V ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT 6

Understand the access control requirements for Social Network- Enforcing Access Control Strategies- Authentication and Authorization- Roles-based Access Control- Host- storage and network access control options- Firewalls- Authentication and Authorization in Social Network- Identity & Access Management- Single Sign-on- Identity Federation- Identity providers and service consumers- The role of Identity provisioning.

TOTAL: 30

LIST OF EXPERIMENTS:

- 1.Design own social media application.
2. Create a Network model using Neo4j.
3. Read and write Data from Graph Database.
- 4 Find "Friend of Friends" using Neo4j.
5. Implement secure search in social media.
6. Create a simple Security & Privacy detector.

TOTAL: 30

TEXT BOOKS:

1. David Easley, Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning about a Highly ConnectedWorld,1st Edition, Cambridge University Press, 2010.
2. Borko Furht,"Hand book of Social Network Technologies and Application",1st Edition,Springer,2010.

REFERENCE BOOKS:

1. Easley D. Kleinberg J, "Networks, Crowds, and Markets –Reasoning about a Highly Connected World",

Cambridge University Press, 2010.

2. Jackson, Matthew O, "Social and Economic Networks", Princeton University Press, 2008.

WEB URLs:

1. <https://www.geeksforgeeks.org/socialnetwork-definition-uses-and-principles/>

2. <https://codehs.com/tutorial/jennifer/social-networksecurity>

3. <https://www.tutorialspoint.com/socialnetworksecurity/index.html>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	2	2	-	1	2	2
CO2	2	1	-	-	1	-	-	2	2	2	-	1	2	2
CO3	3	2	1	-	2	-	-	2	2	2	1	1	2	2
CO4	3	2	1	-	2	-	-	2	2	2	1	2	2	2
CO5	3	2	1	-	2	-	-	2	2	2	1	2	2	2
CO	2.6	1.6	1	-	1.6	-	-	1.8	2	2	1	1.4	2	2

23CYP406 MODERN CRYPTOGRAPHY (Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PRE-REQUISITES: computer networks

OBJECTIVES:

- To acquire the knowledge about fundamentals of symmetric and asymmetric cryptograph
- To understand the mathematical aspects of cryptographic algorithms
- To apply authentication and secret keys haring techniques to secure networks from attacks

OUTCOMES:

Learners should be able to

- CO1:** explain the fundamentals of cryptography, semantic security, and their principles **K2**
- CO2:** describe the various attacks under Message In distinguish ability and Non-malleability **K2**
- CO3:** apply hash functions, and pseudo random generators in cryptographic applications **K3**
- CO4:** make use of pseudo random permutations using the Luby-Rack off Construction and analyze its role in block cipher **K3**
- CO5:** analyze message authentication codes (MACs) and public key signature schemes for secure Communication. **K4**

UNIT I INTRODUCTION 6

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message In distinguish ability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Gold wasser- Micali Encryption. Gold reich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

UNIT II FORMAL NOTIONS OF ATTACKS 6

Attacks under Message In distinguish ability: Chosen Plaintext Attack (IND-CPA), Chosen Cipher text Attacks

(IND- CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM- CPA and NM-CCA2, Inter-relations among the attack model.

UNIT III RANDOM ORACLES 6

Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF).

UNIT IV BUILDING A PSEUDO RANDOM PERMUTATION 6

The Luby Rack off Construction: Formal Definition, Application of the Luby Rack off Construction to the construction of Block Ciphers, The DES in the light of Luby Rack off Construction.

UNIT V MESSAGEAUTHENTICATIONCODES 6

Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme.

TOTAL: 30

LIST OF EXPERIMENTS:

1. Implement Feige-Fiat- Shamir identification protocol
2. Implement GQ identification protocol
3. Implement Schnorr identification protocol
- 4 Implement Rabin one-time signature scheme
5. Implement Merkle one-time signature scheme
6. Implement GMR one-time signature scheme

TOTAL: 30

TEXT BOOKS:

1. Introduction to Modern Cryptography, 3rd Edition Katz, Jonathan and Lindell, Yehuda Hardcover, December 2020.
2. Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag, Second Edition, 2010.

REFERENCE BOOKS:

1. Shaffi Goldwasser and Mihir Bellare, Lecture Notes on Cryptography, 2008.
2. William Stallings, "Cryptography and Network Security: Principles and Practice", PHI 3rd, Edition, 2006.

WEB URLs:

1. https://www.tutorialspoint.com/cryptography/modern_cryptography.htm
2. <https://www.geeksforgeeks.org/cryptography-tutorial/>
3. <https://www.w3schools.in/cyber-security/modern-encryption>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	1	-	2
CO2	2	1	-	-	-	-	-	-	2	2	-	1	-	3
CO3	3	2	1	-	-	-	-	-	2	2	-	1	-	2

CO4	3	2	1	-	-	-	-	-	2	2	-	1	-	2
CO5	3	3	2	1	-	-	-	-	2	2	-	1	-	2
CO	2.6	1.8	1.3	1	-	-	-	-	2	2	-	1	-	2.2

23CYR608 DIGITAL AND MOBILE FORENSICS

(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PRE-REQUISITES: Basics of Cyber Security**OBJECTIVES:**

- To acquire knowledge of digital forensics investigation process and data collection techniques
- To understand digital crimes and the role of law enforcement in the collection of digital evidence
- To apply the tools and techniques for the data collection and investigation on mobile devices

OUTCOMES:

Learners will be able to

- CO1:** explain the fundamentals of digital forensic with its phases and explore its relationship with forensic science **K2**
- CO2:** describe digital crimes, the legal considerations and the methods used for collection of digital evidence **K2**
- CO3:** apply forensic readiness frameworks and methodologies in digital investigations **K3**
- CO4:** analyze the challenges in the rapidly evolving field of digital forensics **K4**
- CO5:** make use of forensic techniques, security measures, and tools to conduct investigations on mobile devices **K3**

UNIT I INTRODUCTION TO DIGITAL FORENSICS 9

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase.

UNIT II DIGITAL CRIME AND INVESTIGATION 9

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence.

UNIT III DIGITAL FORENSIC READINESS 9

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics.

UNIT IV iOS FORENSICS 9

Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – I Cloud.

UNIT V ANDROID FORENSICS 9

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security– Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling.

TOTAL:30

LIST OF EXPERIMENTS:

1. Installation of Sleuth Kit on Linux. List all data blocks. Analyze allocated as well as unallocated blocks of a disk image
2. Data extraction from call logs using Sleuth Kit
3. Data extraction from SMS and contacts using Sleuth Kit
4. Install Mobile Verification Toolkit or MVT and decrypt encrypted iOS backups
5. Extract installed applications from Android devices
6. Extract diagnostic information from Android devices through the adb protocol
7. Generate a unified chronological timeline of extracted records

TOTAL:30

TEXT BOOKS:

1. Chuck Easttom, "An In-depth Guide to Mobile Device Forensics", 1st Edition, CRC Press, 2022.
2. AndreArnes, "DigitalForensics", Wiley, 2018.

REFERENCE BOOKS:

1. EC-Council, "Computer Forensics: Investigating Network Intrusions and Cyber Crime", Cengage Learning, 3rd Edition, 2018.
2. Gerard Johansen, Kristopher Rush, "Digital Forensics and Incident Response: A Practical Guide to Deploying Digital Forensics and Incident Response", A press, 2017.
3. Vacca J, "Computer Forensics, Computer Crime Scene Investigation", 2nd Edition, Charles River Media, 2005.

WEB URLs:

1. <https://www.geeksforgeeks.org/mobile-forensics-definition-uses-and-principles/>
2. <https://codehs.com/tutorial/jennifer/digital-forensics>
3. https://www.tutorialspoint.com/python_digital_forensics/index.html

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	3	2
CO2	2	1	-	-	-	-	-	2	2	2	-	3	2
CO3	3	2	1	-	2	-	-	1	2	2	-	3	2
CO4	3	2	1	-	2	-	-	1	2	2	-	3	2
CO5	3	2	1	-	2	-	-	1	2	2	-	3	2
CO	2.6	1.6	1	-	2	-	-	1.25	2	2	-	3	2

PROFESSIONAL ELECTIVE – IV

CLOUD COMPUTING

23CTP401 DEVOPS

(Common to AD/ CD/ CS/ CT/ CY/ IT)

L	T	P	C
3	0	2	4

PREREQUISITES: Cloud Computing

OBJECTIVES:

- To acquire Knowledge on DevOps terminology, Continuous Integration and Deployment using Jenkins and Ansible
- To Understand how to manage and collaborate code efficiently with teams using Git and GitHub
- To apply the benefits and drive the adoption of cloud-based DevOps tools to solve real world problems

OUTCOMES:

Learners should be able to

- | | | |
|-------------|--|-----------|
| CO1: | Interpret the collaborative culture between DevOps teams and gain information of cloud service providers | K2 |
| CO2: | Develop a strong foundation in version control, collaboration, and project management | K3 |
| CO3: | Build automating test cases in Jenkins and Maven | K3 |
| CO4: | Make use of Jenkins and Ansible for continuous integration and deployment | K3 |
| CO5: | Deploy the applications in Cloud platform using DevOps tools | K3 |

UNIT I	INTRODUCTION TO DEVOPS	6
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Software process models - Iterative Agile software development –DevOps Essentials – Lifecycle, Stages, Workflow and Principles - Roles, Responsibilities, and Skills of a DevOps Engineer - DevOps on cloud - AWS-GCP- Azure

UNIT II VERSION CONTROL WITH GIT AND GITHUB 6

Git and GitHub - Version Control System and Types - Difference between CVCS and DVCS - GIT Basic - GIT Command Line - Installing Git - Initial setup - Git Essentials - Creating repository - Cloning - check- in and committing - Fetch pull and remote - Branching, Creating, Switching and Merging the branches.

UNIT III CONTINUOUS INTEGRATION USING JENKINS 7

Understanding continuous integration - Introduction about Jenkins: Build Cycle, Jenkins Architecture - Jenkins Installation - Overview of Maven – Maven project Structure – Maven Plugins – Project Object Model (POM) – Maven Build life cycle – Adding external dependencies to maven pom.xml – Maven build and test project - Exploring Jenkins Dashboard, Jobs - Creating Jobs, Running the Jobs - Setting up the global environments for Jobs - Disabling and deleting jobs - Build Deployments

UNIT IV	CONFIGURATION MANAGEMENT USING ANSIBLE	5
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Ansible Introduction – Installation - Ansible master/slave architecture - Ansible modules – Ansible Inventory files - Adhoc commands - YAML basics – Ansible Playbook – Creating Roles using Ansible Galaxy, Include vs Import.

UNIT V	DEVOPS ON AWS	6
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AWS DevOps Architecture - Thinking in DevOps: The Build, The Test - Automate Testing - Continuous

Integration - Build the Pipeline - Deployment Strategies for Virtual Machines - Deployment Strategies for Serverless - Deploying to Compute.

TOTAL: 30

LIST OF EXPERIMENTS

1. Study and use of DevOps Automation Tools.
2. Perform implementation of various git commands to push and pull a repository, from GitHub.
3. Creating simple Maven project and perform unit test and resolve dependencies.
4. Create CI pipeline using Jenkins.
5. Create a CD pipeline in Jenkins and deploy in Cloud.
6. Create an Ansible playbook for a simple web application infrastructure.

TOTAL: 30

TEXT BOOKS:

1. Gene Kim, Jez Humble and Patrick Debois, —The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations, revolution press, 2nd Edition, 2021.
2. Brian Ward, —How Linux Works, What Every Superuser Should Know, no starch press, 3rd Edition, 2021.

REFERENCE BOOKS:

1. Mitesh Soni, —Hands-On Azure Devops: Cidc Implementation for Mobile, Hybrid, And Web Applications Using Azure Devops and Microsoft Azure: CICD Implementation for DevOps and Microsoft Azure, 1st Edition, 2020.
2. Mariot Tsitoara, —Ansible Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer, 2nd Edition, 2019.

WEB URLS:

1. <https://www.jenkins.io/user-handbook.pdf>
2. <https://www.maven.apache.org/guides/getting-started/>
3. <https://www.learn.microsoft.com/en-us/azure/education-hub/about-azure-for-students>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	-	-	-	-	-	-	-	1	-
CO2	2	1	1	-	-	-	-	-	-	-	-	-	1	1
CO3	3	2	1	1	-	-	-	-	-	-	-	-	1	1
CO4	3	2	1	1	-	-	-	-	-	-	-	1	2	1
CO5	3	2	1	1	-	-	-	-	-	-	-	1	2	1
CO	2.6	1.6	1	1	-	-	-	-	-	-	-	1	1.4	1

23CTP402 VIRTUALIZATION

L	T	P	C
2	0	2	3

PREREQUISITES: Cloud Computing**OBJECTIVES:**

- To acquire fundamental knowledge of virtualization concepts and technologies
- To understand the different types of virtualization and their applications in modern IT environments
- To apply virtualization tools and techniques for server, network, and storage management

OUTCOMES:

Learners should be able to

- CO1:** explain the basic concepts and architectures of virtualization, along with the concepts, characteristics, and service models of cloud computing **K2**
- CO2:** analyze the different types of server, desktop and network virtualization **K4**
- CO3:** build server and desktop virtualization environments using suitable platforms and tools **K3**
- CO4:** apply network and storage virtualization techniques to improve efficiency and scalability **K3**
- CO5:** demonstrate proficiency in using various virtualization tools and configuring them for practical applications **K3**

UNIT I INTRODUCTION TO VIRTUALIZATION 6

Virtualization and cloud computing - Need of virtualization - Cost, Administration - Fast deployment – reduce infrastructure cost – limitations - Types of hardware virtualization : Full virtualization - Partial virtualization - Para virtualization - Types of Hypervisors

UNIT II SERVER AND DESKTOP VIRTUALIZATION 6

Virtual machine basics - Types of virtual machines - Understanding Server Virtualization - types of server virtualization- Business Cases for Server Virtualization - Uses of Virtual Server Consolidation - Selecting Server Virtualization Platform - Desktop Virtualization - Types of Desktop Virtualization

UNIT III NETWORK VIRTUALIZATION 6

Introduction to Network Virtualization - Advantages – Functions - Tools for Network Virtualization – VLAN - WAN Architecture - WAN Virtualization

UNIT IV STORAGE VIRTUALIZATION 6

Memory Virtualization - Types of Storage Virtualization - Block, File-Address space Remapping-Risks of Storage Virtualization – SAN – NAS - RAID

UNIT V EXPRESS JS AND ADVANCED BACKEND DEVELOPMENT 6

VMWare - Amazon AWS - Microsoft HyperV - Oracle VM Virtual Box - IBM PowerVM - Google Virtualization - Case Study

TOTAL: 30**LIST OF EXPERIMENTS**

1. Create Type 2 virtualization in VMWare or any equivalent open-source tool. Allocate memory and storage space as per requirement. Install Guest OS on VMWare.
2. Configure the following tasks in VMWare:
 - a. Shrink and extend virtual disk

- b. Create, manage, configure, and schedule snapshots
 - c. Create spanned, mirrored, and striped volume
 - d. Create RAID 5 volume
3. Implement desktop virtualization using VNC and Chrome Remote Desktop.
4. Create Type 2 virtualization on ESXI 6.5 server.
5. Create a VLAN in Cisco Packet Tracer.
6. Install KVM in Linux.
7. Create a nested virtual machine (VM under another VM).

TOTAL: 15**TEXT BOOKS:**

1. Gerardus Blokdyk, "Virtualization A Complete Guide - 2020 Edition," 5STARCOoks, 1st Edition, 2021.

REFERENCE BOOKS:

1. IBM Redbooks, "Virtualization Cookbook for IBM Z Volume 1: IBM z/VM 7.2," IBM, 1st Edition, 2021.
2. Marcello Cinque, Domenico Cotroneo, Luigi De Simone, and Stefano Rosiello, "Virtualizing Mixed- Criticality Systems: A Survey on Industrial Trends and Issues," arXiv, 2021.
3. Gerardus Blokdyk, "Service Virtualization A Complete Guide - 2020 Edition," 5STARCOoks, 1st Edition, 2021..

WEB URLS:

1. <https://www.amazon.com/Virtualization-Essentials-2nd-Matthew-Portnoy/dp/1119267722>
2. https://books.google.com/books/about/Virtualization_Essentials.html?id=5PSVnKvAVTMC
3. <https://www.yumpu.com/en/document/view/33266511/virtualization-essentials>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	–	–	1	–	–	–	–	1	1		1	1
CO2	1	1	–	–	–	–	–	–	–	1	1		1	1
CO3	2	2	1	–	1	–	–	–	–	1	1		1	1
CO4	3	2	2	–	1	–	–	–	–	1	1		1	1
CO5	3	2	2	–	1	1	1	–	–	1	1		1	1
CO	2	1.6	1.6	-	1	1	1	–	–	1	1		1	1

23CTP403 CLOUD SERVICES MANAGEMENT

L	T	P	C
3	0	2	4

PREREQUISITES: Cloud Computing**OBJECTIVES:**

- To acquire knowledge of cloud service management fundamentals, service models, and deployment models
- To understand the strategy, architecture, and economics involved in cloud service management
- To apply cloud service management concepts, including governance, value measurement, and cost analysis

OUTCOMES:

Learners should be able to

- CO1:** interpret Information Technology Service Management (ITSM) and Cloud Service Management principles. **K2**
- CO2:** compare fundamental financial models and cloud service architectures. **K4**
- CO3:** identify legacy systems, benchmark servers, and plan capacity, deployment, and service migration. **K3**
- CO4:** apply pricing models, cloud service charging mechanisms, and cost estimation techniques for cloud services. **K3**
- CO5:** analyze the value of cloud services using performance metrics and the balanced scorecard approach. **K4**

UNIT I CLOUD SERVICE MANAGEMENT FUNDAMENTALS 6
Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models.

UNIT II CLOUD SERVICES STRATEGY 6
Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity Matching, Demand Queueing, Change Management, Cloud Service Architecture.

UNIT III CLOUD SERVICE MANAGEMENT 6
Cloud Service Reference Model, Cloud Service Life Cycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management.

UNIT IV CLOUD SERVICE ECONOMICS 6
Pricing models for Cloud Services, Premium, Pay per Reservation, Pay per User, Subscription-based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud Service Charging, Cloud Cost Models.

UNIT V CLOUD SERVICE GOVERNANCE AND VALUE 6
IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix Understanding the Value of Cloud Services-Measuring the value of Cloud Services-Balanced Scorecard-Total Cost of Ownership

TOTAL: 30

LIST OF EXPERIMENTS

1. Create a Cloud Organization in AWS/Google Cloud or any equivalent Open-Source cloud software like OpenStack, Eucalyptus, OpenNebula with Role-based access control.
2. Create a Cost-model for a web application using various services.
3. Perform Cost-benefit Analysis and create a cost-model for a web application.
4. Create alerts for usage of Cloud resources.
5. Create Billing alerts for your Cloud Organization.
6. Compare Cloud costs for a simple web application across AWS, Azure, and GCP.

TOTAL: 30

TEXT BOOKS:

1. Enamul Haque, "Cloud Service Management and Governance: Smart Service Management in Cloud Era," Lulu Press Inc., 1st Edition, 2020.
2. John Bryson, "Service Management: Theory and Practice," Springer, 1st Edition, 2020.

REFERENCE BOOKS:

1. J.R. "Cloud FinOps: Collaborative, Real-Time Cloud Financial Management," O'Reilly Media, 1st Edition, 2020.
2. Enamul Haque, "Cloud Service Management and Governance: Smart Service Management in Cloud Era," Lulu Press Inc., 1st Edition, 2020.

WEB URLS:

1. <https://www.goodreads.com/book/show/54398595-cloud-service-management-and-governance>
2. <https://www.amazon.com/Service-Management-Practice-John-Bryson/dp/3030520595>
3. <https://www.amazon.com/Cloud-FinOps-Collaborative-Real-Time-Management/dp/1492054623>
4. <https://www.betterworldbooks.com/product/detail/cloud-service-management-and-governance-smart-service-management-in-cloud-era-9781716788352.html>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	1	-	-	-	1	-	-	-	1	1
CO2	2	1	1	1	1	-	-	-	1	-	-	-	1	1
CO3	3	2	1	-	2	-	-	-	2	-	-	-	1	1
CO4	3	2	1	-	1	-	-	-	1	1	-	-	1	1
CO5	3	2	1	-	1	-	-	-	1	1	-	-	1	1
CO	2.4	1.8	1	1	1.2	-	-	-	1.2	1	-	-	1	1

23CYP402 SECURITY AND PRIVACY IN CLOUD

L	T	P	C
2	0	2	3

PREREQUISITES: Computer Networks**OBJECTIVES:**

- To acquire the knowledge about cloud security, cryptographic techniques and access control mechanisms
- To understand cloud security design patterns and their role in ensuring secure cloud environments
- To apply access control mechanisms and authentication techniques for cloud security

OUTCOMES:

Learners should be able to

- CO1:** explain the fundamentals of cloud security services, cryptography, and authentication methods **K2**
- CO2:** describe security design principles, attack vectors, data protection, and virtualization for cloud security **K2**
- CO3:** apply access control, identity management, and authentication techniques in cloud environments **K3**

CO4: analyze cloud security design patterns for secure cloud infrastructure and data access

K4

CO5: make use of auditing, and security management techniques to enhance cloud security

K3

UNIT I FUNDAMENTALS OF CLOUD SECURITY CONCEPTS

6

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Non- repudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT II SECURITY DESIGN AND ARCHITECTURE FOR CLOUD

6

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key.

UNIT III ACCESS CONTROL AND IDENTITY MANAGEMENT

6

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles- based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention.

UNIT IV CLOUD SECURITY DESIGN PATTERNS

6

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud.

UNIT V MONITORING, AUDITING AND MANAGEMENT

6

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management.

TOTAL: 30

LIST OF EXPERIMENTS

1. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in Cloud Sim
2. Simulate resource management using cloud sim
3. Simulate log forensics using cloud sim
4. Simulate a secure file sharing using a cloud sim
5. Implement data anonymization techniques over the simple dataset (masking, k- anonymization)
6. Implement any encryption algorithm to protect the images

TOTAL: 30

TEXT BOOKS:

1. Eduardo Fernandez-Buglioni , "Cloud Security Patterns: Practical Applications of the NIST Cyber security Framework for Cloud Computing" , Wiley, 2019.
2. Mather, Kumaraswamy and Latif, "Cloud Security and Privacy", OREILLY 2011.

REFERENCE BOOKS:

1. Dave shackleford, "Virtualization Security", SYBEX a Wiley Brand 2013.
2. Raj Kumar Buyya , James Broberg, andrzej Goscinski, "Cloud Computing", Wiley, 2013.

3. Ben Halpert, "Auditing Cloud Computing: A Security and Privacy Guide", Wiley, 2011.

WEB URLS:

1. <https://studytm.wordpress.com/wp-content/uploads/2014/03/hand-book-of-cloud-computing.pdf>
2. https://terrorgum.com/tfox/books/cloudcomputingbasics_asefteachingintroduction.pdf
3. https://dphoto.lecturer.pens.ac.id/lecture_notes/internet_of_things/CLOUD%20COMPUTING%20Principles%20and%20Paradigms.pdf

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	2	2	-	1	2	2
CO2	2	1	-	-	2	-	-	1	2	2	-	2	2	2
CO3	3	2	1	-	2	-	-	2	2	2	1	2	3	2
CO4	3	2	1	-	2	-	-	2	2	2	1	2	3	2
CO5	3	2	1	-	2	-	-	2	2	2	1	2	3	2
CO	2.6	2	1	-	2	-	-	1.6	2	2	1	1.8	2.6	2

23CTP403 STORAGE TECHNOLOGIES

L	T	P	C
2	0	2	3

PREREQUISITES: Computer Networks

OBJECTIVES:

To acquire knowledge of the key components, architectures, and technologies of storage systems

To understand the various storage networking technologies, their protocols, and their applications

To apply storage management, backup, replication, and security techniques in real-world scenarios

OUTCOMES:

Learners should be able to

- CO1:** Explain the various storage systems, including their components, types and architectures **K2**
- CO2:** Compare intelligent storage systems RAID configurations and their performance. **K4**
- CO3:** Implement storage networking solutions using technologies such as SAN, iSCSI and FCoE **K3**
- CO4:** Analyze backup, archival and replication methods to address disaster recovery requirements **K4**
- CO5:** Apply security measures to protect storage infrastructure from threats and vulnerabilities **K3**

UNIT I STORAGE SYSTEMS

6

Introduction to Information Storage - Digital data and its types - Information storage - Key characteristics of data center - Evolution of computing platforms - Information Lifecycle Management - Third Platform Technologies - Cloud computing and its essential characteristics - Cloud services and cloud deployment models - Big data analytics - Social networking and mobile computing - Characteristics of third platform infrastructure - Imperatives for third platform transformation - Data Center Environment: Building blocks of a data center - Compute systems and compute virtualization - Software-defined data center

UNIT II INTELLIGENT STORAGE SYSTEMS AND RAID 6

Components of an intelligent storage system - Components, addressing, and performance of hard disk drives and solid-state drives - RAID - Types of intelligent storage systems - Scale-up and scale-out storage architecture

UNIT III STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION 6

Block-Based Storage System - File-Based Storage System - Object-Based and Unified Storage - Fibre Channel SAN - Software-defined networking - FC SAN components and architecture - FC SAN topologies - Link aggregation and zoning - Virtualization in FC SAN environment - Internet Protocol SAN - iSCSI - Protocol, network components, and connectivity - Link aggregation, switch aggregation, and VLAN - FCIP protocol, connectivity, and configuration - Fibre Channel over Ethernet SAN: Components of FCoE SAN - FCoE SAN connectivity - Converged Enhanced Ethernet - FCoE architecture

UNIT IV BACKUP, ARCHIVE AND REPLICATION 6

Introduction to Business Continuity - Backup architecture - Backup targets and methods - Data deduplication - Cloud-based and mobile device backup - Data archive - Uses of replication and its characteristics - Compute-based, storage-based, and network-based replication - Data migration - Disaster Recovery as a Service (DRaaS)

UNIT V SECURING STORAGE INFRASTRUCTURE 6

Information security goals - Storage security domains - Threats to a storage infrastructure - Security controls to protect a storage infrastructure - Governance, risk, and compliance - Storage infrastructure management functions - Storage infrastructure management processes

TOTAL: 30**LIST OF EXPERIMENTS**

1. Set up accounts on different cloud platforms (AWS, Azure, Google Cloud, etc.).
2. Simulate drive failures and recovery scenarios.
3. Explore features like link aggregation and VLANs in the SAN environment.
4. Evaluate different backup targets (e.g., tape, disk, cloud) and methods (full, incremental, differential).
5. Identify potential vulnerabilities and threats (e.g., unauthorized access, data breaches).
6. Implement security controls such as encryption, access controls, and monitoring tools.

TOTAL: 30**TEXT BOOKS:**

1. Chris Hanson and Gerald Jay Sussman, "Software Design for Flexibility," MIT Press, 1st Edition, 2021.
2. Jeremy G. Siek, "Essentials of Compilation," MIT Press, 1st Edition, 2023.

REFERENCE BOOKS:

1. Hans-Georg Fill, "Software Technologies: 15th International Conference, ICSOFT 2020", Springer, 1st Edition, 2021.
2. David Bourgeois, "Information Systems for Business and Beyond," Biola University, 2nd Edition, 2019.
3. Olivier Ezratty, "Understanding Quantum Technologies 2024," Self-published, 7th Edition, 2021.

WEB URLS:

1. <https://mitpress.mit.edu/9780262045490/software-design-for-flexibility/>
2. <https://mitpress.mit.edu/9780262048248/essentials-of-compilation/>
3. <https://link.springer.com/book/10.1007/978-3-030-83007-6>
4. <https://bus206.pressbooks.com/>

5.<https://www.oezratty.net/wordpress/2021/understanding-quantum-technologies-2021/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	-	1	-	-	-	1	1	-	-	1	1
CO2	2	2	-	-	1	-	-	-	1	1	-	-	1	1
CO3	3	2	2	-	1	-	-	-	1	1	-	-	1	1
CO4	3	2	1	-	1	-	-	-	1	1	-	-	1	1
CO5	3	2	1	-	1	-	-	-	1	1	-	-	1	1
CO	2.4	1.8	1.3	-	1	-	-	-	1	1	-	-	1	1

23CTP404 SOFTWARE DEFINED NETWORKS

L	T	P	C
2	0	2	3

PREREQUISITES: Computer Networks

OBJECTIVES:

- To acquire knowledge of the evolving network requirements and the architecture of Software Defined Networks (SDN)
- To understand the functions, protocols, and components in SDN, including Open Flow and SDN controllers
- To apply SDN and Network Function Virtualization (NFV) concepts to design and implement network services and management

OUTCOMES:

Learners should be able to

- CO1:** explain the architecture of SDN and its components, including the data plane, control plane, and application plane. **K2**
- CO2:** analyze SDN protocols such as OpenFlow and understand the communication between SDN controllers and switches. **K4**
- CO3:** build SDN applications and services using controllers and network protocols. **K3**
- CO4:** implement virtual networks using SDN and NFV principles in a virtualized environment. **K3**
- CO5:** apply NFV concepts and orchestrate network functions using tools such as VIM-EMU and OSM. **K3**

UNIT I SDN INTRODUCTION

6

Evolving Network Requirements - The SDN Approach - SDN Architecture - SDN Data Plane, Control Plane, and Application Plane

UNIT II VIRTUALIZATION

6

Data Plane Functions and Protocols - Open Flow Protocol - Flow Table - Control Plane Functions –South bound Interface - Northbound Interface - SDN Controllers - Ryu, Open Daylight, ONOS - Distributed Controllers

UNIT III	SDN APPLICATIONS	6
SDN Application Plane Architecture - Network Services Abstraction Layer - Traffic Engineering - Measurement and Monitoring - Security - Data Center Networking		
UNIT IV	NETWORK FUNCTION VIRTUALIZATION	6
Network Virtualization - Virtual LANs - OpenFlow VLAN Support - NFV Concepts - Benefits and Requirements - Reference Architecture		
UNIT V	NFV FUNCTIONALITY	6
NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration - NFV Use Cases - SDN and NFV		
		TOTAL: 30

LIST OF EXPERIMENTS

- Setup your own virtual SDN lab
 - VirtualBox/Mininet Environment for SDN - <http://mininet.org>
 - <https://www.kathara.org>
- Setup your own Virtual SDN Lab using GNS3
- Create a simple Mininet topology with an SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT.
- Create an SDN application that uses the Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering, Firewall
- Create a simple end-to-end network service with two VNFs using vim-emu (<https://github.com/containernet/vim-emu>)
- Install OSM, onboard and orchestrate a network service.

TOTAL: 30**TEXT BOOKS:**

- Ahmad Arabkoohsar, "Mechanical Energy Storage Technologies," Elsevier Science, 1st Edition, 2020.
- Luisa F. Cabeza (Editor), "Advances in Thermal Energy Storage Systems: Methods and Applications," Woodhead Publishing, 2nd Edition, 2020

REFERENCE BOOKS:

- Michael Sterner and Ingo Stadler (Editors), "Handbook of Energy Storage: Demand, Technologies, Integration," Springer, 1st Edition, 2019.
- Mark Z. Jacobson, "100% Clean, Renewable Energy and Storage for Everything," Cambridge University Press, 1st Edition, 2020.
- Sean White and Saad Youssefi, "Energy Storage Basics: A Study Guide for Energy Practitioners," 1st Edition, 2020.

WEB URLS:

- <https://www.barnesandnoble.com/w/mechanical-energy-storage-technologies-ahmad-arabkoohsar/1136717183>
- <https://www.amazon.com/Advances-Thermal-Energy-Storage-Systems/dp/0128198850>
- <https://link.springer.com/book/10.1007/978-3-662-55504-0>
- <https://www.cambridge.org/highereducation/books/100-clean-renewable-energy-and-storage-for-everything/26E962411A4A4E1402479C5AEE680B08>

5. https://www.amazon.com/Books-Energy-Storage/s?rh=n%3A283155%2Cp_28%3AEnergy%2BStorage

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	–	–	1	–	–	–	1	1	–	–	1	–
CO2	1	2	–	–	–	–	–	–	1	1	–	–	1	–
CO3	2	2	2	–	2	–	–	–	1	1	–	–	1	1
CO4	3	2	2	–	2	–	–	–	1	1	1	–	1	1
CO5	3	2	2	1	2	–	–	–	1	1	1	–	1	1
CO	2	1.8	2	1	1.8	–	–	–	1	1	1	–	1	1

PROFESSIONAL ELECTIVE – V**FULL STACK DEVELOPMENT****23CSP501 MERN STACK DEVELOPMENT**

(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PREREQUISITES: Web Application Development**OBJECTIVES:**

- To acquire the basic knowledge of front-end development using ReactJS
- To understand the backend development concepts using Node.js and ExpressJS
- To apply the concepts of data storage and manipulation for web application using MongoDB

OUTCOMES:

Learners should be able to

- CO1:** utilize ReactJS concepts for front end development and manage state effectively across different components **K3**
- CO2:** integrate MongoDB with Node.js applications to perform CRUD operations and handle data storage efficiently. **K3**
- CO3:** develop RESTful web services using Node.js and Express.js **K3**
- CO4:** use the best practices in ReactJS, Node.js, and Express.js for improving performance and security of web applications **K3**
- CO5:** implement full-stack web applications by using the MERN stack, incorporating front-end, back-end, and database components **K3**

UNIT I INTRODUCTION TO THE MERN STACK & REACT JS BASICS 6

MERN Stack: Overview of MongoDB, Express.js, ReactJS, Node.js. ReactJS Basics: Introduction to ReactJS - DOM and Virtual DOM - Setting Up the Development Environment - React Components: Function Components, Class Components - JSX and Rendering Elements - Handling Events - State and Lifecycle: useState Hook - useEffect Hook - Conditional Rendering - Lists and Keys - Forms and Controlled Components - Lifting State Up - Composition vs Inheritance - Axios for HTTP requests.

UNIT II FRONTEND DEVELOPMENT WITH REACT JS ADVANCED 6

React Router: Navigation - Advanced Hooks: useImmer – useContext – useReducer – useRef - useMemo – useCallback – useLayoutEffect - useImperativeHandle - Custom Hooks - Context API for State Management - Introduction to Redux - Higher-Order Components - Error Boundaries - React Performance Optimization - Lazy Loading and Suspense for Code Splitting - Testing with React Testing Library and Jest - Styling: CSS Modules - Styled Components - Material UI

UNIT III WORKING WITH MONGODB 6

MongoDB Basics: Introduction to MongoDB - MongoDB Basics - Documents - Collections - Query Language - Installation - The Mongo Shell - Schema Initialization - MongoDB Node.js Driver - Reading from MongoDB - Writing to MongoDB - CRUD - MongoDB Atlas for Cloud Database Management.

UNIT IV NODE JS BASICS 6

Node.js Basics: Introduction to Node.js - Setting Up Node.js: Installation and Version Management, Node.js REPL - Node.js Modules: Built-in Modules (os, fs, path, http) - Creating and Exporting Modules - Using npm - Asynchronous Programming: Callbacks – Promises - Async/Await – Building a Simple Web Server: Using the

HTTP Module - Handling Requests and Responses - Working with APIs: Making HTTP Requests - Consuming APIs - Error Handling.

UNIT V EXPRESS JS AND ADVANCED BACKEND DEVELOPMENT

6

Express.js Basics: Introduction to Express.js - Middleware: Built-in Middleware, Third-party Middleware - Custom Middleware - Routing: Defining Routes - Route Parameters - Handling Different HTTP Methods - Modular Routes - Serving Static Files - Working with Templates: Using Template Engines - Data Access and REST APIs - Authentication and Authorization: JWT Authentication - Error Handling: Error Handling Middleware - Deploy MERN application in Cloud Platform

TOTAL: 30

LIST OF EXPERIMENTS

1. Develop basic React components to understand JSX, state, events and routing.
2. Manage state in a complex application using Context API and Redux.
3. Set up MongoDB and perform basic CRUD operations using MongoDB shell and Mongoose.
4. Create a basic web server with Node.js to handle HTTP requests and serve static files.
5. Develop RESTful APIs using Express.js, including CRUD operations and middleware.
6. Deploy a full-stack MERN application to a cloud platform.

TOTAL: 30

TEXT BOOKS:

1. Nabendu Biswas, "Ultimate Full-Stack Web Development with MERN: Design, Build, Test and Deploy Production-Grade Web Applications with MongoDB, Express, React and NodeJS", Orange Education Pvt Ltd, 1st Edition, 2023.
2. David Choi, "Full-Stack React, TypeScript, and Node", Packt Publishing, 1st Edition, 2020.

REFERENCE BOOKS:

1. Anthony Accomazzo, Nate Murray, Ari Lerner, Clay Allsopp, David Guttman, and Tyler McGinnis "Full-stack React: The Complete Guide to ReactJS and Friends", Fullstack.io, 1st Edition, 2020.
2. Bethany Griggs, "Node Cookbook", Packt Publishing, 4th Edition, 2020.
3. Vasan Subramanian, "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node", Apress, 1st Edition, 2018.

WEB URLS:

1. <https://www.react.dev/>
2. <https://www.nodejs.org/docs/latest/api/>
3. <https://www.mongodb.com/resources/products/fundamentals/basics>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO2	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO3	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO4	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO5	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO	3	2	1	-	2	-	-	-	2	1	-	1	2	2

23CYP302 WEB APPLICATION SECURITY

(Common to CD/CS/CY/IT)

L	T	P	C
2	0	2	3

PREREQUISITES: Fundamentals of Web Design**OBJECTIVES:**

- To acquire knowledge about fundamentals of web application
- To understand the development and deployment of web applications in a secure manner. Bottom of Form
- To apply hacking techniques and tools for ensuring the security of web applications

OUTCOMES:

Learners should be able to

- CO1:** explain the concepts of software security and recognize common web application threats **K2**
- CO2:** interpret the practices involved in secure software development, including various lifecycle models **K2**
- CO3:** illustrate techniques for authentication and authorization in web applications **K2**
- CO4:** implement effective security measures for APIs, including secure communication and threat mitigation strategies **K3**
- CO5:** use tools to assess vulnerabilities and apply best practices to address common web security risks **K3**

UNIT I FUNDAMENTALS OF WEB APPLICATION SECURITY 6

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation

UNIT II SECURE DEVELOPMENT AND DEPLOYMENT 6

Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

UNIT III SECURE API DEVELOPMENT 6

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

UNIT IV VULNERABILITY ASSESSMENT AND PENETRATION TESTIN 6

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database- based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT V HACKING TECHNIQUES AND TOOLS 6

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross- Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

TOTAL: 30**LIST OF EXPERIMENTS**

1. Install wire shark and explore the various protocols
 - a. Analyze the difference between HTTP vs HTTPS
 - b. Analyze the various security mechanisms embedded with different protocols.
2. Identify the vulnerabilities using OWASP ZAP tool
3. Create simple REST API using python for following operation
 - a. GET
 - b. PUSH
 - c. POST
 - d. DELETE
4. Install Burp Suite to do following vulnerabilities:
 - a. SQL injection
 - b. cross-site scripting (XSS)
5. Attack the website using Social Engineering method

TOTAL: 30**TEXT BOOKS:**

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.

REFERENCE BOOKS:

1. Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
2. Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
3. Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.

WEB URLS:

1. <https://www.cloudflare.com/learning/ssl/transport-layer-security-tls/>
2. <https://www.istio.io/latest/docs/concepts/security/>
3. <https://www.openvas.org>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	1
CO3	3	2	2	-	2	-	-	1	-	-	-	-	2	2
CO4	3	3	2	-	2	-	-	1	-	-	-	1	2	2
CO5	3	3	2	-	2	-	-	-	2	2	1	1	2	2
CO	3	2.4	2	-	2	-	-	1	2	2	1	1	2	1.6

23CSP502 MOBILE DEVELOPMENT FRAMEWORK
(Common to AD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PREREQUISITES: Web Technology or Fundamentals of Web Design

OBJECTIVES:

- To acquire knowledge of the Flutter framework, its architecture, and the Dart programming language
- To understand the principles of UI design, state management, and networking in Flutter applications
- To apply Flutter for building cross-platform mobile applications with efficient backend integration

OUTCOMES:

Learners should be able to

- | | | |
|-------------|--|-----------|
| CO1: | integrate Dart fundamentals with Flutter's setup to establish a robust mobile development foundation | K3 |
| CO2: | develop interactive user interfaces by combining Flutter's basic and advanced widget techniques | K3 |
| CO3: | construct multi-screen navigation flows and use state management strategies to enhance app responsiveness | K3 |
| CO4: | implement asynchronous programming with integrated networking and database operations in dynamic mobile applications | K3 |
| CO5: | use core programming principles of Flutter, API integration, and database integration techniques to construct and deploy comprehensive mobile applications | K3 |

UNIT I INTRODUCTION TO DART 6

Introduction to Dart – History - Features – Tools - Variables – Data Types – Operators – Control Flow Statements – Functions and Methods – Classes – Objects – Constructors – Null Safety – Exception Handling – Collections – Inheritance - Polymorphism - Mixins - Interfaces – Futures – Streams Async-Await – JSON Serialization – libraries and packages.

UNIT II INTRODUCTION TO FLUTTER 6

Introduction to Flutter – Flutter Architecture – Setting Up Flutter Development Environment – First Flutter App – Hot Reload and Hot Restart – Basic Widgets – Layout Widgets – Flexible & Expanded – Styling and Theming - Colors - Fonts - Material Design.

UNIT III **ADVANCED UI AND INTERACTIVITY** **6**

Understanding Widgets – Stateless and Stateful Widgets – Text and Image Widgets – Button Widgets – Aligning and Positioning Widgets – Scrollable Widgets - Building Simple UI Layouts – Handling User Input – Form Fields and Validation – Gesture Detection - Tap - Drag - Swipe – ListView and GridView – Working with Cards and ListTiles.

UNIT IV ROUTING AND STATE MANAGEMENT 6

Navigation and Routing – Dialogs - Snackbars and Bottom Sheets – Theming and Styling Widgets – Animations and Transitions – Creating Responsive UI – Managing State Using Provider and Riverpod - Cubit – Using `setState()` – Working with Shared Preferences.

UNIT V NETWORKING & DATABASE INTEGRATION 6

HTTP requests – API Integration with HTTP and Chopper – Introduction to Firebase – Firebase Authentication – Firestore Database – CRUD Operations in Firestore – Local Database Integration Using SQLite and Drift – Building and Releasing Flutter Apps for Android and iOS – Publishing to Google Play Store and App Store..

TOTAL: 30

LIST OF EXPERIMENTS

1. Create a console app to manage students, courses, enrollment, and grades. Support GPA calculation using Futures and store data using JSON.
2. Design a responsive app showing user photo, name, job title, contact info, and social handles using layout and theming widgets.
3. Build an application where users can add, view, and delete tasks using forms, ListView, and gesture detectors with input validation.
4. Create a two-screen app with navigation, theming, and animations. Use SharedPreferences and Provider for data and state management.
5. Develop an app that fetches data from an API using HTTP and JSON. Display results asynchronously and also use SharedPreferences.
6. Build an app with Firebase Authentication and Firestore. Enable login, task CRUD, and real-time sync with StreamBuilder.

TOTAL: 30

TEXT BOOKS:

1. Michael Katz, Kevin David Moore, Vincent Ngo, and Vincenzo Guzzi, “Flutter Apprentice”, Kodeco Inc, 4th Edition, 2024.
2. Jonathan Sande, “Data Structures & Algorithms in Dart”, Kodeco Inc, 2nd Edition, 2023.

REFERENCE BOOKS:

1. Priyanka Tyagi, “Pragmatic Flutter: Building Cross-Platform Mobile Apps for Android, iOS, Web & Desktop”, CRC Press, 1st Edition, 2021.
2. Atul Vashisht, “Flutter Architectures: Write code with a good architecture”, Sitaram dev, 1st Edition, 2023.
3. Daria Orlova, Esra Kadah, Jaime Blasco, “Flutter Design Patterns and Best Practices: Build scalable, maintainable, and production-ready apps using effective architectural principles”, Packt Publishing, 1st Edition, 2024.
4. Majid Hajian, “Flutter Engineering”, Staten House, 1st Edition, 2024.

WEB URLS:

1. <https://www.docs.flutter.dev/>
2. <https://www.dart.dev/effective-dart/>
3. <https://www.firebase.google.com/docs/auth/web/start>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO2	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO3	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO4	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO5	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO	3	2	1	-	2	-	-	-	2	1	-	1	2	2

23CSP503 C# and .NET PROGRAMMING
(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PREREQUISITES: Java Programming

OBJECTIVES:

- To acquire the basic knowledge of CLR execution and technologies of the .NET framework
- To understand the Object-Oriented Programming in C
- To apply the concepts of .NET (ASP.NET) for developing web-based application

OUTCOMES:

Learners should be able to

CO1:	interpret the basic features of C# programming language	K2
CO2:	develop software applications using classes and objects	K3
CO3:	make use of exception handling features to safeguard program against runtime anomalies	K3
CO4:	develop web-based applications using .NET	K3
CO5:	make use of virtual machine component of Microsoft's .NET Framework	K3

UNIT I INTRODUCTION TO C# 6

Introducing C#- Understanding .NET- Program Structure and Syntax: Basic Syntax and Variables & Data Types-Control Structures: Conditional Statements and Loops-Implicit and explicit casting -Constant-Arrays: Array Class, Array List-String: String Builder.

UNIT II OBJECT ORIENTED ASPECT OF C# 6

Object – Oriented Programming Concepts: Class, Objects- Constructors and its types-Inheritance-Polymorphism- Sealed class and methods - Interface - Abstract class - Overloading - Threading.

UNIT III APPLICATION DEVELOPMENT ON .NET 6

Building windows application - Creating our own window forms with events and controls - SDI and MDI application, Dialog Box(Modal and Modeless)- Accessing data with ADO.NET, Data Set- Typed dataset - Data Adapter, updating database using stored procedures - SQL Server with ADO.NET -Handling exceptions - Validating controls - Windows application configuration.

UNIT IV WEB BASED APPLICATION DEVELOPMENT ON .NET 6

Introduction to ASP.NET Core - Creating Virtual Directory and Web Application - Session management techniques, web.config, web services, passing datasets-Returning datasets from web services - Handling transaction, handling exceptions, returning exceptions from SQL Server.

UNIT V CLR AND .NET FRAMEWORK 6

Assemblies- Versioning, Attributes, reflection - Viewing meta data - Type discovery - Reflection on type - Marshalling - Remoting- Security in .NET.

TOTAL: 30

LIST OF EXPERIMENTS

1. Implement a basic console application in C# demonstrating syntax, variables and data types.
2. Create a class hierarchy in C# involving inheritance and polymorphism.
3. Develop a Windows Forms application using Visual Studio with event handling and basic functionality.
4. Build a CRUD web application using ASP.NET Core MVC, including controllers, views and data passing.

- Construct a Windows Forms application that connects to a SQL Server database using ADO.NET for data access and validation.
- Implement reflection and attributes in a C# application to dynamically inspect types and apply attributes to classes and methods.

TOTAL: 30**TEXT BOOKS:**

- Balagurusamy E, "Programming in C#", Tata McGraw Hill, 4th Edition 2017.
- Programming C# 12: Build Cloud, Web, and Desktop Applications ,O'Reilly Media, , 1st Edition, 2024.

REFERENCE BOOKS:

- Andrew Troelsen and Philip Japikse, "Pro C# 9.0 with .NET 5: Foundational Principles and Practices in Programming", Apress, 10th Edition, 2021.
- Mark J. Price, "C# 10 and .NET 6 – Modern Cross-Platform Development", Packt Publishing, 6th Edition, 2021.
- Christian Nagel, "Professional C# and .NET", Wrox, 1st Edition, 2022.
- Joseph Albahari, "C# 10 in a Nutshell: The Definitive Reference", O'Reilly Media, 1st Edition, 2022.

WEB URLS:

- <https://www.dotnet.microsoft.com/en-us/learn>
- <https://www.w3schools.com/cs/index.php>
- <https://www.geeksforgeeks.org/csharp-programming-language/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	1	-	-	-	1	1	-	-	2	2
CO2	2	2	2	-	1	-	-	-	1	1	-	-	2	2
CO3	3	2	2	-	1	-	-	-	1	1	-	-	2	2
CO4	3	2	2	-	1	-	-	-	1	1	-	-	2	2
CO5	3	2	2	-	2	-	-	-	1	1	-	-	2	2
CO	2.6	1.8	1.8	-	1.2	-	-	-	1	1	-	-	2	2

23CSP504 SOFTWARE TESTING AND AUTOMATION
(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PREREQUISITES: Agile Software Development**OBJECTIVES:**

- To acquire the knowledge of the basics of software testing
- To understand the concept of various testing strategies and planning methodologies
- To apply test design strategies to develop test cases and execute them

OUTCOMES:

Learners should be able to

CO1: explain the principles, methodologies, and need for software testing, including defect **K2**

management and the software testing life cycle

- CO2:** develop test plans and apply various software testing strategies to ensure software quality and reliability **K2**
- CO3:** apply different test design techniques such as boundary value analysis, equivalence partitioning, and path testing to create effective test cases **K3**
- CO4:** demonstrate the use of advanced testing methods, including performance, security, and usability testing for web and mobile applications **K2**
- CO5:** implement software test automation using Selenium and other automation tools to validate applications efficiently **K3**

UNIT I FOUNDATIONS OF SOFTWARE TESTING 6

Introduction to Manual Testing, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Agile Model, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing

UNIT II TEST PLANNING 6

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

UNIT III TEST DESIGN AND EXECUTION 6

Test Objective Identification, Test Design Strategies, Boundary Value Analysis, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.

UNIT IV ADVANCED TESTING CONCEPTS 6

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, testing in the Agile Environment, Testing Web and Mobile Applications.

UNIT V TEST AUTOMATION AND TOOLS 6

Software test automation, Skills needed for automation – scope of automation, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

TOTAL: 30

LIST OF EXPERIMENTS

1. Develop the test plan for testing an e-commerce web/mobile application (www.amazon.in).
2. Design the test cases for testing the e-commerce application
3. Develop the test plan and design the test cases for an inventory control system.
4. Test the performance of the e-commerce application.
5. Automate the testing of e-commerce applications using Selenium.
6. Mini Project:
 - a) Build a data-driven framework using Selenium and TestNG
 - b) Build Page object Model using Selenium and TestNG

c) Build BDD framework with Selenium, TestNG and Cucumber

TOTAL: 30

TEXT BOOKS:

1. Parsa S, , “Software Testing Automation Testability Evaluation Refactoring Test Data Generation And Fault Localization ”, Springer, Press, 1st Edition, 2023.
2. Durga Prasad Mohapatra, Satya Avasarala, " Automated Software Testing: Foundations, Applications and Challenges", Springer, 1st Edition, 2021.

REFERENCE BOOKS:

1. Glenford J. Myers, Corey Sandler, Tom Badgett, “The Art of Software Testing”, John Wiley & Sons, Inc. 3rd Edition, 2018.
2. Carl Cocchiari, “Selenium Framework Design in Data-Driven Testing”, Packt Publishing, 1st Edition, 2018.
3. Satya Avasarala, “Selenium WebDriver Practical Guide”, Packt Publishing, 1st Edition, 2014

WEB URLS:

1. <https://www.coursera.org/specializations/software-testing-automation>
2. <https://www.udemy.com/course/learn-selenium-automation-in-easy-python-language/?couponCode=NVDIN35>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	-	-	-	2	2	2	1	3	3
CO2	3	2	1	1	1	-	-	-	2	2	2	2	2	2
CO3	3	2	1	1	1	-	-	-	2	2	1	2	2	3
CO4	2	1	1	1	1	-	-	-	2	2	1	2	3	3
CO5	2	2	1	1	1	-	-	-	2	2	1	1	3	2
CO	2.6	2	1.2	1	1	-	-	-	2	2	1.4	1.6	2.6	2.6

23CDR605 UI/UX DESIGN
(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
3	0	2	4

PREREQUISITES: Computer Fundamentals and Communication

OBJECTIVES:

- To acquire the principles of UI & UX design.
- To understand the tools used in UI & UX in creating wireframe and prototype.
- To apply methods of user evaluation of product with real time scenario.

OUTCOMES:

Learners should be able to

CO1:	identify the principles of user interface (UI) design in order to design with intention	K1
CO2:	learn the effective user experience (UX) and the psychology behind user decision making	K1
CO3:	know the importance of UX process and user Psychology	K1
CO4:	elucidate the implications for designing web application with multimedia effects	K2
CO5:	implement prototypes for model mobile and web project	K2

UNIT I FOUNDATIONS OF DESIGN 9

Overview of UI & UX Design process - Difference between User Interface (UI) vs User Experience (UX) - Defining problem and vision statement - Persona creation-Primary and Secondary persona - Requirement definition Creative ideation brainstorming and ideation techniques Scenarios and functionality extraction- Solution ideation-Flow diagrams - Case studies on Design Thinking

UNIT II FOUNDATIONS OF UI AND UX DESIGN 9

Visuals and UI principles - UI Elements and Patterns-Material Design and Human Interface Design - Interaction Behaviors and Principles-Branding-Style Guides - Understanding User Experience - UX Design Process and its Methodology Research in User Experience Design - Tools and Method used for Research

UNIT III ELEMENTARY SKETCHING & WIREFRAMING 9

Sketching Principles - Wireframing - Creating Wireflows - Click through Wireframing Prototyping - Wireflow Creation - Work with different tools-Figma-Low-High Fidelity Design: Inclusive Design and Designing for Accessibility - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Designing animations and interactions.

UNIT IV UNDERSTAND STYLE GUIDES, ELEMENTS, PROTOTYPING 9

Building a Design System Style guides, color palette, fonts, grid, iconography, UI elements, photography or imagery, and illustration - Use of grids in UI design - Design animations and interaction patterns for key UI elements.

UNIT V UASBILITY EVALUATION AND PRODUCT DESIGN 9

Software test automation, Skills needed for automation – scope of automation, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

TOTAL: 30**LIST OF EXPERIMENTS**

1. Designing a Responsive layout for a societal application.
2. Developing an interface with proper UI Style Guides.
3. Developing Wireflow diagram for application using open-source software.
4. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles).
5. Creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping.
6. Sketch, design with popular tool and build a prototype and perform usability testing and identify improvements.

TOTAL: 30**TEXT BOOKS:**

1. Joel Marsh, "UX for Beginners", O'Reilly Media, Inc., 1st Edition 2015.
2. Xia Jiajia, "UI UX Design", O'Reilly, Artpower International, 2016.
3. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3rd Edition, O'Reilly 2020

REFERENCE BOOKS:

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3rd Edition, O'Reilly 2020.
2. Steve Schoger, Adam Wathan "Refactoring UI", 2018.

WEB URLS:

4. <https://www.sl-courses.iiitb.ac.in/ui-ux-design>
5. <https://www.course.ccs.neu.edu/cs5500sp17/09-UX.pdf>
6. <https://www.github.com/hendurhance/ui-ux>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	2	-	-	-	2	2	-	-	1	-
CO2	3	2	-	-	2	-	-	-	2	2	-	-	1	1
CO3	3	2	-	-	2	-	-	-	2	2	-	-	1	1
CO4	3	2	-	-	2	-	-	-	2	2	-	-	1	1
CO5	3	2	2	2	2	-	-	-	2	2	-	-	1	1
CO	3	2	2	2	2	-	-	-	2	2	-	-	1	1

23ADP601 DIGITAL MARKETING

(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PREREQUISITES: Nil**OBJECTIVES:**

- To acquire knowledge about tools and techniques for effective online marketing and brand management.
- To understanding digital marketing concepts and strategies.
- To apply contemporary digital marketing trends and technologies.

OUTCOMES:

Learners should be able to

CO1:	infer the fundamental concepts and principles of digital marketing	K2
CO2:	develop effective digital marketing strategies using social media.	K3
CO3:	utilize digital marketing tools and platforms for promotion activity.	K3
CO4:	plan to measure the effectiveness of digital marketing campaigns.	K3
CO5:	survey contemporary trends and best practices in digital marketing.	K4

UNIT I INTRODUCTION TO DIGITAL MARKETING 6

Definition and Importance of Market Risk and Supply Chain Analytics - Overview of Financial Markets and Supply Chain Management - Types of Analytics: Descriptive, Predictive, and Prescriptive - Role of Data in Decision-Making - Key Performance Indicators (KPIs) and Metrics for Risk and Supply Chain - Analytics Process and Lifecycle - Challenges and Opportunities.

UNIT II SEARCH ENGINE OPTIMIZATION (SEO) AND SEARCH ENGINE MARKETING 6

Data Types and Sources in Market Risk and Supply Chain - Data Collection Methods - Data Quality and Data Cleaning Techniques - Data Integration and Transformation - Handling Missing Data - Data Preprocessing for Analysis - Exploratory Data Analysis (EDA) - Data Visualization Techniques - Tools for Data Collection and Preparation (Excel, SQL, ETL Tools)

UNIT III SOCIAL MEDIA MARKETING AND CONTENT MARKETING 6

Statistical Analysis and Hypothesis Testing - Regression Analysis and Predictive Modeling - Time Series Analysis and Forecasting - Classification and Clustering Techniques - Simulation and Scenario Analysis -

Machine Learning Algorithms for Risk and Supply Chain Analytics - Optimization Techniques for Decision Making.

UNIT IV EMAIL MARKETING AND AFFILIATE MARKETING

6

Value at Risk (VaR), Expected Shortfall (ES), Stress Testing - Sensitivity Analysis, Greeks (Delta, Gamma, Vega, Theta) - Risk Management Software (RiskMetrics, Bloomberg) - Network Design and Configuration - Facility Location and Allocation - Transportation and Distribution Planning - Inventory Management and Control.

UNIT V WEB ANALYTICS AND CONVERSION RATE OPTIMIZATION

6

Hedging Strategies and Instruments (Options, Futures, Swaps) - Supply Chain Analytics in Retail, Manufacturing, Healthcare - IoT, Big Data, Blockchain in Supply Chain - Ethical and Legal Considerations - Future Trends in Market Risk and Supply Chain Analytics - Case Studies - Practical Exercises on Analyzing Contemporary Issues.

TOTAL: 30

LIST OF EXPERIMENTS

1. Research and Analysis
2. On-page SEO Optimization
3. Running a Google Ads Campaign
4. Social Media Campaign Creation and Management
5. Creating and Distributing Content for Content Marketing
6. Designing and Implementing an Email Marketing Campaign

TOTAL: 30

TEXT BOOKS:

1. Philip Kotler, Hermawan Kartajaya, Iwan Setiawan, "Marketing 4.0: Moving from Traditional to Digital", Wiley, 2021.
2. Damian Ryan, "Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation", Kogan Page, 2020.

REFERENCE BOOKS:

1. Tony. Dave Chaffey, Fiona Ellis-Chadwick, "Digital Marketing: Strategy, Implementation and Practice", Pearson, 2021.
2. Ann Handley, C.C. Chapman, "Content Rules: How to Create Killer Blogs, Podcasts, Videos, Ebooks, Webinars (and More) That Engage Customers and Ignite Your Business", Wiley, 2021.
3. Avinash Kaushik, "Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity", Wiley, 2021.

WEB URLS:

1. <https://www.coursera.org/specializations/digital-marketing>
2. <https://grow.google/certificates/digital-marketing-ecommerce/>
3. <https://business.adobe.com/blog/basics/digital-marketing>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	1	1	-	-	1	1
CO2	2	1	-	-	-	-	-	-	1	1	-	-	-	1

CO3	2	1	-	-	-	-	-	-	1	1	-	-	1	-
CO4	3	2	1	-	1	-	-	-	2	2	-	1	1	1
CO5	3	2	1	-	1	1	-	-	2	2	-	1	-	1
CO	3	2	1	-	1	1	-	-	2	2	-	1	1	1

PROFESSIONAL ELECTIVE – VI**EMERGING TECHNOLOGIES****23CSP601 GAME THEORY**

(Common to AD/CD/CS/CT/CY/EC/EE/ET/IT)

L	T	P	C
2	0	2	3

PREREQUISITES: Theory of Computation**OBJECTIVES:**

- To acquire the fundamentals knowledge of 2D and 3D graphics for game development
- To understand the various game development environments and toolkits
- To apply the simple games using the Pygame framework

OUTCOMES:

Learners should be able to

- CO1:** understand 2D and 3D graphics, game design principles, and game engine architecture **K2**
- CO2:** apply game development concepts like level design, game balancing, and AI techniques **K3**
- CO3:** explore different game development tools, frameworks, and platforms like Unity and Pygame **K2**
- CO4:** implement physics, sound, and AI in 2D and 3D games **K3**
- CO5:** design and develop interactive games using Pygame and Unity **K3**

UNIT I 3D GRAPHICS FOR GAME DESIGN 6

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation.

UNIT II GAME DESIGN PRINCIPLES 6

Character Development, Rudiments of game design, Storyboard Development for Gaming, The Anatomy of a Game Designer – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production.

UNIT III GAME ENGINE DESIGN 6

Game Engine Architecture, Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Path finding.

UNIT IV GAMING PLATFORMS AND FRAMEWORKS 6

Game Development Technical Aspects, Game Design Team Roles, Pygame Game Development,– Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and Multi-Player games.

UNIT V GAME DEVELOPMENT USING PYGAME 6

Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based arcade Games – Puzzle Games.

TOTAL: 30**LIST OF EXPERIMENTS**

1. Character design, sprites, movement and character control
2. Level design: design of the world in the form of tiles along with interactive and collectible objects
3. Design of interaction between the player and the world, optionally using the physics engine
4. Developing a 2D interactive using Pygame
5. Developing a 3D Game using Unreal
6. Developing a Multiplayer game using unity

TOTAL: 30**TEXT BOOKS:**

1. Jason Gregory, "Game Engine Architecture", CRC Press, 3rd Edition, 2018.
2. Sloan Kelly, "Python, PyGame, and Raspberry Pi Game Development", Apress, 2nd Edition, 2019.
3. Eric Lengyel, "Mathematics for 3D Game Programming and Computer Graphics", CRC Press, 4th Edition, 2022.

REFERENCE BOOKS:

1. Ian Millington, "AI for Games", CRC Press, 3rd Edition, 2019.
2. Steve Rabin, "Game AI Pro 360: Guide to Character Behavior", CRC Press, 1st Edition, 2019.
3. Alan Thorn, "Practical Game Design: Learn the Art of Game Design through Applicable Skills and Cutting-Edge Insights", Packt Publishing, 2nd Edition, 2021.

WEB URLS:

1. <https://www.learn.unity.com/>
2. <https://www.pygame.org/docs/>
3. <https://www.gamedev.net/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	2	1	-	1	2	2
CO2	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO3	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO4	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO5	3	2	1	-	2	-	-	-	2	1	-	1	2	2
CO	2.8	1.8	1	-	2	-	-	-	2	1	-	1	2	2

23CTP601 ROBOTICS PROCESS AUTOMATION

(Common to AD/CD/CS/CT/CY/EC/EE/ET/IT)

L	T	P	C
2	0	2	3

PREREQUISITES: Web Technology**OBJECTIVES:**

- To understand the basic concepts of Robotic Process Automation
- To expose to key RPA design and development strategies and methodologies

- To identify Exception Handling, Debugging, and Logging operations in RPA

OUTCOMES:

Learners should be able to

CO1:	outline the benefits of Robotic Process Automation in industrial sectors	K2
CO2:	identify the robotic process automation tools for process mining	K3
CO3:	utilize RPA control design flows and workflows for the target process	K3
CO4:	build an application to handle exceptions in automation processes	K3
CO5:	develop orchestration to control the bots in the RPA process	K3

UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 6

Emergence of Robotic Process Automation (RPA) - Evolution of RPA - Differentiating RPA from Automation- Benefits of RPA - Application areas of RPA - Components of RPA - RPA Platforms - Robotic Process Automation Tools - Templates - User Interface - Domains in Activities - Workflow Files

UNIT II AUTOMATION PROCESS ACTIVITIES 6

Sequence - Flowchart & Control Flow - Sequencing the Workflow - Activities - Flowchart - Control Flow for Decision Making - Data Manipulation - Variables - Collection - Arguments - Data Table - Clipboard Management - File Operations - Controls - Finding the Control - Waiting for a Control - Act on a Control - UiExplorer - Handling Events.

UNIT III APP INTEGRATION, RECORDING, AND SCRAPING 6

App Integration - Recording - Scraping - Selector - Workflow Activities - Recording Mouse and Keyboard Actions - Scraping Data from Website - Writing to CSV - Process Mining

UNIT IV EXCEPTION HANDLING AND CODE MANAGEMENT 6

Exception handling - Common exceptions - Logging - Debugging techniques - Collecting crash dumps - Error reporting - Code management and maintenance - Project organization - Nesting workflows - Reusability - Templates - Commenting techniques - State Machine

UNIT V DEVOPS 6

Publishing using publish utility - Orchestration Server - Control bots - Orchestration Server to deploy bots - License management - Publishing and managing updates - RPA Vendors - Open-source RPA - Future of RPA.

TOTAL: 30

LIST OF EXPERIMENTS

1. Create a Sequence to obtain user inputs and display them using a message box
2. Create a State Machine workflow to compare user input with a random number
3. Build a process in the RPA platform using UI Automation Activities
4. Implement Automation using System Trigger
5. Automate login to (web) Email account
6. Implement Error Handling in the RPA platform

TOTAL: 30

TEXT BOOKS:

1. Gerardus Blokdyk, "RPA Robotic Process Automation A Complete Guide," 5STARCOOKS, 1st Edition, 2020.
2. Tom Taulli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,"

Apress, 1st Edition, 2020..

REFERENCE BOOKS:

1. Christian Kirschniak, "Robotic Process Automation (RPA) – Digitization and Automation of Processes," Springer Gabler, 1st Edition, 2021.
2. Klaus Rüdiger (Editor), "Blockchain and Robotic Process Automation Forum," Springer, 1st Edition, 2020.
3. Al Naqvi and J. Mark Munoz (Editors), "Handbook of Artificial Intelligence and Robotic Process Automation: Policy and Government Applications," Anthem Press, 1st Edition, 2020.

WEB URLS:

1. <https://www.amazon.com/Robotic-Process-Automation-Complete-Guide/dp/0655936211>
2. <https://link.springer.com/book/10.1007/978-3-658-38692-4> (<https://link.springer.com>)

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	2	-	-	-	2	1	-	1	2	1
CO2	3	2	1	-	2	-	-	-	2	1	-	1	2	1
CO3	3	2	1	-	2	-	-	-	2	1	-	1	2	1
CO4	3	2	1	-	2	-	-	-	2	1	-	1	2	1
CO5	3	2	1	-	2	-	-	-	2	1	-	1	2	1
CO	3	2	1	-	2	-	-	-	2	1	-	1	2	1

23CSP602 3D PRINTING AND DESIGN

(Common to AD/CD/CS/CT/CY/ IT)

L	T	P	C
2	0	2	3

PREREQUISITES: Nil

OBJECTIVES:

- To acquire the basic knowledge of 3D printing process
- To understand about Materials, and Additive Manufacturing
- To apply 3D printing process in real time application

OUTCOMES:

Learners should be able to

CO1:	understand the fundamental concepts of 3D printing process	K2
CO2:	identify suitable materials based on application requirements	K3
CO3:	make use of different processes for their effectiveness in various applications	K3
CO4:	apply knowledge to obtain quality outputs	K3
CO5:	develop products using appropriate techniques	K3

UNIT I	INTRODUCTION	6
Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, RP data formats, Classification of 3D printing process, Applications to various fields.		
UNIT II	PROCESS	6
Process, Process parameter, Process Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defense, Automotive, Construction, Food Processing, Machine Tools.		
UNIT III	MATERIALS	6
Polymers, Metals, Non-Metals, Ceramics, Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. Support Materials.		
UNIT IV	ADDITIVE MANUFACTURING EQUIPMENT	6
Process Equipment- Design and process parameters-Governing Bonding Mechanism Common faults and troubleshooting - Process Design- Post Processing: Requirement and Techniques- Product Quality.		
UNIT V	INDUSTRIAL APPLICATIONS	6
Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology, Displays Future trends		

TOTAL: 30**LIST OF EXPERIMENTS**

1. Create 3D models of individual components using advanced CAD tools.
2. Perform CAD data exchange across multiple platforms and generate STL files suitable for various additive manufacturing processes.
3. Identify a suitable product for additive manufacturing and prepare a detailed process plan, including process parameters selection based on application requirements.
4. Study different forms of raw materials (powder, filament, liquid) and identify suitable materials for specific AM processes.
5. Set up an AM machine, configure process parameters, and produce a component with focus on bonding mechanisms and troubleshooting.
6. Design an industrial problem (in healthcare, automotive, or aerospace) and develop a functional prototype using additive manufacturing.

TOTAL: 30**TEXT BOOKS:**

1. Rupinder Singh and J. Paulo Davim, "Additive Manufacturing Applications and Innovations", Taylor & Francis Limited, 1st Edition, 2021.
2. Dr. Sabrie Soloman, "3D Printing & Design", Khanna Publishing House, 1st Edition, 2020.

REFERENCE BOOKS:

1. Yusheng Shi, Chunze Yan, Yan Zhou, Jiamin Wu, Yan Wang, Shengfu Yu, Chen Ying, "Materials for Additive Manufacturing", Elsevier Science, 1st Edition, 2021.
2. Joan Horvath and Rich Cameron, "Mastering 3D Printing A Guide to Modeling, Printing, and Prototyping", Apress, 2nd Edition, 2020.
3. Ibrahim Zeid, "CAD/CAM: Theory And Practice", Tata McGraw-Hill Publishing Co., 2nd Edition, 2009.

WEB URLs:

1. <https://web.stanford.edu/class/me137/>
2. <https://www.sculpteo.com/en/3d-printing/>
3. [https:// www.onlinecourses.nptel.ac.in/noc21_me115/preview](https://www.onlinecourses.nptel.ac.in/noc21_me115/preview)
4. [https:// www.onlinecourses.swayam2.ac.in/ntr24_ed17/preview](https://www.onlinecourses.swayam2.ac.in/ntr24_ed17/preview)

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	-	-	-	-	-	1	1	-	-	2	2
CO2	1	1	1	-	-	-	-	-	1	1	-	-	2	2
CO3	2	2	2	-	2	-	-	-	1	1	-	-	2	2
CO4	2	2	2	-	2	-	-	-	1	1	-	-	2	2
CO5	2	2	2	-	2	-	-	-	1	1	-	-	2	2
CO	1.6	1.6	1.6	-	2	-	-	-	1	1	-	-	2	2

23CSP602 GENERATIVE AI

(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PREREQUISITES: Artificial Intelligence, Machine Learning Techniques and Deep Learning**OBJECTIVES:**

- To acquire the foundational concepts of generative models.
- To understand the generative models, including GANs, VAEs, and Transformers.
- To apply generative models in real-time application.

OUTCOMES:

Learners should be able to

CO1:	recall the fundamentals of generative AI, including types of generative models	K2
CO2:	interpret knowledge on auto encoder architecture in generative AI	K2
CO3:	develop generative adversarial networks for data augmentation.	K3
CO4:	create transformer models for text generation for neural networks.	K3
CO5:	Apply ethical implications and responsible ai practices	K3

UNIT I FOUNDATIONS OF GENERATIVE MODELS**6**

Introduction to Generative AI : Overview of generative AI and its applications- Types of generative models- Introduction to deep learning frameworks. Probability and Statistical Methods : Probability distributions and Bayesian inference - Maximum likelihood estimation (MLE) - Variational inference.

UNIT II VARIATIONAL AUTOENCODERS (VAES)**6**

Autoencoders: Basic autoencoder architecture- Training autoencoders- Applications of autoencoders. Introduction to VAEs: Structure and theory of VAEs- Latent space representation- Variational inference in VAEs. Advanced Topics in VAEs: Conditional VAEs- Semi-supervised learning with VAEs- Applications of VAEs in data generation and anomaly detection.

UNIT III GENERATIVE ADVERSARIAL NETWORKS (GANS)**6**

Introduction to GANs: Fundamentals of GANs-Generator and discriminator networks-Training GANs and common challenges. Advanced GAN Architectures: Deep Convolutional GANs (DCGANs)- Conditional GANs (cGANs)- CycleGANs and StyleGANs. Practical Applications of GANs: Image synthesis and editing-Data augmentation-Evaluation metrics for GANs.

UNIT IV TRANSFORMER MODELS AND TEXT GENERATION**6**

Introduction to Transformers: Architecture of Transformer Models-Self-attention mechanism-Training Transformers. Language Models and Text Generation: Recurrent neural networks (RNNs) and LSTMs-Generative Pre-trained Transformers (GPT) and applications in text generation and language translation - Chat Bot.

UNIT V ADVANCED APPLICATIONS AND ETHICAL CONSIDERATIONS**6**

Generative Models for Images and Audio: Image generation techniques-Neural style transfer Audio synthesis and music generation. Ethical and Societal Implications: Ethical issues in generative AI-Deep fakes and their impact-Responsible AI practices.

TOTAL: 30**LIST OF EXPERIMENTS**

1. Implement the encoder and decoder networks for a VAE.
2. Implement a conditional VAE (CVAE).
3. Implement the generator and discriminator networks for a GAN.
4. Implement a Deep Convolutional GAN (DCGAN).
5. Implement a CycleGAN for image-to-image translation (e.g., converting horses to zebras).
6. Implement a basic Transformer model.

TOTAL: 30**TEXT BOOKS:**

1. David Foster," Deep Learning: Teaching Machines to Paint, Write, Compose and Play", O'Reilly Media, 2nd edition, 2023.
2. Numa Dhamani, "Introduction to Generative AI", Manning, First edition, 2024.
3. Carlos Rodriguez, "Generative AI Foundations in Python: Discover key techniques and navigate modern challenges in LLMs", Packt Publishing, First edition, 2024.

REFERENCE BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017.
2. Rafael Valle, "Hands-on Generative Adversarial Networks with Keras". Packt Publisher, 2019.

WEB URLs:

1. <https://www.coursera.org/learn/generative-ai-introduction-and-applications>
2. <https://www.coursera.org/learn/generative-ai-prompt-engineering-for-everyone>
3. <https://www.coursera.org/learn/generative-ai-foundation-models-and-platforms>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	2	2	-	3	-	3

CO2	3	2	1	-	-	-	-	-	2	2	-	3	-	3
CO3	3	2	1	1	1	-	-	-	2	2	-	3	-	3
CO4	3	2	1	1	1	-	-	-	2	2	-	3	-	3
CO5	3	2	1	1	1	-	-	-	2	2	-	3	-	3
CO	2.4	2.2	1	1	1	-	-	-	2	2	-	3	-	3

23CYP404**CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES**

(Common to AD/CD/CS/CT/CY/IT)

L	T	P	C
2	0	2	3

PREREQUISITES: Cryptography and Cyber Security**OBJECTIVES:**

- To acquire knowledge about the fundamentals of blockchain technology and its cryptographic techniques.
- To understand the protocols and consensus algorithms used in Blockchain technology
- To apply the architectural frameworks and tools for the implementation of real time applications

OUTCOMES:

Learners should be able to

- CO1:** explain the concepts related to cryptocurrency and blockchain technologies **K2**
- CO2:** illustrate the concept of a public ledger supporting cryptocurrency transactions **K2**
- CO3:** develop a basic cryptocurrency application using blockchain technology **K3**
- CO4:** build a decentralized application that interacts with an Ethereum smart contract. **K3**
- CO5:** compare the security features of Proof of Work (PoW) versus Proof of Stake (PoS) consensus algorithms **K4**

UNIT I INTRODUCTION TO BLOCKCHAIN**6**

Blockchain- Public Ledgers, Blockchain as Public Ledgers – Block in a Blockchain, Transactions- The Chain and the Longest Chain – Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree.

UNIT II BITCOIN AND CRYPTOCURRENCY**6**

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.

UNIT III BITCOIN CONSENSUS**6**

Bitcoin Consensus- Proof of Work (PoW)- Hashcash PoW - Bitcoin PoW- Attacks on PoW- monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner- Mining Difficulty- Mining Pool- Permissioned model and use cases.

UNIT IV HYPERLEDGER FABRIC & ETHEREUM**6**

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT V BLOCKCHAIN APPLICATIONS**6**

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance- Case Study.

TOTAL: 30

LIST OF EXPERIMENTS

1. Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run
2. Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.
3. Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules
4. Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network
5. Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards
6. Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan

TOTAL: 30

TEXT BOOKS:

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014.

REFERENCE BOOKS:

1. Daniel Drescher, "Blockchain Basics", 1st Edition, Apress, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder "Bitcoin and cryptocurrency technologies: a comprehensive introduction". Princeton University Press, 2016.
3. Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015

WEB URLS:

1. <https://consensus.io/blockchain-use-cases/case-studies>
2. <https://www.ibm.com/blockchain/use-cases/>
3. <https://blockchain.gov.in/Home/CaseStudy?CaseStudy=PDS>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	2	2	2	-	1	2	2
CO2	2	1	-	-	2	-	-	1	2	2	-	1	2	2
CO3	3	2	1	-	2	-	-	1	2	2	-	1	2	2
CO4	3	2	1	-	2	-	-	2	2	2	-	1	2	2
CO5	3	3	2	1	2	-	-	2	2	2	-	1	2	2
CO	2.6	1.8	1.3	1	2	-	-	1.6	2	2	-	1	2	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)**23EXC204 LIFE SKILLS - I**

L	T	P	C
0	0	2	1

OBJECTIVES:

- To acquire the knowledge on Quantitative aptitude
- To understand the importance of Quantitative aptitude
- To apply the concept of Quants to solve real world problems

OUTCOMES:

Learners should be able to

- CO1:** explain fundamental concepts of quantitative aptitude and their applications in solving numerical problems **K2**
- CO2:** utilize numerical techniques and ratios to solve real-world problems involving proportional relationships **K3**
- CO3:** implement mathematical operations and methods to address practical challenges in areas like interest calculations, profit and loss, and time and work **K3**
- CO4:** examine and evaluate mathematical models used in solving complex problems such as probability, permutations, and combinations, highlighting their limitations **K4**
- CO5:** investigate data sets to assess probabilities and make logical conclusions based on quantitative information **K4**

Topics:

Number Systems, Problems on Numbers, Simplification, Average, Ratio and Proportion, Problems on Ages, Percentage, Profit and Loss, Logarithms, Mixture and Allegation, Interest Calculation, Time, Speed Distance, Problems on Trains, Boats and Streams, Time and Work, Pipes and Cisterns, Permutation and Combination, Probability, Data Interpretation, Mensuration 2D, Mensuration 3D, Cryptarithmic Series

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-		
CO2	3	1	-	-	-	-	-	-	-	-	1	1		
CO3	3	1	-	-	-	-	-	-	-	-	1	1		
CO4	3	3	-	-	-	-	-	-	-	-	1	-		
CO5	3	3	-	-	-	-	-	-	-	-	1	1		
CO	2.8	1.8	-	-	-	-	-	-	-	-	1	1		

23EXC305 LIFE SKILLS – II

L	T	P	C
0	0	2	1

OBJECTIVES:

- To acquire the knowledge on reasoning
- To understand the importance of reasoning ability
- To apply the concept of reasoning to solve problems

OUTCOMES:

Learners should be able to

- CO1:** utilize problem-solving techniques to decode patterns, sequences, and puzzles effectively in various logical reasoning scenarios **K3**
- CO2:** solve complex reasoning problems by identifying patterns and relationships in data involving directions, ranking, and data arrangements **K3**
- CO3:** differentiate between valid and invalid arguments or statements, identifying logical inconsistencies in complex scenarios **K4**
- CO4:** make Use of appropriate reasoning techniques to build coherent and logical arguments in various problem-solving contexts like syllogisms and sequence arrangements **K3**
- CO5:** compare and analyze logical problems, drawing conclusions from assumptions, data sufficiency, and problem structures to make informed decisions **K4**

Topics:

Number Series, Coding & Decoding, Direction, Blood Relation, Image Analysis, Logical Sequence of Words, Order and Ranking, Odd Man Out & Analogy, Syllogism, Puzzle, Clocks, Calendar, Data Arrangement, Statement Argument, Data Sufficiency, Flow Chart, Statement and conclusion, Statement Assumption

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	2	-	-	-	1	-	-		
CO2	1	-	-	-	-	2	-	-	-	1	-	-		
CO3	1	-	-	-	-	2	-	-	-	1	-	-		
CO4	1	-	-	-	-	2	-	-	-	1	-	-		
CO5	1	-	-	-	-	2	-	-	-	1	-	-		
CO	1	-	-	-	-	2	-	-	-	1	-	-		

23EXC506 LIFE SKILLS - III**OBJECTIVES:**

- To acquire the knowledge on verbal ability
- To understand the importance of communication
- To apply the concept of verbal communication to present findings

OUTCOMES:

Learners should be able to

- CO1:** utilize effective communication and self-presentation skills to navigate both personal and professional environments **K3**
- CO2:** implement strategies to engage in respectful and diverse communication, enhancing active listening and articulation skills **K3**
- CO3:** use linguistic knowledge to construct grammatically sound and complex sentences for professional settings **K3**
- CO4:** develop self-awareness and apply techniques to manage emotions and stress in various scenarios **K3**
- CO5:** demonstrate effective communication techniques through structured presentations and public speaking engagements **K3**

Topics:

Parts of Speech, Tenses, Speech, Voices, Articles & Concord, Types & Kinds of Sentence, Conditional Clauses, Contextual Vocabulary, One Word Substitution, Verbal Analogy, Idioms & Phrases, Question Tag, Spot the Error, Sentence Improvement / Correction, Para Jumbles / Sentence, Formation, Formal & Informal Sentence, Reading Comprehension / Passage Analysis, Cloze Test
Sentence Completion, Traits, Self Introduction, Presentation, Resume Building

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	-		
CO2	-	-	-	-	-	-	-	-	-	3	-	-		
CO3	-	-	-	-	-	-	-	1	-	3	-	-		
CO4	-	-	-	-	-	-	-	-	-	3	-	-		
CO5	-	-	-	-	-	-	-	1	-	3	-	-		
CO	-	-	-	-	-	-	-	1	-	3	-	-		

23EXC407 INTERNSHIP-I

OBJECTIVES:

- To percept the role and responsibility of engineer in the industry
- To apply the learned knowledge in the professional world
- To build professional network

OUTCOMES:

Learners should be able to

- CO1:** examine workplace behaviors and assess their alignment with professional standards and expectations in an engineering context **K4**
- CO2:** implement effective communication and technical skills to engage with industry professionals and adhere to engineering practices and discipline **K3**
- CO3:** utilize advanced tools and techniques learned during industrial training to solve real-world engineering problems **K3**
- CO4:** apply insights from the internship experience to address personal, educational, and career goals in engineering **K3**
- CO5:** prepare structured reports and deliver professional presentations that reflect the internship experience and acquired skills **K3**

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	1	1	3	-	-	1	-	-
CO2	1	-	-	-	-	-	-	3	3	3	-	1	-	-
CO3	3	3	2	1	3	3	-	-	-	-	-	1	-	-
CO4	-	-	-	-	-	1	-	-	1	-	-	2	-	-
CO5	-	-	-	-	-	-	-	2	-	3	-	3	-	-
CO	2	3	2	1	3	1.6	1	2	2.3	3	-	1.6	-	-

23EXC409 MINI PROJECT – I**OBJECTIVES:**

- To define the problem of the proposed research work
- To apply the concepts of engineering knowledge in solving the research problem
- To demonstrate and validate the results of the design concept

OUTCOMES:

Learners should be able to

CO1:	engage in independent study to conduct appropriate surveys and identify a product to be developed with desired specifications for the benefit of the society.	K5
CO2:	design, develop, analyse the product using engineering principles and implement the for the product as per the specification, environmental standards/ safety norms and abiding professional ethics	K5
CO3:	schedule the project, engage in budget analysis, and assign responsibility for the team members	K3
CO4:	communicate effectively through oral communication, project report, presentation, demonstration	K3
CO5:	perform in the team, contribute to the team and mentor/lead the team	K3

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	3	3	-	3	3	3	3		
CO2	3	3	3	3	3	3	3	3	3	3	3	3		
CO3	-	-	-	-	-	-	-	-	3	3	3	3		
CO4	-	-	-	-	-	-	-	2	-	3	-	1		
CO5	-	-	-	-	-	-	-	-	3	1	-	1		
CO	3	3	3	2.5	3	2	2	2.5	3	2.6	3	2.2		

23EXC713 PROJECT WORK – PHASE I

L	T	P	C
0	0	8	4

PRE-REQUISITES: Core courses

COURSE OBJECTIVES:

- To apply the engineering knowledge to obtain solutions for real-world problems.
- To understand the various possible solutions and propose the best solution based on findings.
- To acquire skills in project management

COURSE DESCRIPTION:

The students in a group has to identify a problem and find suitable solution and formulate methodology for the same. Has to prepare a comprehensive project report and submit the report and present before the committee for evaluation.

COURSE OUTCOMES:

Students should be able to

CO1:	conduct a research literature, identify a research work in mechanical and allied engineering	K4
CO2:	select suitable engineering tools /components for the research work accepting the engineering standards	K4
CO3:	schedule, manage the project and plan for budget	K3
CO4:	communicate through oral communication, project report, presentation	K3
CO5:	perform in the team and contribute effectively	K3

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	-	-	-	-	-	-	3	3	1
CO2	3	3	2	1	1	3	3	3	-	-	-	3	3	1
CO3	-	-	-	-	-	-	-	-	-	-	1	3	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-	3	-	-
CO	3	3	2	1	1	3	3	3	3	3	1	3	3	1

23EXC814 PROJECT WORK – PHASE II

L	T	P	C
0	0	16	8

PRE-REQUISITES: Core courses**COURSE OBJECTIVES:**

- To apply the engineering knowledge to obtain solutions for real-world problems.
- To understand the possible solutions and propose the best solution based on findings.
- To acquire skills in project management and presentation

COURSE DESCRIPTION:

The students in a group has to identify a problem and find suitable solution and develop a prototype. Has to prepare a comprehensive project report and submit the report and present before the committee for evaluation.

COURSE OUTCOMES:

Students should be able to

CO1:	conduct identify and a research work and solve the problem using engineering concepts	K4
CO2:	make use of appropriate engineering tools to design, analyze and interpret the results of the work adopting engineering and ethical standards	K4
CO3:	schedule the project, engage in budget analysis	K4
CO4:	communicate through oral communication, project report, presentation and publication	K3
CO5:	perform in the team, contribute and mentor/lead the team	K3

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	-	-	3	3	-
CO2	3	3	3	3	3	3	3	3	-	-	-	3	3	3
CO3	-	-	-	-	-	-	-	-	-	-	3	3	-	-
CO4	-	-	-	-	-	-	-	3	-	3	-	3	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-	3	-	-
CO	3	3	3	3	3	3	3	3	3	3	3	3	3	3

OPEN ELECTIVE

23ITO101 FUNDAMENTALS OF COMMUNICATION AND IoT

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

OBJECTIVES:

- To acquire the concepts of data communication, networking models and IoT architecture.
- To understand various data transmission techniques, signal encoding methods and communication protocols relevant to IoT.
- To apply the knowledge and skills to design and develop IoT-based applications.

OUTCOMES:

Learners should be able to

- CO1:** explain the fundamentals of data communication, networking models, and protocol architectures, IoT basics. **K2**
- CO2:** interpret various data transmission techniques, signal encoding methods, and transmission media and IoT technologies. **K3**
- CO3:** determine the architecture, communication models, and enabling technologies of IoT. **K3**
- CO4:** analyze machine-to-machine (M2M) communication and IoT, and evaluate the role of SDN and NFV in IoT system management. **K3**
- CO5:** develop IoT applications by implementing methodologies, functional models, and service specifications. **K3**

UNIT I DATA COMMUNICATIONS 9

Communications model – Data communications – Networks – The internet – Need for a protocol architecture – A simple protocol architecture – TCP/IP protocol architecture – Standardization within a protocol architecture – Traditional internet – Based applications – Multimedia – Sockets programming.

UNIT II DATA TRANSMISSION AND SIGNAL ENCODING TECHNIQUES 9

Data Transmission: Concepts and terminology – Analog and digital transmission – Channel capacity transmission media: Guided transmission media – Wireless transmission – Wireless propagation – Line of sight transmission – Signal encoding techniques – Analog and digital data – Analog and digital signals.

UNIT III INTERNET OF THINGS 9

Introduction to IoT – Definition – Characteristics – Physical design of IoT – Things in IoT – IoT protocols – Logical design of IoT : Functional blocks – Communication models – Communication APIs – IoT enabling technologies – Wireless sensor networks – Cloud computing – Big data analytics – Communication protocols – Embedded systems – Applications – Home automation – Cities – Environment.

UNIT IV M2M AND SYSTEM MANAGEMENT 9

Introduction – M2M – Difference between M2M and IoT – SDN and NFV for IoT : Software define networking – Network function virtualization – System management: Need for IoT systems management – Simple network management protocol: Limitations of SNMP – Network operator requirements – NETCONF – YANG.

UNIT V DEVELOPING INTERNET OF THINGS 9

IoT methodology – Purpose and requirements specification – Process specification – Domain model specification – Information model specification – Service specification – IoT level specifications.

TOTAL: 45

TEXT BOOKS:

1. Arshdeep Bahga and Vijay Madisetti "Internet of Things: A Hands-On Approach" 1st Edition Universities Press(India) Pvt.Ltd. 2016.
2. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, 2013.

REFERENCE BOOKS:

1. Behrouz Forouzan A , Data Communications and Networking , Tata McGraw- Hill, 5th Edition 2016.
2. Oliver Hersent, David Boswarthick and OmarEloumi "The internet of things – Key applications and protocols" John Wiley, 1st Edition 2012.
3. Pethuru Raj and Anupama C Raman "The Internet of Things: Enabling Technologies, Platforms, and Use Cases" CRC Press, 1st Edition 2017.

WEB URLS:

1. www.freeprogrammingresources.com/tcp.html
2. www.onlinecourses.nptel.ac.in/noc17_cs22/preview
3. www.codeproject.com/Learn/IoT/

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	1	-	-	-	-	-	-	-	-	-	-
CO5	3	3	2	1	-	-	-	-	-	-	-	-	-	-
CO	2.8	2	2	1	-	-	-	-	-	-	-	-	-	-

23ITO102**INTRODUCTION TO OPERATING SYSTEM**

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL**OBJECTIVES:**

- To acquire the role of operating system types and its functions
- To understand the process and memory management scheduling
- To apply the file and storage management systems for modern operating systems

OUTCOMES:

Learner should be able to

- CO1:** explain the basic concepts, types, and functions of operating systems. **K2**
- CO2:** demonstrate knowledge of process management scheduling and synchronization techniques. **K3**
- CO3:** elaborate different memory management techniques with paging and segmentation. **K3**
- CO4:** construct file system structures, storage management techniques and disk scheduling algorithms. **K3**
- CO5:** compare security mechanisms of various operating systems like Windows, Linux, and Android. **K4**

UNIT I INTRODUCTION TO OPERATING SYSTEMS**9**

Definition and Need for an Operating System - Functions and Components of an OS - Types of Operating Systems: Batch, Time-Sharing, Distributed, Real-Time - Structure of an OS: Monolithic, Layered, Microkernel - Introduction to System Calls and Kernel

UNIT II PROCESS MANAGEMENT 9

Concept of Process and Threads - Process States and Process Control Block - Process Scheduling and Scheduling Algorithms: FCFS, SJF, Round Robin - Interprocess Communication and Synchronization - Deadlocks: Causes, Prevention, and Avoidance

UNIT III MEMORY MANAGEMENT 9

Introduction to Memory Management - Contiguous and Non-Contiguous Memory Allocation - Paging and Segmentation - Virtual Memory and Demand Paging - Page Replacement Algorithms: FIFO, LRU, Optimal

UNIT IV FILE AND STORAGE MANAGEMENT 9

File System Concepts: File Types, Operations, and Structures - Directory Structure and File Allocation Methods - Disk Management and Scheduling Algorithms: FCFS, SSTF, SCAN, C-SCAN - Introduction to RAID

UNIT V SECURITY AND CASE STUDIES 9

Basics of OS Security: Authentication, Authorization, and Access Control - Introduction to Malware: Virus, Worms, Trojans and Protection Mechanisms - Overview of Popular Operating Systems: Windows, Linux, and Android - Case Study on Open-Source and Proprietary OS

TOTAL: 45**TEXT BOOKS**

1. Andrew S Tanenbaum and Herbert Bos, "Modern Operating Systems", Pearson education, 5th edition, 2022
2. Remzi H Arpaci-Dusseau and Andrea C Arpaci-Dusseau, "Operating Systems: Three Easy Pieces", OSTEP Book, 2020

REFERENCE BOOKS

1. Abraham Silberschatz, Peter B Galvin, and Greg Gagne, "Operating System Concepts", Wiley, 10th edition, 2018
2. William Stallings, "Operating Systems: Internals and Design Principles", Pearson education, 9th edition 2017
3. Thomas Anderson and Michael Dahlin, "Operating Systems: Principles and Practice", Recursive books, 2nd edition, 2014

WEBSITES:

1. <https://nptel.ac.in/courses/106/106/106106144/>
2. <https://www.os-book.com/>
3. https://www.tutorialspoint.com/operating_system/index.htm

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	2	2	-	-	-	-	-	-	-	-	-	-
CO	2.8	1.8	1.6	1.3	-	-	-	-	-	-	-	-	-	-

23ITO103**FUNDAMENTALS OF DATA STORAGE TECHNOLOGIES**

L	T	P	C
3	0	0	3

PRE-REQUISITES: Computer Architecture, Operating Systems and Computer Network

OBJECTIVES:

- To acquire the fundamental concepts of data storage technologies and their applications.
- To understand the concepts of intelligent storage systems and RAID
- To apply the concepts for data protection, backup, recovery, and disaster methods

OUTCOMES:

Learners should be able to

- CO1:** interpret the fundamentals of various storage technologies and its applications. **K2**
- CO2:** illustrate the usage of intelligent storage systems with security and backup mechanism **K2**
- CO3:** summarize various replications and its security mechanisms **K3**
- CO4:** examine the different role in providing disaster recovery and remote replication technologies **K4**
- CO5:** infer the security needs and security measures to be employed in information storage management **K4**

UNIT I STORAGE SYSTEMS 9

Evolution of storage technologies-Storage models, File systems and Databases-Distributed file systems- Locks-Data storage for online transaction processing system-Big table-megastore-Storage reliability-database provenance. Data Center Environment: Application, Host, Connectivity, Storage.

UNIT II INTELLIGENT STORAGE SYSTEMS AND RAID 9

Components of an Intelligent Storage System, Storage Provisioning, Types of Intelligent Storage Systems, Concepts in Practice: Symmetric and VNX. RAID Implementation Methods, RAID Array Components, RAID Techniques, RAID Levels, RAID Impact on Disk Performance, RAID Comparison, Hot Spares

UNIT III STORAGE NETWORKING TECHNOLOGES 9

Storage components- Data organization: File vs. Block, Object; Data store; Searchable models- Storage Devices (including fixed content storage devices)- File Systems- Volume Managers. Network components- Connectivity: switches, directors, highly available systems- Fibre Channel- 1GE/10GE, Metro-ethernet- Aggregation- Infiniband.

UNIT IV BACKUP, ARCHIVE AND REPLICATION 9

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).

UNIT V STORAGE SECURITY AND MANAGEMENT 9

Security Framework, Storage security domains, List and analyzes the common threats in each domain, Security Implementations. Managing The Storage Infrastructure: Monitoring the Storage Infrastructure, Storage Management Activities, Challenges and solutions

TOTAL: 45

TEXT BOOKS:

1. Robert Spalding, "Storage Networks: The complete Reference". Tata McGraw Hill Publishing, 2020
2. Tom Clark," Storage Virtualization: Technologies for Simplifying Data Storage and Management", Pearson education, 1st edition, 2018.

REFERENCE BOOKS:

1. S Deshpande, Subhash C Sharma, Sateesh K Peddoju, "Security and Data Storage Aspect in Cloud Computing", Springer, 2021.
2. Nigel Poulton, "Data Storage Networking", Wiley publication, 3rd edition, 2019
3. Jiwu Shu, "Data Storage Architectures and Technologies", Springer Singapore, 2024.
4. K L James, "Data Storage Technologies", Pearson Education, 2nd edition (14th Impression), 2019.

WEB URLS:

1. <https://archive.nptel.ac.in/courses/106/108/106108058/>
2. <http://www.ictacademy.in/Pages/Information-Storage-and-Management.aspx>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	-	-	-	1	-	-	1
CO2	2	1	1	1	1	-	-	-	-	-	1	-	-	1
CO3	3	2	2	1	1	-	-	-	-	-	1	-	-	-
CO4	3	2	2	1	1	-	-	-	-	-	1	-	-	1
CO5	3	2	2	2	1	-	-	-	-	-	1	-	-	-
CO	2.6	1.6	1.6	1.2	1	-	-	-	-	-	1	-	-	1

23ITO104**INTRODUCTION TO OPEN-SOURCE TECHNOLOGIES**

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL**OBJECTIVES:**

- To acquire knowledge of open-source software, its philosophy, development methodology, and ecosystem.
- To understand open-source policies, licensing models, security considerations, and ethical implications.
- To apply open-source platforms such as Apache, Linux, OpenStack, and Kubernetes for practical software solutions.

OUTCOMES:

Learners should be able to

- CO1:** describe the philosophy, methodology, and ecosystem of open-source software **K2**
- CO2:** illustrate open-source policies, licensing models, security frameworks, and ethical considerations **K2**
- CO3:** relate different open-source platforms based on their features and functionalities **K3**
- CO4:** apply proficiency in using open-source platforms for infrastructure management and software development **K3**
- CO5:** use the software solutions using open-source tools, frameworks, and cloud-based technologies **K3**

UNIT I OPEN-SOURCE AND OPEN STANDARDS**9**

Introduction – Open Source – Free Software Foundation - The Linux Era - The Open-Source Initiative - FSF and OSI Comparisons - Open Source and Closed Source - Other Varieties of Software - Open Standards - Building Standards - Open Source with Open Standards – Open-Source Vulnerability Management - Policies and Compliance.

UNIT II LICENSES AND SECURITY**9**

Trusted Open Source Licenses - Licensing Options - The Apache License – BSD – MIT – GNU – Mozilla – Eclipse - License Proliferation - Profiting from Open Source -Security in the Software Development Life Cycle - Security Organizations – OWASP – OSSF.

UNIT III INFRASTRUCTURE MANAGEMENT**9**

Physical Infrastructure Components – Virtual Infrastructure Components – Software-Defined Networking – Software-Defined Storage – Ceph - Cloud Computing – OpenStack – Kubernetes - Management and Orchestration.

UNIT IV EMERGING TECHNOLOGIES**9**

Artificial Intelligence Implementation - AI Engine Framework and Tooling - Hardware for AI/ML/IoT Workloads - Use Cases – Aerospace – Agriculture – Gaming – Healthcare – Blockchain.

UNIT V GROWTH AND TRENDS**9**

Popular Open-Source Projects - Language Statistics – Emerging Domains – Cryptocurrency – Machine Learning – Gaming - Open Source in Education - Initiating Open-Source Projects - Web 3.0 – Metaverse – Multiexperience - Quantum Computing - Decentralized Finance – NFT.

TOTAL: 45**TEXT BOOKS:**

1. Sachin Rathee, Amol Chobe, “Getting Started with Open Source Technologies: Applying Open Source Technologies with Projects and Real Use Cases”, Apress, 1st edition (14th Impression), 2022.
2. Gordon Haff, “How Open Source Ate Software: Understand the Open Source Movement and So Much More”, Apress, 2nd Edition, 2021.

REFERENCE BOOKS:

1. Nadia Eghba, “Working in Public: The Making and Maintenance of Open Source Software”, Stripe Matter Incorporated, 1st edition, 2020.
2. Francisco Jose Monasco, “Business Models and Strategies for Open Source Projects”, IGI Global, 1st edition, 2023.
3. John Mertic, “Open Source Projects - Beyond Code: A Blueprint for Scalable and Sustainable Open Source Projects”, Packt Publishing, 1st edition, 2023
4. Fouad Sabry, “Open Source Hardware: Advancing Robotics Through Collaborative Design and Innovation”, One Billion Knowledgeable, 1st edition, 2025.

WEB URLS:

1. <https://www.solutionshub.epam.com/blog/post/open-source-licenses-definition-types-and-comparison>
2. <https://www.imperva.com/learn/application-security/owasp-top-10/>
3. <https://www.harpoon.io/blog-post/the-role-of-kubernetes-in-blockchain>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO	2.2	1.2	1	-	-	-	-	-	-	-	-	-	-	-

23ITO105**FUNDAMENTALS OF MOBILE APPLICATION DEVELOPMENT**

L	T	P	C
3	0	0	3

PRE-REQUISITES Basic Knowledge of Programming Languages (Java, Kotlin, or Swift)**OBJECTIVES:**

- To understand the concepts of mobile application development, including platforms, frameworks, and tools.
- To acquire knowledge of designing, implementing, and integrating mobile applications with backend services and databases.
- To apply optimization techniques to enhance performance, ensure security, and manage deployment strategies for mobile applications.

OUTCOMES:

Learners should be able to

- CO1:** elucidate the philosophy, methodology, and ecosystem of mobile application development. **K2**
- CO2:** describe security frameworks and ethical considerations. **K2**
- CO3:** compare different mobile platforms based on their features and functionalities. **K2**
- CO4:** demonstrate proficiency in using mobile development frameworks and tools. **K3**
- CO5:** deploy software solutions using mobile technologies. **K3**

UNIT I INTRODUCTION TO MOBILE APPLICATION DEVELOPMENT 9

Overview of Mobile Application Development – Mobile Platforms: Android- iOS – and Cross-Platform Solutions- Development Environments and Tools: Android Studio- Xcode – Flutter – React Native – Application Lifecycle and Architecture – UI/UX Design Principles for Mobile Applications.

UNIT II MOBILE APPLICATION DEVELOPMENT FRAMEWORKS 9

Need for Cross-Platform Development – Flutter Framework: Widgets – Navigation – and State Management – React Native: Components – Navigation – and State Management – Xamarin and Kotlin Multiplatform Overview – Debugging and Performance Optimization in Cross-Platform Apps.

UNIT III DESIGNING INTERACTIVE MOBILE UI 9

UI Components for Cross-Platform Applications – Layouts – Views – and User Interaction – Handling Navigation and State Management – Integration of APIs and Backend Services – Testing UI Components in Different Platforms.

UNIT IV DATA MANAGEMENT AND BACKEND INTEGRATION 9

Data Storage and Management – Implementing Backend Integration with RESTful APIs – Authentication and User Management – Real-time Data Synchronization Across Platforms – Security and Performance Considerations in Cross-Platform Apps

UNIT V TESTING, DEPLOYMENT, AND SECURITY IN MOBILE APPLICATIONS 9

Cross-Platform Mobile Application Testing Strategies – Deployment Challenges in Cross-Platform Development – Security Considerations in Cross-Platform Apps– Performance Optimization for Cross-Platform Applications – Emerging Trends in Cross-Platform.

TOTAL: 45**TEXTBOOKS:**

1. Neil Smyth, "Android Studio Development Essentials - Kotlin Edition", Payload Media, 1st edition, 2023.
2. Eric Windmill, "Flutter in Action", Manning Publications, 2021.

REFERENCE BOOKS:

1. Reto Meier, "Professional Android Development", Wiley, 1st edition 2023.
2. Matt Neuburg, "iOS Programming: The Big Nerd Ranch Guide", Pearson education, 7th edition, 2022.
3. Adam Boduch, "React Native Cookbook", Packt Publishing, 2nd edition, 2022.

WEB URLS:

1. <https://developer.android.com>
2. <https://docs.flutter.dev>
3. <https://developer.apple.com>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-		1	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	1	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	1	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	1	-	-	1	-	-	-	-	-	-
CO5	3	2	1	-	1	-	-	1	-	-	-	-	-	-
CO	2.4	1.4	1	-	1	-	-	1	-	-	-	-	-	-

23ITO106 FOUNDATION OF BLOCKCHAIN TECHNOLOGY

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL**OBJECTIVES:**

- To acquire functions of cryptocurrencies and blockchain networks
- To understand about the Hyperledger and distributed ledger technology
- To analyse the blockchain applications tools across industries

OUTCOMES:

Learners should be able to

- CO1:** explain blockchain's architecture, consensus mechanisms, and challenges in both theoretical and practical contexts. K2
- CO2:** apply knowledge of Bitcoin's transaction process, mining, and blockchain's role in solving the double-spend problem. K3
- CO3:** analyze the functioning of Ethereum accounts, wallets, and transactions, and apply this understanding to create Ethereum-based applications. K3
- CO4:** synthesize knowledge of Solidity and Ethereum wallets to develop efficient and secure smart contracts. K4
- CO5:** evaluate the potential and challenges of using blockchain in different industries, assessing scalability, security, and adoption. K4

UNIT I INTRODUCTION TO BLOCKCHAIN**9**

History: Digital Money to Distributed Ledgers -Design Primitives: Protocols, Security, Consensus, Permissions, Privacy- : Block chain Architecture and Design-Basic crypto primitives: Hash, Signature - Hash chain to Block chain-Basic consensus mechanisms.

UNIT II BITCOIN AND CRYPTOCURRENCY**9**

Requirements for the consensus protocols-Proof of Work (PoW)-Scalability aspects of Block chain consensus protocols: Permissioned Block chains-Design goals-Consensus protocols for Permissioned Block chains.

UNIT III INTRODUCTION TO ETHEREUM**9**

Decomposing the consensus process-Hyper ledger fabric components-Chain code Design and

Implementation: Hyper ledger Fabric II:-Beyond Chain code: fabric SDK and Front End-Hyper ledger composer tool.

UNIT IV HYPERLEDGER AND SOLIDITY PROGRAMMING

9

Block chain in Financial Software and Systems (FSS): -Settlements, -KYC, -Capital markets-Insurance-Block chain in trade/supply chain: Provenance of goods, visibility, trade/supply chain finance, invoice management/discounting.

UNIT V BLOCKCHAIN APPLICATIONS

9

Block chain for Government: Digital identity, land records and other kinds of record keeping between government entities, public distribution system / social welfare systems: Block chain Cryptography: Privacy and Security on Block chain

TOTAL: 45

TEXT BOOKS:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Packt Publishing, 2nd edition, , 2018.
2. Narayanan, Bonneau J, Felten E, Miller A, Goldfeder S, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University Press, 2016

REFERENCE BOOKS:

1. Antonopoulos, "Mastering Bitcoin", O'Reilly Publishing, 2014.
2. Antonopoulos and Wood G, "Mastering Ethereum: Building Smart Contracts and Dapps", O'Reilly Publishing, 2018.
3. Drescher D, "Blockchain Basics", Apress, 2017

WEB URLS:

1. blockgeeks.com/guide/what-is-block-chain-technology
2. <https://nptel.ac.in/courses/106105184/>
3. <https://www.geeksforgeeks.org/hyperledger-fabric-component-design/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2		-	-	-	-	-	-	-	-	-
CO3	3	3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	3	3	2	2	1	-	-	-	-	-	-	-	-	-
CO5	3	3	2	2	2	2	1	1	1	-	-	-	-	-
CO	2.8	2.8	1.8	1.8	1.3	2	1	1	1	-	-	-	-	-

23ITO107

FUNDAMENTALS OF COMPUTER NETWORKS

L	T	P	C
3	0	0	3

PRE-REQUISITES: Programming in C

OBJECTIVES:

- To acquire the basic taxonomy and terminology of computer networking.
- To understand the different components of computer networks, various protocols, modern technologies and their applications.
- To apply the fundamental concepts of computer networking and advanced networking concepts

OUTCOMES:

Learners should be able to

- CO1:** explain data communication system components and the significance of layered architecture in networking. **K2**
- CO2:** illustrate the functionality and interactions of OSI and TCP/IP reference model layers. **K2**
- CO3:** utilize the data link layer and network layer protocols, including switching and forwarding mechanisms. **K3**
- CO4:** apply the transport layer performance metrics, including congestion control and Quality of Service (QoS). **K3**
- CO5:** demonstrate the role of application layer protocols in internet services and Network management. **K3**

UNIT I DATA COMMUNICATIONS 9
Data Communication- Networks-The OSI Model- Layers in the OSI Model – TCP/IP Protocol Suite – Addressing – Transmission Media.

UNIT II DATA LINK LAYER 9
Link and Medium Access protocols – Framing – Error Detection – Reliable Transmission – IEEE 802 Standards – Ethernet – Token Rings – Wireless LANs.

UNIT III NETWORK LAYER 9
Circuit Switching – Packet Switching – Switching and Forwarding – Bridges and LAN Switches – Cell Switching – Internetworking – Routing Techniques: Distance vector (RIP) – Link state (OSPF) – Subnetting – CIDR- BGP - IPv6.

UNIT IV TRANSPORT LAYER 9
UDP – TCP – Congestion Control and Resource Allocation –TCP Congestion Control – Congestion Avoidance Mechanisms – Quality of Service- Integrated Services – Differentiated Services.

UNIT V APPLICATION LAYER 9
Domain Name System – Electronic Mail – File Transfer- WWW and HTTP-Network Management System – Simple Network Management Protocol.

TOTAL: 45

TEXT BOOKS:

1. Andrew S Tanenbaum, Computer Networks, Pearson, 6th edition, 2022.
2. Behrouz A. Forouzan, Data Communication and Networking, McGraw Hill Education (India) Private Limited, 6th edition, 2022.

REFERENCE BOOKS:

1. William Stallings, Data and Computer Communications, Prentice Hall, 10th edition, 2017.
2. Larry Peterson, Bruce Davie, “Computer Networks: A Systems Approach”, Elsevier, Online Edition, 2019.
3. James F Kurose, Keith W Ross, “Computer Networking – A Top-Down Approach Featuring the Internet”, Pearson Education, 7th edition, 2017.
4. Nader F Mir, “Computer and Communication Networks”, Pearson Prentice Hall Publishers, 2nd edition, 2015.

WEB URLS:

1. https://www.udemy.com/topic/cisco-ccna/free/?srsltid=AfmBOooYyGaydA6ZYV89_TgNOsCYBx_Mytv5DJNdbKlOHm5g28iZv3ca
2. <https://www.cisco.com/site/us/en/learn/training-certifications/certifications/enterprise/ccna/index.html>
3. <http://nptel.ac.in/courses/106105081>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	1	-	-	-	-	-	-	-	-	-
CO2	2	2	1	1	1	-	-	-	-	-	-	-	-	-
CO3	3	1	1	1	1	-	-	-	-	-	-	-	-	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	1	-	-	-	-	-	-	-	-	-
CO	2.6	1.8	1	1	1	-	-	-	-	-	-	-	-	-

23ITO108

INTRODUCTION TO XML AND WEB SERVICES

L	T	P	C
3	0	0	3

PRE-REQUISITES: HTML

OBJECTIVES:

- To acquire the fundamental structure, syntax, and validation methods of XML, including DTDs and XML Schemas. Apply the basics of how data flows from one node to another.
- To understand the WSDL, UDDI, and SOAP, and their significance in enabling interoperability in distributed computing
- To apply the hands-on experience in creating XML schemas, parsing XML documents, and deploying Web Services using Java and other technologies.

OUTCOMES:

Learners should be able to

- CO1:** describe the knowledge of XML fundamentals, including its structure, syntax, and validation techniques **K2**
- CO2:** explain DTDs and XML Schemas (XSDs) to define and validate XML documents. **K2**
- CO3:** use the principles of Web Services, their architecture, and the role of SOAP, WSDL, and UDDI. **K3**
- CO4:** generalise XML-based Web Services using appropriate tools and programming languages. **K3**
- CO5:** estimate the impact of Web Services and SOA in modern distributed computing environments and enterprise applications. **K3**

UNIT I INTRODUCTION TO XML

9

Introduction to XML: Getting Multilingual with XML - The Convergence of HTML and XML - XML and Web Browsers - XML Building Blocks - XMLs Five Commandments - Schemas and XML Data Modeling - Document Type Definitions (DTDs) - XML Schema (XSDs) - Comparing DTDs and XSDs - The Importance of Document Validation.

UNIT II DTD AND XML SCHEMA

9

DTD Construction Basics: Pondering Elements and Attributes - Empty Elements - Empty-Only Elements - Mixed Elements - Putting Attributes to Work - String Attributes - Enumerated Attributes, Tokenized Attributes - Working with Multiple Attributes. Using XML Schema: XSD Data Types - XSD Schemas and XML Documents - Working with Simple Types - Complex XML Schema Example - World of Entities.

UNIT III INTRODUCTION TO WEB SERVICES

9

Evolution and Emergence of Web Services – Evolution of distributed computing, Core distributed computing technologies — client/server, CORBA, JAVA RMI role of J2EE and XML in distributed computing, emergence of Web Services and Service Oriented Architecture (SOA) - Web Services Architecture — Web services

Architecture and its characteristics - core building blocks of web services - web services communication models - basic steps of implementing web services.

UNIT IV WSDL 9

WSDL — WSDL in the world of Web Services, Web Services life cycle, anatomy of WSDL definition document, WSDL bindings, WSDL Tools, limitations of WSDL.

UNIT V SERVICE DISCOVERY AND UDDI 9

Service discovery, role of service discovery in a SQA, service discovery mechanisms, UDDI — UDDI registries, uses of UDDI Registry, Programming with UDDI, UDDI data structures, Publishing API, Publishing, searching and deleting information in a UDDI Registry, limitations of UDDI

TOTAL: 45

TEXT BOOKS

1. Heather Williamson, “XML: The Complete Reference”, McGraw-Hill, 2nd edition 2021
2. Nagappan R, Skoczylas R, Sriganesh R P, “Architecting and Developing Secure Web Services Using Java”, Wiley India, 1st edition 2021

REFERENCE BOOK

1. Thomas Erl, “Service-Oriented Architecture: A Field Guide to Integrating XML and Web Services”, Prentice Hall, 2021.
2. Michael P Papazoglou, “ Web Services: Principles and Technology”, Prentice Hall, 1st edition, 2021
3. Eric Newcomer, “Understanding Web Services: XML, WSDL, SOAP, and UDDI”, Addison-Wesley Professional Edition: 1st edition, 2020.

REFERENCE URL

1. <https://www.w3.org/XML/>
2. <https://www.oasis-open.org/>
3. <https://docs.oracle.com/en/java/javase/>

COURSE ARTICULATION MATRIX

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	-	-
CO	2.8	1.8	1.3	1	-	-	-	-	-	-	-	-	-	-



KARPAGAM EDUCATIONAL INSTITUTIONS

- Karpagam Academy of Higher Education (Deemed to be University)
- Karpagam College of Engineering
- Karpagam College of Pharmacy
- Karpagam Nursing College
- Karpagam Institute of Technology
- Karpagam Faculty of Medical Sciences and Research