SRI SANKARA ARTS AND SCIENCE COLLEGE

(AUTONOMOUS)

ENATHUR, KANCHIPURAM – 631 561.

Learning Outcome-based Curriculum Framework (LOCF)

for

B.SC., COMPUTER SCIENCE

Choice Based Credit System (CBCS)

(Effective from the academic year 2022 - 2023)

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Preamble

The curriculum of **B.Sc., Computer Science** programme offered by Department of Computer Science is prepared in accordance with UGC and Tamil Nadu State Council of Higher Education (TANSCHE). The Programme complies with the Outcome Based Education (OBE) and is designed with relevance to Choice Based Credit System (CBCS) affiliated to the University of Madras.

The curriculum and syllabi conform to the Learning Outcomes-based Curriculum Framework (LOCF) to make it student-centric, interactive and outcome-oriented education for the student's community. The Programme Outcome (PO), Programme Specific Outcome (PSO) and Course Outcome (CO) were discussed and finalized keeping the broad requirements of the programme.

A comprehensive and detailed curriculum and syllabi along with Text books and Reference books were framed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Research Organizations and Parents to capture the voice of the respective stakeholders.

The students are offered a well-rounded curriculum that includes the core concepts of Computer Science and along with it the latest trends such as Artificial Intelligence, Internet of Things, Machine Learning, Mobile Application Development, Open-Source Software among many other courses.

1. Introduction

The field of Computer Science has been on an evolution spree for the past three decades and the state-of-the-art technologies have often been breached day-in and day-out by the emergence of new technologies. The mutual growth of hardware and software has supplemented and complimented each other to propel the field of computer science and expanded the horizons of the field. Computers have invaded into every form of human lives giving them instant solutions for the problems that they encounter in their daily life. So, its safe to say that computers have become an integral part of humankind and inevitable to stay away from its magic.

The field of Computer science has been stretching its contours at a rapid pace so much so that even highly complex problems are being breached with consummate ease with the ever-evolving cutting-edge technologies. The latest topics that are hogging the limelight of late are Machine Learning, Artificial Intelligence, Internet of things, Image Processing, Cloud Computing, Natural Language Processing, etc.,

The B.Sc. Computer Science programme aims to instill core competencies through introduction of basic and fundamental courses and along with corporate-savvy courses that trains the students to be corporate-ready. The curriculum is designed meticulously so as to enhance the employability skill, entrepreneurship skill, research-oriented skill and skill necessary for cracking the competitive exams. In particular, the course prepares the students to be employable as Web Developer, Software Engineer, Software Tester, Network Administrator, Database Administrator, Data Analyst.

The Learning Outcomes-based Curriculum Framework for B.Sc. CS is structured and developed to facilitate the students to achieve the following:

- To acquire basic core competencies in fundamental subjects with good foundation in theory and its applications such as Data structures, Operating system, Database systems, Software Engineering, Algorithms, Communication and Networking.
- To develop an ability to synthesize the learned knowledge to analyze the real-world problems and to propose new self-thought solutions from the acquired knowledge.
- To learn advanced and latest technologies to meet the industry standards and challenges. The course outcomes and objectives are designed to cater to the enlisted purposes.

2. Learning Outcomes-based Curriculum Framework

2.1 Nature and Extent of the B.Sc. CS Programme

The undergraduate programs in Computer Science adds-on to the science-oriented knowledge gained in the higher secondary school education, which provides strong rooting in basic computation science and basic programming languages. This sets up the young students for a more rigorous theories and practices of the world of computer science.

Curriculum and syllabi framework is intended to introduce students to the foundation of computing along with core technologies and its applications. It is highly critical in inculcating a strong foundation in the fundamentals of computer science so as to venture into a diversified spectrum of applications of computer science. The curriculum in computer science is integrated with courses in the sciences and the humanities to offer foundation and allied courses to enhance student employment opportunities.

3. Graduate Attributes:

Graduate Attributes (GA) are the qualities, skills and understandings that students should develop during their graduation. These qualities prove to be the characteristics and defining roles of the graduates. Graduate attribute is a key outcome that underpin curriculum planning and development. The graduate attributes are fostered through meaningful learning experiences made available through the curriculum, college experience and a process of critical and reflective thinking.

The graduate attributes can be viewed as qualities as listed subcategories:

- **Disciplinary knowledge:**

The graduate must demonstrate comprehensive and in-depth knowledge and understanding of the core concepts offered in the curriculum of Computer Science.

- **Communication skills:**

Since the scope for the employment for a computer science graduate has spawned over the world, it is pertinent that the graduates have good communication skills. They should confidently share one's view and express their ideas to the world. They should possess the ability to present the complex information in a precise, concise and unambiguous manner.

- **Problem Solving and Design:**

Problem solving skills empower students to find methodical solutions to any real-world problems or real-time problems using computational algorithms and solutions. Problem solvers are most sought-after attributes of the graduates form the field of Computer Science. They should possess the ability to clearly understand the problem, think creatively or out-of-the-box thinking and to convert the problem into a computational model to find a scientific solution backed by the theories.

- **Ethical Practices:**

Ethical practice is a key component of professionalism and needs to be instilled in curricula across courses. Ethical practices give the graduates a sense of discretion and moral responsibility for carrying out their duties in a diverse and fiercely competing society. It shall imbibe cultural diversity, linguistic differences and complex nature of our world.

- **Critical Thinking:**

Critical Thinking gives the capability to apply analytic thought to find a solution to a problem by analysing the problem, evaluating the evidences, identifying the path to the solutions, formulating the methods and procedures to the possible solutions.

3.1. LIST OF GRADUATE ATTRIBUTES FOR B.SC CS:

GA-1: A commitment to excellence in all scholarly and intellectual activities, including critical judgement.

GA-2: Ability to engage constructively and methodically when exploring ideas, theories and philosophies.

GA-3: Ability to consider other points of view and make a thoughtful argument

GA-4: Commitment to sustainability and high ethical standards in social and professional practices.

GA-5: To be open-mined about cultural diversity, linguistic difference and the complex nature of our world.

GA- 6: Open to objective and constructive feedback from supervisors and peers.

4. Qualification Descriptors:

Qualification Descriptors are generic statements that define the outcomes of the graduates. The Qualification descriptors are used as metric by two parties:

The first party is the designer of academic programmes who can use the qualification metrics to measure the achievement of students for the award of the qualification.

The second party is the employers of the graduates who can use the qualification descriptors to assess the quality and capabilities of the graduates holding the qualification.

4.1. Qualification Descriptors for B.Sc. with CS

On completion of B.Sc. with Computer Science, the expected learning outcomes that a student should be able to demonstrate are the following.

QD-1: Fundamental understanding of the principles of Computer Science and its connections with other disciplines.

QD-2: Skills and tools in areas related to Computer Science and current development in Government and public service.

QD-3: Communicate the results of studies undertaken in Computer Science accurately in a range of different contexts using the main concepts, constructs and techniques.

QD-4: Apply Computer Science knowledge and transferable skills to new / unfamiliar contexts.

QD-5: Demonstrate subject-related and transferable skills that are relevant to industry and employment opportunities.

5. PROGRAMME OUTCOMES (PO)

PO-1. Enriching the knowledge in theoretical and practical aspects.

PO-2. Developing research aptitude among the students and encouraging them to take up research projects and publish research papers.

PO-3. Enabling the students to come out successfully in competitive examinations.

PO-4. Developing students' skills, based on current trends by offering Job oriented, Entrepreneurial, certificate courses and Value-added courses.

5.1 PROGRAMME SPECIFIC OUTCOME (PSO)

PSO-1. Acquainting students with basic software and hardware skills, laying a strong foundation for applied knowledge in the field of computer science.

PSO-2. Imbibing students with hands-on practical sessions, catering to the latest demands in the IT field making them more employable.

PSO-3. Equipping students with state-of-the-art technologies and cutting-edge solutions to motivate student's foray into Entrepreneurship.

PSO-4. Augmenting students with necessary skills by training them for various competitive exams like NET, SET and other exams for career prospects.

PSO-5. Inculcating students with a drive and passion for Research aptitude by motivating them to venture into Advanced Research.

PO – PSO MATRIX

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
PO-1	✔				
PO-2					✔
PO-3				✔	
PO-4		✔	✔		

6.   Syllabus and Regulation

Choice Based Credit System.

Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

Sl.No	Level	Parameter	Description
1	K1	Knowledge / Remembering	It is the ability to remember the previously learned
2	K2	Comprehension / Understanding	The learner explains ideas or concepts
3	K3	Application / Applying	The learner uses the information in a new way
4	K4	Analysis / Analysing	The learner distinguishes among different concepts
5	K5	Evaluation / Evaluating	The learner justifies a stand or decision
6	K6	Synthesis / Creating	The learner creates a new product of point of view

6.1 ELIGIBILITY FOR ADMISSION:

Candidates for admission to the first year of the Degree of Bachelor of Science courses shall be required to have passed the Higher Secondary Examinations with a computer science / Mathematics / Statistics / Business Mathematics (Academic Stream) conducted by the Government of Tamil Nadu or CBSE pattern shall be permitted to appear and qualify for the B.Sc Degree Examination of the University of Madras affiliated colleges of this University.

6.2 STRUCTURE OF THE COURSE

The course is organized on semester basis with a total of six semesters. Each student will opt for a comprehensive, interactive course with one of the faculty member. The topic of specialization and course content will be determined by the dept/course advisor.

Core practical **Laboratory:** Independent system shall be provided for the each student. It is recommended that the practical training be organized as an exercise rather than simple demonstration. The student must actually perform the experiments.

6.3 ELIGIBILITY FOR THE AWARD OF DEGREE

A Candidate shall be eligible for the award of the Degree only if he/she has undergone the prescribed course of study in a Autonomous College for a period of not less than three academic years, passed the examinations of all the Six Semesters prescribed earning **140** credits in Parts-I, II, III, IV, V & VI and fulfilled such conditions as have been prescribed therefore.

The parent university will award degrees to the students evaluated and recommended by autonomous colleges. The degree certificates will be in a common format devised by the university. The name of the college will be mentioned in the degree certificate, if so desired. The declaration of results wasdecided by the examination committee.

6.4 DURATION:

Each academic year shall be divided into two semesters. The first academic year shall comprise the first and second semesters, the second academic year the third and fourth semesters and the third academic year the fifth and sixthsemesters respectively.

The odd semesters shall consist of the period from June to November of each year and the even semesters from December to April of each year. There shall be not less than 90 working days for each semester exclusive of the days for the conduct of semester examinations.

In each semester, Papers are administered in 15 teaching weeks and another 5 weeks are utilized for evaluation and grading purposes. Each week has 30 working hours spread over in a 5 day week. Depending upon the content and specialization, a paper may have 1 to 6 credits. Total number of teaching hours in a semester will be 450 hrs. One credit of each theory paper is equal to 15 hrs of lectures or 30 hrs of practical works.

6.5 MAXIMUM PERIOD FOR COMPLETION OF THE PROGRAMMES

The candidates shall complete the B.Sc Degree Programmes within 6 years from the date of admission. The term completing the programmes means passing all the prescribed examinations of the programme to become eligible for the degree. No candidate shall be permitted to appear for the examinations after the prescribed period for completing the programme.

6.6 COURSE OF STUDY

A Bachelor's programme consists of a number of papers. The term Course is used to indicate logical part of a subject matter of the programme. In each of Bacherlor's programmes, there will be a prescription of (i) language –I (Tamil, Sanskrit or other languages), (ii) language – II (English), (iii) a set of compulsory courses (called core subjects), some optional courses (called elective / allied subjects) and projects, (iv) a set of papers recommended by UGC and TANSCHE (Advanced Tamil / Soft skill / Environmental Studies / Value education), and (v) Extension activities.

The detail of the Study for Bachelor Degree Courses shall consist of the following:

PART – I Language Courses (LC) [Tamil / Other Languages]

PART – II English Language Courses (ELC)

PART – III Core Subjects

　　　　　Allied Subjects Projects / Field work

PART – IV

1. (a) Those who have not studied Tamil up to XII Std. and taken a Non-Tamil Language under

　Part-I shall take Tamil comprising of two papers (level will be at 6th Standard).

(b) Those who have studies Tamil up to XII Std. and takena Non-Tamil Language under Part- I shall take Advanced Tamil comprising of two papers.

(c) Others who do not come under a + b can choosenon-major elective comprising of two papers.

2. Skill Based Subjects - Soft Skills

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed papers on Soft Skills. For three years UG degree Programme, a candidate mustundergo a minimum of 4 papers (4 x 2 = 8 credits). Papers will be finalized in due course.

3. Environmental Studies

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed paper on Environmental studies. For three years UG degree Programme, a candidate must undergo environmental studies during third semester of second year (2 credits). Syllabus is common to all UG courses.

4. Value Education

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed paper on value education. For three years UG degree Programme, a candidate must undergo value education during fourthsemester of second year (1 credit). Paper will be finalized in due course.

PART – V Extension Activities

A candidate shall be awarded a maximum of 1 Credits for Compulsory Extension Service. All the Students shall have to enroll for NSS /NCC/ NSO (Sports & Games) Rotract / Youth Red cross or any other service organizations in the college and shall have to put in Compulsory minimum attendance of 40 hours which shall be duly certified by the Principal of the college before 31st March in a year. If a student LACKS 40 HOURS ATTENDANCE in the First year, he/she shall have to compensate the same during the subsequent years. Students those who complete minimum attendance of 40 hours in One year will get HALF A CREDIT and those who complete the attendance of 80 or more hours in Two Years will ONE CREDIT. Literacy and population Education Field Work shall be compulsory components in the above extension service activities. Theworking hours should not overlaps the normal teaching hours.

Student advisor

All teachers of the department shall function as student advisors. There will be more or less an equal number ofstudents assigned to each student advisor of a department. The student advisor will help the students in choosing core and elective papers of study. The student advisor shall be responsible for registration of papers (subjects) by his students. The student advisor will offer all possible student support services

6.7 CREDITS

The term credit is used to describe the quantum of syllabus for various programmes in terms of periods of study. It indicates differential weightage given according to the content's duration of the courses in the curriculum design. The minimum credit requirement for a three-year Bachelor's programme shall be **140** credits. Each subject (course) is designed variously under lectures / tutorials / laboratory work / seminar / project work etc., to meet effective teaching and learning needs and credits are assigned suitably.

One credit for each lecture / tutorial / project work period per week shall be allotted. One credit for two laboratory hours per week shall be allotted. In practical, each credit should cover minimum of six experiments. Thus normally, in each of the subject, credits will be assigned on the basis of the lectures / tutorials / laboratory work / project work and other forms of learning in a 15-week schedule.

6.8 SCHEME OF EXAMINATION

There shall be continuous, comprehensive evaluation of students through internal and external examination. At least 2 internal examinations (Sessional Tests) per semester and 1 semester ending examination should be conducted.

Sessional Test I will he held during sixth week for syllabi covered till then. Sessional Test I will be a combination of a variety of tools such as class test, assignment, paper presentation etc., that would be suitable for the paper. This required an element of openness. The students are to be informed in advance about the nature of assessment and the procedures.

However, the tests are compulsory. Test I may be for one hour duration. The pattern of question paper will be decided by the respective board of studies.

Sessional Test I will carry 20% of marks of the entire paper.

Sessional Test II will he held during eleventh week for syllabi covered between seventh and eleventh weeks. Sessional Test I will be a combination of a variety of tools such as class test, assignment, paper presentation etc. that would be suitable for the paper. It will also have an element of openness. The students are to be informed in advance about the nature of assessment and the procedures. However, the tests are compulsory. Test II may be for one hour duration. The pattern of question paper will be decided by the respective board of studies.

Sessional Test II will carry 20% of marks of the entire paper.

There will be one End Semester examination of 2 - 3 hours duration in each paper. The End semester examination will cover all the syllabi of the paper for 60% of Marks.

A dissertation may be offered in lieu of one / two papers / practicals. It shall be evaluated by two examiners one external and one internal appointed by the Controller of Examination. Wherever there is viva-voce, it shall be conducted by the common Viva Board consisting of the Chairman and internal members of the Board of Examination in the concerned subject, internal guide and one external expert as approved by the Controller of Examinations.

End semester practical examinations shall be held before the theory examinations to benefit the students to undertake examinations of other departments.

Every course offered will have three components associated with the teaching-learning process of the course, namely (i) Lecture - L (ii) Tutorial - T (iii) Practicals - P, (iv) Self study - S where,

L stands Lecture session. **T** stands Tutorial session consisting participatory discussion / self-study / desk work / brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands Practice session and it consists of Hands-on experience / Laboratory Experiments / Field Studies / Case studies that equip students to acquire the much required skill component.

S stands Self-study session consisting participatory discussion by student with the guidance of faculty. This session is not included in the weekly hour plan.

In terms of credits, every one-hour session of L amounts to 1 credit per semester, a minimum of two-hour session of T or P amounts to 1 credit per semester and no credits allotted to self-study hour, over a period of one semester of 15 weeks for teaching-learning process. The total duration of a semester is 20 weeks inclusive of semester-end examination.

A course shall have either or all the three components. That means a course may have only lecture component, or only practical component or combination of any two or all the three components. The total credits earned by a student at the end of the semester upon successfully completing the course are L + T + P + S. The credit pattern of the course is indicated as L: T: P: S. For example: a theory course with a L-T-P-S schedule of 4-0-0-2 will be assigned 4 credits, and a lab practical course with a L-T-P-S schedule of 0-0-3-0 will be assigned 3 credits.

For B.Sc. courses Part I, Part II and Part IV subjects will be provided to first to fourth semesters. In fifth and sixth semesters only part III papers provided. Total of 30 hrs. was to be maintained constantly for all semesters.

Total credits of 140 attained through three years of their study period.

7 Question Paper Pattern

SECTION – A (30 words)

10 OUT OF 12   -10 X 2 marks   = 20 marks

SECTION – B (200 words)

5 out of 7   -5 x 5   marks   = 25 marks

SECTION – C (500 words)

3 out of 5   - 3x 10 marks   = 30 marks

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TOTAL   =   75 marks

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6.9 SCHEME OF EXAMINATIONS:

SUBJECTS	CREDITS	EXAM HRS	MAX. MARKS		
			Internal	External	TOTAL
PART I Language	3	3	25	75	100
PART II English	3	3	25	75	100
PART III Core Subject	4	3	25	75	100
Core Practical	3	3	40	60	100
Allied Paper	5	3	25	75	100
Allied Practical	3	3	40	60	100
PART IV 1. (a) Those who have not studied Tamil up to XII Std.and taken a Non-Tamil Language under Part-I shall take Tamil comprising of two-paper (level will be at 6th Standard). (b) Those who have studiesTamil up to XII Std. and taken a Non-Tamil Language under Part-I shalltake Advanced Tamil comprising of two papers (c) Others who do not comeunder a + b can choose non-major elective comprising of twopapers.	2	2	25	75	100
2. Skill based subjects – SoftSkill	3	2	50	50	100
PART V – Extensionactivities	1				
TOTAL	**27**				

The following procedure be followed for internal Marks

The number of working hours per week for the students for getting the **140** prescribed credits should not exceed 30 hours of class per week and no faculty member should be allocatedextra hours beyond the prescribed 16 lecture hours.

The following procedure be followed for Internal Marks

Theory Papers: **Internal Marks 25**

INTERNAL MARKS

Tests (2 out of 3)	10
Attendance	5
Seminars	5
Assignments	5
TOTAL	**25**

Break-up Details for Attendance

Below 60%- No marks

60%	To	75%	- 3 marks
76%	To	90 %	- 4 marks
91%	To	100%	- 5 marks

Practical	**Internal Marks**	**40**
	Attendance	5 marks
2 out of 3	Practical Test best	30 marks
	Record	5 marks

6.10 REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTER

i. Candidates shall register their names for the First Semester Examination after the admission in UG Courses.

ii. Candidates shall be permitted to proceed from the First Semester up to Final Semester irrespective of their failure in any of the Semester Examination subject to the condition that the candidates should register for all the arrear subject of earlier semesters along the current (subsequent) Semester Subjects.

iii. Candidates shall be eligible to go to subsequent semester, only if they earn sufficient attendance as prescribed therefore by the Academic Council from time to time. Provided in case of a candidate earning less than 50% of attendance in any one of the Semesters due to any extraordinary circumstances such as medical grounds, such candidates who shall produce Medical Certificate issued by the Authorised Medical Attendant (AMA), duly certified by the Principal of the college, shall be permitted to proceed to the next semester and to complete the Course of study. Such Candidates shall have to repeat the missed Semester by rejoining after completion of Final Semester of the course, after paying the fee for the break of study as prescribed by the Academic Council from time to time.

iv. There shall be examinations at the end of each semester, for odd semesters in the month of October / November, for even semesters in April / May. A candidate who does not pass the examination in any paper(s) shall be permitted to appear in such failed courses in the subsequent examinations to be held in October / November or April / May.

v. The results of all the examinations will be published through the College website.

6.11 PASSING MINIMUM

A candidate shall be declared to have passed:

a) There shall be no Passing Minimum for Internal.

b) For External Examination, Passing Minimum shall be of 40 % (Forty Percentage) of the maximum marks prescribed for the paper for each Paper/Practical/Project and Viva-voce.

c) In the aggregate (External + Internal) the passing minimum shall be of 40%. d) He/She shall be declared to have passed the whole examination, if he/she passes in all the papers and practicals wherever prescribed / as per the scheme of examinations by earning **140** CREDITS in Parts-I, II, III, IV & V. He/she shall also fulfill the extension activities prescribed earning a minimum of 1 Credit to qualify for the Degree. He/She shall also complete two certificate courses to qualify for the Degree.

6.12 CLASSIFICATION OF SUCCESSFULCANDIDATES

PART- I TAMIL / OTHER LANGUAGES

TAMIL/OTHER LANGUAGES: Successful candidatespassing the Examinations for the Language and securing the marks (1) 60 percent and above and (ii) 50 percent and above but below 60 percent in the aggregate shall be declared to have passed the examination in the FIRST and SECOND class, respectively. All other successful candidates shall be declared to have passed the examination in the THIRD Class.

PART – II ENGLISH

ENGLISH: Successful candidates passing the examinations for English and securing the marks (i) 60 percent and above and (ii) 50 percent and above but below 60 percent in the aggregate shall be declared to have passed the examination in the FIRST and SECOND Class, respectively. All other successful candidates shall be declared to have passed the examination in the THIRD class.

PART – III consisting of CORE SUBJECTS, ALLIED SUBJECTS, PROJECT with three papers: Successful candidates passing the examinations for Core papers together and securing the marks (i) 60 percent and above (ii) 50 percent and above but below 60 percent in the aggregate of the marks prescribed for the Core papers together shall be declared to have passed the examination in the FIRST and SECOND Class respectively. All other successful candidates shall be declared to have passed the examinations in the THIRD Class.

PART – IV consisting of sub items 1 (a), (b) & (c), 2, 3 and 4

Successful Candidate earning of 2 credits for each paper SHALL NOT BE taken into consideration for Classification /Ranking / Distinction.

PART – V EXTENTION ACTIVITIES

Successful Candidate earning of 1 credit for extension activities SHALL NOT BE taken into consideration for Classification / Ranking / Distinction.

7   RANKING

Candidates who pass all the examinations prescribed for the Course in the FIRST APPEARANCE ITSELF ALONE are eligible for Ranking / Distinction.

Provided in the case of Candidates who pass all the examinations prescribed for the Course with a break in the First Appearance due to the reasons as furnished in the Regulations 8(iii) category are only eligible for Classification.

6.13 GRADING SYSTEM:

1. Passing Minimum is 40% of the ESE and also 40% ofthe maximum of that paper/course.

2. Minimum Credits to be earned:

For THREE-Year-Programme: Best 140 Credits
(Part I and II: Languages, Part III Major, Elective, Part –IV Soft skills and Part V: Extension activities)

3. Marks and Grades:

The following table gives the marks, grade points, letter grades and classification to indicate the performance of the candidate.

Conversion of Marks to Grade Points and LetterGrade (Performance in a Course / Paper)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90–100	9.0–10.0	O	Outstanding
80–89	8.0–8.9	D+	Excellent
75–79	7.5–7.9	D	Distinction
70–74	7.0–7.4	A+	Very Good
60–69	6.0–6.9	A	Good
50–59	5.0–5.9	B	Average
40–49	4.0–4.9	C	Satisfactory
00–39	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

C_i = Credits earned for course-i in any semester.
G_i = Grade Point obtained for course- i in any semester.
n   refers to the semester in which such courses were credited.

For a Semester:

GRADE POINT AVERAGE [GPA] = $\sum_i C_i G_i / \sum_i C_i$

Sum of the multiplication of grade points by the credits of the courses

GPA =   --

Sum of the credits of the courses in a semester

For the entire programme:

CUMULATIVE GRADE POINT AVERAGE [CGPA] = $\sum n \sum i C_{in} G_{ini} / \sum n \sum C_{ini}$

Sum of the multiplication of grade points by thecredits of the entire programme

CGPA = --

Sum of the credits of the courses of the entire programme

CGPA	GRADE	CLASSIFICATION OF FINAL RESULT
9.5-10.0	O+	First Class - Exemplary *
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class withDistinction *
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
4.5 and above but below 5.0	C+	Third Class
4.0 and above but below 4.5	C	
0.0 and above but below 4.0	U	Re-appear

* The candidates who have passed in the first appearanceand within the prescribed

semester of the UG Programme (Major, Allied and Electivecourses alone) are eligible.

16.14   TRANSITORY PROVISION

Candidates who have undergone the course of study prior to the academic year 2022-2023 will be permitted to appear for the examinations under those Regulations for a period of TWO years i.e. upto and inclusive of April - May 2025 Examinations. Thereafter, they will be permitted to appear for the examination only under the Regulations then in force.

B.Sc., COMPUTER SCIENCE
effective from the academic year 2022- 2023 SYLLABUS

Course Structure

S.NO	PART	SUBJECT NAME	CRIDITS	EXAM DURATION	MAXIMUM MARKS		
					CIA	UE	TOTAL
		SEMESTER I					
1	I	**Tamil – I / Sanskrit –I**	3	3	25	75	100
2	II	**Communicative English – I**	3	3	50	50	100
3	III	**Allied Maths – I**	5	3	25	75	100
4	III	**Core I : Python Programming**	4	3	25	75	100
5	IV	**Softskill – I (English for Physical Sciences 1)**	3	2	50	50	100
6	IV	**Basic Tamil/Advanced Tamil/ Non Major Elective I**	2	3	25	75	100
7	III	**Core I : Python Programming Lab**	3	3	40	60	100
		Total Credits	**23**				
		SEMESTER II	CRIDITS	EXAM DURATION	CIA	UE	TOTAL
8	I	**Tamil – II / Sanskrit –II**	3	3	25	75	100
9	II	**Communicative English – II**	3	3	50	50	100
10	III	**Allied Maths – II**	5	3	25	75	100
11	III	**Core II : Digital Computer Architecture And Microprocessor**	4	3	25	75	100
12	IV	**Non-Major ElectiveLab**	2	3	40	60	100
13	IV	**Softskill – II (English for Physical Sciences 1)**	3	2	50	50	100
14	III	**Practical II : Microprocessor Lab**	3	3	40	60	100

		Total Credits	23				

		SEMESTER III	CRIDITS	EXAM DURATION	CIA	UE	TOTAL
15	I	Tamil–III/Sanskrit –III	3	3	25	75	100
16	II	Language through Literature – I	3	3	50	50	100
17	III	Core III: Java Programming and Data Structures	4	3	25	75	100
18	III	Allied-Statistical methods & theirApplication –I	5	3	25	75	100
19	IV	Environmental Studies	Examination will be held in Semester IV				
20	IV	Soft skill – 3 (Personality Enrichment)	3	2	50	50	100
21	III	Practical III: Data Structures using Java Lab	3	3	40	60	100
		Total Credits	21				

S.NO	PART	SEMESTER IV SUBJECT NAME	CRIDITS	EXAM DURATION	CIA	UE	TOTAL
22	I	Tamil–IV/Sanskrit –IV	3	3	25	75	100
23	II	Language through Literature – II	3	3	50	50	100
24	III	Core IV: Data analytics with R	4	3	25	75	100
25	III	Allied-Statistical methods & their Application –II	5	3	25	75	100
26	IV	Soft skill – 4 (Quantitative Aptitudes)	3	2	50	50	100
27	III	Practical IV: Data Analytics with R Lab	3	3	40	60	100
28	IV	EnvironmentalStudies	2	3	25	75	100
		Total Credits	23				

		SEMESTER V	CRIDITS	EXAM DURATION	CIA	UE	TOTAL
					MAXIMUM MARKS		
29	III	**Core V: Operating System**	4	3	25	75	100
29	III	**Core VI: Relational Database Management System**	4	3	25	75	100
30	III	**Core VII: Mobile Application Development**	4	3	25	75	100
31	III	**Elective – I:**	5	3	25	75	100
32	III	**Practical: RDBMS Lab**	3	3	40	60	100
33	III	**Practical VI: Mobile Application Development Lab**	3	3	40	60	100
34	IV	**Value Education**	2	3	25	75	100
		Total Credits	**25**				
		SEMESTER VI	CRIDITS	EXAM DURATION	CIA	UE	TOTAL
35	III	**Core VIII: Computer Networks**	4	3	25	75	100
36	III	**Core IX: Web Development Using Open-Source Technology**	4	3	25	75	100
37	III	**Core X: Software Testing**	4	3	25	75	100
38	III	**Practical VII: Web Development Using Open-Source Technology Lab**	2	3	40	60	100
39	III	**Practical VIII: Mini Project**	5	3	40	60	100
40	III	**Elective II**	5	3	25	75	100
41	V	**Extension Activities**	1				
		Total Credits	**25**				
		Total Credits (Core, Elective, SBS)	**140**				

		Non –Major Elective: Semester - I	LaTex / Web Office / Fundamentals of Programming
		Non –Major Elective: Semester - II	LaTex - Lab / Web Office - Lab / Fundamentals of Programming - Lab
		Elective I:	**Software Engineering/ Data Mining / Internet-Of-Things**
		Elective II:	**Cloud Computing / Artificial Intelligence / Software Project Management**

Core Paper Theory – 1			
Title of the paper withsubject code	**PYTHON PROGRAMMING**		
Category of the course	Year	Semester	Credits
Core	**I**	**I**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:
- To implement the python programming features in practical applications.
- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries, turtles, Files and modules.

COURSE OUTCOMES:

CO-1: Understand the fundamentals of Tokens, Data types, operators, library functions and Input / Output statements of Python-language.

CO-2: Comprehend the branching constructs and looping constructs of python-language and write simple programs implementing each of the constructs.

CO-3: Analyze Complex data types, List, Tuple, Sets and Dictionary. Review User-defined functions, recursive functions with an example program illustrating its use.

CO-4: Demonstrate the object-oriented programming concepts, modules and exception handling in python.

CO-5: Review the concepts of file operations. Create programs to illustrate the usage of file pointer and file handling for input and output of data.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**INTRODUCTION TO PYTHON:** Python Tokens, Python Data types, Python Operators, Python Blocks.	12	CO-1	K1, K2
II	**PYTHON FLOW CONTROL, BRANCHING STATEMENTS**: if, else and else if, Python Flow Control: Looping statements- Definite and Indefinite Loops, For loops, ranges, While loops, Use of pass,	12	CO-2	K3

	continue, break and else in Loops.			
III	**PYTHON COMPLEX DATA TYPES**: String data type and string operations, List, Tuple, Set and Dictionary, String manipulation, List. Set and Dictionary manipulation, User Defined functions, Call by Value, Call by Reference, Recursive functions, Default arguments in functions, variable scope.	12	CO-3	K4
IV	**OBJECT ORIENTED PROGRAMMING USING PYTHON**: Objects, Abstraction, Encapsulation, Inheritance, Polymorphism, Python Modules, Exception Handling	12	CO-4	K5
V	**PYTHON FILE OPERATIONS**: Reading files, Writing files in python, Understanding read functions, read(), readline(), readlines(). Understanding write functions, write() and writelines() Manipulating file pointer using seek Programming, using file operations.	12	CO-5	K6

TEXT BOOK:

1. Charles Dierbach, "Introduction to Computer Science using Python – A computational Problem solving Focus", Wiley India Edition, 2015.

2. Wesley J. Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education, 2016

3. Taming Python by Programming, Jeeva Jose, Khanna Publishing House

REFERENCE BOOKS:

1. Mark Lutz, "*Learning Python Powerful Object Oriented Programming*", O'reilly Media 2018, 5th Edition.

2. Timothy A. Budd, "*Exploring Python*", Tata MCGraw Hill Education Private Limited 2011, 1st Edition.

3. Allen Downey, Jeffrey Elkner, Chris Meyers, "*How to think like a computer scientist: learning with Python*", 2012.

4. Sheetal Taneja & Naveen kumar, "*Python Programming a Modular approach – A Modular approach with Graphics, Database, Mobile and Web applications*", Pearson, 2017.

5. Ch Satyanarayana M Radhika Mani, B N Jagadesh, "*Python programming*", Universities Press 2018.

WEB REFERENCES

- http://interactivepython.org/courselib/static/pythonds
- http://www.ibiblio.org/g2swap/byteofpython/read/
- http://www.diveintopython3.net/
- http://greenteapress.com/wp/think-python-2e/
- NPTEL & MOOC courses titled Python programming
- http://spoken-tutorial.org/tutorial-search/?search_foss=Python&search_language=English
- http://docs.python.org/3/tutorial/index.html

Core Practical – 1			
Title of the paper withsubject code	**PYTHON PROGRAMMING LAB**		
Category of the course	Year	Semester	Credits
Core	**I**	**I**	**3**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:
- To implement the python programming features in practical applications.
- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.

COURSE OUTCOMES:

CO-1: Understand the basic concept of Python Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions and File programming

CO-2: Acquire knowledge about the basic concept of writing a program.

CO-3: Role of constants, variables, identifiers, operators, type conversion and other building blocks of Python Language.

CO-4: Use of conditional expressions and looping statements to solve problems associated with conditions and repetitions.

CO-5: Role of Functions involving the idea of modularity.

LIST OF EXERCISES:

EX NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	Program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.		
2	Program to calculate total marks, percentage and grade of a student. Marks obtained in each of the five subjects are to be input by user. Assign grades according to the following criteria: Grade A: Percentage >=80 Grade B: Percentage >=70 and <80 Grade C: Percentage >=60 and <70 Grade D: Percentage >=40 and <60 Grade E: Percentage <40	CO-1 CO-2 CO-3 CO-4 CO-5	K1, K2, K3 K4, K5, K6
3	Program, to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.		
4	Program to display the first n terms of Fibonacci series.		
5	Program to find factorial of the given number using recursive unction.		
6	Write a Python program to count the number of even and odd numbers from array of N numbers.		
7	Python function that accepts a string and calculate the number of upper case letters and lower case letters.		
8	Python program to reverse a given string and check whether the give string is palindrome or not.		
9	Write a program to find sum of all items in a dictionary.		

Core Paper Theory – 2			
Title of the paper withsubject code	**DIGITAL COMPUTER ARCHITECTURE AND MICROPROCESSOR**		
Category of the course	Year	Semester	Credits
Core	**I**	**II**	**4**
Paper mainly focusses on	**SKILL DEVELOPEMENT**		

COURSE OBJECTIVES:
- To understand the basic principles of logic gates, sequential and combinational circuits.
- To comprehend the basic organization of computers and the working of each component and CPU
- To bring the programming features of 8085 Microprocessor and know the features of latest microprocessors.
- To understand the principles of Interfacing I/O devices and Direct Memory accesses

COURSE OUTCOMES:

CO-1: Demonstrate number systems and the logic gates. Apply Boolean algebra and theorem for simplification of Boolean functions and also apply Karnaugh map, tabulation method for reducing Boolean expressions and working of sequential circuits.

CO-2: Comprehend the basic components of computer architecture and its functions.

CO-3: Deduce the principles of computer architecture concepts such as instruction formats, addressing modes, registers and pipelining concepts

CO-4: Apply computer arithmetic algorithms and memory organization structures.

CO-5: Deduce assembly level programs to perform the conversions between number systems and BCD to write simple arithmetic programs in assembly level language

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**NUMBER SYSTEM:** Logic Gates – Digital Logic Circuits - Boolean Algebra – Karnaugh Map Simplification – Demorgan's Theorem - Combinational Circuits - Adder –Half adder- Full adder – Subtractor-Half subtractor- Full subtractor-	12	CO-1	K1

	Sequential Circuits – Flip-Flops.			
II	**COMPUTER ARCHITECTURE:** General Register and Stack Organizations- Instruction formats - Addressing modes - Data transfer and manipulation - Program Control- RISC - Pipelining - Vector processing and Array processors.	12	CO-2	K2
III	**COMPUTER ARITHMETIC**: Addition and subtraction – Multiplication and division algorithms – I/O interface – Direct memory Access-Memory Organization: Memory Hierarchy – Main Memory-Auxiliary Memory – Associative Cache and Virtual Memory.	12	CO-3	K3
IV	**INTRODUCTION OF 8085:** Architecture of 8085 – Pin diagram – Bus structure – Address, data and control Bus - Addressing Modes – Instruction Formats – Instruction Set 0f 8085- Programming Techniques such as Looping, Counting and Indexing - Subroutine.	12	CO-4	K4
V	**PROGRAMMING IN 8085:** BCD to Binary and Binary to BCD conversions – BCD to HEX and HEX to BCD - ASCII to BCD and BCD to ASCII conversions - Binary to ASCII and ASCII to Binary conversions. BCD Arithmetic - BCD Addition and Subtraction.	12	CO-5	K5,K6

TEXT BOOKS:

1. M.M. Mano, "Computer System architecture". Pearson, Third Edition, 2007
2. Digital Electronics, A. Anand Kumar, PHI
3. R. S. Gaonkar- "Microprocessor Architecture- Programming and Applications with 8085"- 5 th Edition- Penram- 2009. 3. Tripti Dodiya & Zakiya Malek, "Computer Organization and Advanced Microprocessors", Cengage Learning, 2012.
4. Computer Fundamentals Architecture and Organization, B. Ram, New Age International

REFERENCE BOOKS:

 1. Mathur- "Introduction to Microprocessor"- 3 rd Edition- Tata McGraw-Hill-1993.
 2. P. K. Ghosh and P. R. Sridhar- "0000 to 8085: Introduction to Microprocessors for Engineers and Scientists"- 2 nd Edition- PHI- 1995.
 3. Computer Organization & Architecture, Rajaraman, PHI Learning
 4. Modern Digital Electronics, R.P. Jain, TMH
 5. V. Vijayendran- "Fundamentals of Microprocessors – 8085"- S. Viswanathan Pvt. Ltd.- 2008

Core Practical – 2			
Title of the paper withsubject code	**MICROPROCESSORS LAB**		
Category of the course	Year	Semester	Credits
Core	**I**	**II**	**3**
Paper mainly focusses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To understand the basic principles of logic gates, sequential and combinational circuits.
- To comprehend the basic organization of computers and the working of each component and CPU
- To bring the programming features of 8085 Microprocessor and know the features of latest microprocessors.

COURSE OUTCOMES:

CO-1: Demonstrate addition and subtraction operations for 8-bit and 16-bit numbers using assembly level language.

CO-2: Deduce the array construct and subroutine structures in assembly-level programming.

CO-3: Apply computer arithmetic algorithms and memory organization operations.

CO-4: Understand 8085 microprocessor, its architecture, pin diagram and Assembly language constructs such as branching, looping, subroutines, conditional calls and addressing modes of 8085 MPU

CO-5: Deduce assembly level programs to perform the conversions between number systems and BCD to write simple arithmetic programs in assembly level language

LIST OF EXERCISES:

EX NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	8-bit addition		
2	16-bit addition		
3	8-bit subtraction		
4	8-bit division		

5	8-bit multiplication		
6	BCD addition		
7	BCD subtraction	CO-1	
8	BCD Multiplication	CO-2	K1, K2, K3
9	Binary to Hexadecimal	CO-3	K4, K5, K6
10	Hexadecimal to Binary	CO-4	
11	ASCII TO Binary	CO-5	
12	Binary to ASCII		
13	Searching an element in an Array		
14	Reversing the array element		
15	Block move		

Core Paper Theory – 3			
Title of the paper withsubject code	**JAVA PROGRAMMING AND DATA STRUCTURES**		
Category of the course	Year	Semester	Credit s
Core	**II**	**III**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:
- To enable the students to learn the basic concepts of Java programming
- To use class and objects to create applications
- To have an overview of interfaces, packages, multithreading and exceptions.
- To familiarize students with basic data structures and their use in algorithms.

COURSE OUTCOMES:

CO-1: Conceive the Programming constructs such as branching statements and looping statements of JAVA language, Class, object, and file stream classes.

CO-2: Recall the principles of Object-Oriented Programming paradigm, its advantages, disadvantages and applications. Understand how JAVA programming language can be used to implement the OOP's concepts through Class, Object, inheritance, polymorphism.

CO-3: Understanding the concepts of Packages, Exception handling and Multithreading in JAVA.

CO-4: Comprehend the basic data structures such as stack, queue, Linked-list, applications of stacks.

CO-5: Understanding of Trees, Graphs and their traversals. Calculate the single source shortest path using Dijkstra's Algorithm by representing the problem as graph.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Features of Java – Java Virtual Machine - Object Oriented Paradigm in Java – Data Types – Naming Conventions-Variables- Type Conversion and Casting- Operators – Branching and Looping Statements – Arrays.	12	CO-1	K1 ,K2
II	Classes - Objects - Constructors – Inheritance – Interface - String and Vector Class- Overloading and Overriding methods - Using super-Abstract class - this keyword – finalize() method.	12	CO-2	K3
III	Packages - Importing Packages - Exception Handling – Multithreaded Programming – Java thread life cycle and Synchronization in Threads - Thread Priorities - I/O Streams - File Streams - Applets .	12	CO-3	K4
IV	Abstract Data Types(ADTs)-List ADT-Array based implementation-linked list implementation-singly linked list-doubly linked list-circular linked list-Stack ADT operations-Applications-Evaluating arithmetic expressions-Conversion of infix to postfix expression-Queue ADT-operations-Applications of Queues.	12	CO-4	K5
V	Trees-Binary Trees- representation - Operations on Binary Trees- Traversal of a Binary Tree -Binary Search Trees, Graphs-Representation of Graphs - Traversal in Graph - Dijkstra's Algorithm, Depth-First vs Breadth-First Search.	12	CO-5	K6

TEXT BOOKS:

1. E. Balagurusamy," *Programming with Jav: A Primer*", Tata McGraw Hill 2014, 5th Edition.
2. Mark Allen Weiss, "*Data Structures and Algorithms Analysis in C++*", Person Education 2014, 4th Edition.
3. Fundamentals of Data Structures, Sartaj Sahni, University Press

REFERENCES BOOKS:

1. Herbert Schildt, "*JAVA 2: The Complete Reference*", McGraw Hill 2018, 11th Edition.
2. Aho, Hopcroft and Ullman, "*Data Structures and Algorithms* ", Pearson Education 2003.
3. Data Structures, RS Salaria, Khanna Publishing House

WEB REFERENCES:
- NPTEL & MOOC courses titled Java and Data Structures
- https://nptel.ac.in/courses/106106127/
- https://nptel.ac.in/courses/106105191/

Core Practical – 3			
Title of the paper withsubject code	**DATA STRUCTURES USING JAVA LAB**		
Category of the course	Year	Semester	Credits
Core	**II**	**III**	**3**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To enable the students to learn the basic concepts of Java programming
- To use class and objects to create applications
- To have an overview of interfaces, packages, multithreading and exceptions.

COURSE OUTCOMES:

CO-1: Apply object-oriented programming features to program design and implementation

CO-2: Understand object-oriented concepts and how they are supported by JAVA

CO-3: Understand implementation issues related to object-oriented techniques.

CO-4: Demonstrate the ability to analyze, use, and create functions, classes, to overload operators.

CO-5: Demonstrate the ability to understand and use inheritance and interface when creating or using classes.

CO-6: Determine which algorithm or data structure to use in different scenarios and be familiar with writing recursive methods.

CO-7: Demonstrate understanding of the abstract properties of various data structures such as stacks, queues, lists, trees and graphs and use various data structures effectively in application programs.

LIST OF EXERCISES:

EX NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	Write a Java program to implement the Stack ADT using a singly linked list.		
2	Write a Java program to implement the Queue ADT using a singly linked list.		
3	Write a Java program for the implementation of circular Queue.		
4	Write a Java program that reads an infix expression, converts into postfix form		
5	Write a Java program to evaluate the postfix expression (use stack ADT).		
6	Write a Java program to an Insert an element into a binary search tree.	CO-1	
7	Write a Java program to delete an element from a binary search tree.	CO-2 CO-3	K1, K2, K3
8	Write a Java program to search for a key element in a binary search tree.	CO-4 CO-5	K4, K5, K6
9	Write a Java program for the implementation of BFS for a given graph.		
10	Write a Java program for the implementation of DFS for a given graph.		

Core Paper Theory – 4			
Title of the paper withsubject code	**DATA ANALYTICS WITH R**		
Category of the course	Year	Semester	Credits
Core	**II**	**IV**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:
- To enable the students to learn the basic concepts of Data Analytics.
- To have a basic understanding of R-Programming.
- To have an overview of Data analytical packages used in R-language.
- To familiarize students with basic regression and data mining concepts implemented using R-language.

COURSE OUTCOMES:

CO-1: Understand how to download R-package and handling of R packages. Exploring the data types in R.

CO-2: Analyze the data and data frames in R and operators available in R

CO-3: Demonstrate the concepts of linear regression, logistic regression and its types.

CO-4: Understand the decision tree representation in R and clustering concepts.

CO-5: Synthesis association rules and clustering algorithms in Data mining concepts.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Introduction to R-Downloading and Installing R, IDEs and Text Editors, Handling Packages in R, Getting Started with R - Working with Directory, Data Types in R, Few Commands for Data Exploration,	12	CO-1	K1. K2
II	Loading and Handling Data in R-Challenges of Analytical Data Processing, Expression, Variables and Functions, Missing Values Treatment in R, Using the 'as' Operator, Vectors, Matrices, Factors, List, Few Common Analytical Tasks, Aggregating and Group Processing, Simple Analysis, Methods for Reading Data, Comparison of R GUIs for Data Input - Exploring Data in R - Data Frames, Understanding Data in Data Frames, Load Data Frames, Exploring Data, Missing Values, Outliers, Descriptive Statistics, data Visualizations	12	CO-1 CO-2	K3
III	Linear Regression using R-Model Fitting, Linear Regression, Assumptions, Validating Linear Assumption, - Logistic Regression-What is Regression?, Generalized Linear Models, Logistic Regression, Binary Logistic Regression, Diagnosing Logistic Regression , Multinomial Logistic Regression Models	12	CO-3	K4
IV	Decision Tree - What is a Decision Tree?, Representation in R, Appropriate Problems, Learning Algorithms, Measuring Features, Hypothesis Space Search, Inductive Bias, Why Prefer Short Hypotheses, Issues-Clustering - What is Clustering?, Basic Concepts, Hierarchical Clustering, k-means Algorithm, CURE Algorithm, Clustering in Non-Euclidean Space	12	CO-4 CO-5	K5, K6
V	Association Rules-Frequent Itemset, Data Structure Overview, Mining Algorithm Interfaces, Auxiliary Functions, Sampling from Transaction, Generating Synthetic Transaction Data, Additional Measures of Interestingness, Distance-based Clustering Transaction and Associations - Mining Frequent Patterns, Associations, and Correlations, Frequent Itemsets, Closed Itemsets and Association Rules, Frequent Itemsets: Mining Methods, Pattern Evaluation Methods	12	CO-5	K5, K6

TEXT BOOKS:

1. Data Analytics using R, Seema Acharya, McGraw Hill Education

2. Data Science & Analytics, V.K. Jain, Khanna Publishing House

3. Beginner's Guide for Data Analysis using R Programming, Jeeva Jose, ISBN: 978-93-86173454

REFERENCE BOOKS:

1. THE BIG R-BOOK *FROM DATA SCIENCE TO LEARNING MACHINES AND BIG DATA* , *Philippe J.S. De Brouwer , 2021,* John Wiley & Sons
2. A First Course in Statistical Programming with R, 2nd Edition, W. John Braun and Duncan J. Murdoch
3. Data Mining: Concepts and Techniques by Jiawei Han, Micheline Kamber, and Jian Pei, 2011

Core Practical – 4			
Title of the paper withsubject code	**DATA ANALYTICES UING R LAB**		
Category of the course	Year	Semester	Credits
Core	**II**	**IV**	**3**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To enable the students to learn the basic concepts of Data Analytics.
- To have a basic understanding of R-Programming.
- To have an overview of Data analytical packages used in R-language.

COURSE OUTCOMES:

CO1: Understand R programming language concepts such as branching and looping constructs.

CO2: Understand various Data analytical procedures using R applications.

CO3: Implement correlation analysis and covariance analysis using R applications.

CO4: Understand the Min-Max normalization and Z-score normalizations.

CO5: Apply decision and iteration control structures to implement algorithms

CO6: Write K-means and clustering algorithms in R.

CO7: Implement Decision tree and frequent pattern mining algorithms.

List of Practical Exercises:

EX NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	Finding mean, mode, median, and IQR		
2	Finding variance, standard deviation and drawing quantile plot & histogram		
3	Finding dissimilarity between binary attributes		
4	Finding Euclidean distance, manhattan distance and Supremum distance		
5	Finding dissimilarity between ordinal attributes		
6	Finding COsine similarity between two term frequency vectors		
7	Finding Correlation analysis of nominal attributes using chi2 & Covariance analysis of numeric attribute		
8	Finding Min-Max normalization & Z score normalization	CO-1	
9	R script for implementing of "a data cube is a lattice of cuboids"	CO-2	
10	Finding rare patterns and negative patterns & Negatively related patterns	CO-3	K1, K2, K3 K4, K5, K6
11	Finding closed and maximal itemsets & pattern distance	CO-4	
12	Finding Semantic annotations of a frequent patterns	CO-5	
13	Generating ROC Curve		
14	Implementing Backpropagation algorithm		
15	Implementing k-means algorithm		
16	Fuzzy clustering using the EM algorithm		
17	Detecting outliers using different techniques		
18	Implementing linear & logistic regression		
19	Implementing Decision tree algorithms		
20	Implementing frequent pattern mining algorithms		

Core Paper Theory – 5			
Title of the paper withsubject code	**OPERATING SYSTEM**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**4**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To understand the fundamental concepts and role of Operating System.
- To learn the Process Management and Scheduling Algorithms
- To understand the Memory Management policies
- To gain insight on I/O and File management techniques

COURSE OUTCOMES:

CO-1: Understand the fundamentals of Operating System structures, focusing on process scheduling, memory management, file systems and I/O systems. Summarize various process-scheduling algorithms for a processor

CO-2: Identify the problem of race condition in time sharing operating system and the need for process synchronization. Relate the effects of synchronization on creation of deadlock. Discuss the methods of deadlock avoidance, prevention and ignoring.

CO-3: Compare and contrast different memory management methods and discuss how virtual memory is implemented by memory management unit using page replacement algorithm.

CO-4: Summarize the file structures and directory structure concepts along with its protection, implementation and recovery of file system. Deduce how file systems is implemented in Unix OS and Window OS.

CO-5: Demonstrate how I/O subsystems work and discuss how Mass storage structure work such as disk scheduling and management.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**OPERATING SYSTEM BASICS:** Basic Concepts of Operating System - Services of Operating System-Classification of Operating System-Architecture and Design of an Operating System-Process Management **-** Introduction to Process-Process State -PCB - Process Scheduling - Interprocess Communication. **THREAD:** Definition, Various states, Benefits of threads, Types of threads, Concept of Multithreads.	12	CO -1	K1
II	**OPERATING SYSTEM SCHEDULING:** CPU Scheduling**:** Introduction - Types of CPU Scheduler - Scheduling Criteria - Scheduling Algorithms - FCFS Scheduling – SJF Scheduling -Priority Scheduling - Round-Robin Scheduling- Multilevel Queue Scheduling. **PROCESS SYNCHRONIZATION**: critical section problem - Hardware synchronization- Semaphores – classical problems of synchronization. **DEADLOCK**: Basic Concept of Deadlock- Deadlock Prevention - Deadlock Avoidance- Deadlock - Detection and Recovery.	12	CO-2	K2, K3
III	**MEMORY MANAGEMENT:** Memory Management - Basic Concept of Memory - Address Binding; Logical and Physical Address Space-Memory Partitioning - Memory Allocation-Protection-Fragmentation and Compaction	12	CO-3	K4
IV	**SWAPPING:** Swapping- Paging-Mapping of Pages to Frames - Hierarchical Page Tables- Segmentation - Virtual Memory - Basic Concept of Virtual Memory- Demand Paging - Transaction Look aside Buffer (TLB) - PageReplacement Algorithms	12	CO-4 CO-5	K5
V	**FILE MANAGEMENT:** Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed) **I/O HARDWARE:** I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software – Components of the I/O Subsystem.	12	CO-5	K6

TEXT BOOKS:
1. Abraham Silberschatz Peter B. Galvin, G. Gagne, "Operating System Concepts",Sixth Edition, Addison Wesley Publishing Co., 2003.
2. Operating Systems: Internals   and   Design Principles,   5th Edition, William Stallings, Prentice Hall of India.
3. Operating Systems A Concept-Based Approach, Dhananjay M. Dhamdhere, McGraw Hill

REFERENCE BOOKS:
1.   Operating Systems, Ekta Walia, Khanna Publishing House, DelhiOperating Systems: A Spiral Approach – Elmasri, Carrick, Levine, TMH Edition

2.   Operating Systems – Flynn, McHoes, Cengage Learning

3.   Operating Systems – Pabitra Pal Choudhury, PHI

Core Paper Theory – 6			
Title of the paper withsubject code	**RELATIONAL DATABASE MANAGEMENT SYSTEM**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- Gain a good understanding of the architecture and functioning of Database Management Systems
- Understand the use of Structured Query Language (SQL) and its syntax.
- Apply Normalization techniques to normalize a database.
- Understand the need of transaction processing and learn techniques for controlling the consequences of concurrent data access.

COURSE OUTCOMES:

CO-1: Understand the basics of Database management, architecture, Architecture, Data models, ER diagrams and various types of Normal forms.

CO-2: Infer the concepts of Relational model and relational calculus. Apply the rules for converting ER model to a relational model and implement SQL queries on the relational model.

CO-3: Summarize the normal forms for the relational model based on functional dependencies, multi-values dependencies and join dependencies.

CO-4: Discuss various SQL commands for DDL, DML such as Join, Set and Aggregate functions. Understand the PL/SQL structures, operations and procedures such as exception handling and triggers.

CO-5: Evaluate the concepts of transaction and concurrency controls using Locking protocols.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**INTRODUCTION TO DBMS**: Data and Information - Database – Database Management System – Objectives - Advantages – Components - Architecture. ER Model: Building blocks of ER Diagram – Relationship Degree – Classification – ER diagram to Tables – ISA relationship – Constraints – Aggregation and Composition – Advantages	12	CO-1	K1
II	**RELATIONAL MODEL**: CODD's Rule- Relational Data Model - Key - Integrity – relational Algebra Operations – Advantages and limitations – Relational Calculus – Domain Relational Calculus - QBE.	12	CO-2 CO-2	K2
III	**STRUCTURE OF RELATIONAL DATABASE**: Introduction to Relational Database Design - Objectives – Tools – Redundancy and Data Anomaly – Functional Dependency - Normalization – 1NF – 2NF – 3NF – BCNF. Transaction Processing – Database Security.	12	CO-3	K2, K3
IV	**SQL**: Commands – Data types – DDL - Selection, Projection, Join and Set Operations – Aggregate Functions – DML – Modification - Truncation - Constraints – Subquery. **PL/SQL**: Structure - Elements – Operators Precedence – Control Structure – Iterative Control - Cursors - Procedure - Function - Packages – Exceptional Handling - Triggers.	12	CO-4	K4
V	**TRANSACTIONS AND CONCURRENCY MANAGEMENT**: Transactions - Concurrent Transactions - Locking Protocol - Serializable Schedules - Locks Two Phase Locking (2PL) - Deadlock and its Prevention - Optimistic Concurrency Control.	12	CO-5	K5, K6

TEXT BOOK:

1. S. Sumathi, S. Esakkirajan, "*Fundamentals of Relational Database Management System*",Springer International Edition 2007.

2. Fundamental of Database Systems, E. Ramez and Navathe, Pearson

3. Database Management Systems, R.P. Mahapatra & Govind Verma, Khanna Publishing House

REFERENCE BOOKS:

1. Abraham Silberchatz, Henry F. Korth, S. Sudarshan, "*Database System Concepts*", McGrawHill2019, 7th Edition.

2. Alexis Leon & Mathews Leon, "*Fundamentals of DBMS*", Vijay Nicole Publications 2014, 2nd Edition.

Core Paper Theory – 7			
Title of the paper withsubject code	**MOBILE APPLICATION DEVELOPMENT**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**4**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To make the student understand the basic concepts of mobile application development, be aware of Characteristics of mobile applications, User-interface design, basics of graphics and multimedia.

- To gain knowledge about testing and publishing of Android application

COURSE OUTCOMES:

CO-1: Comprehend the mobile application development platforms and mobile application development life cycle along with mobile application front-end and back-end.

CO-2: Understand the IDE of the mobile application development such as screen orientation user interface

CO-3: Understand various types of view in mobile application development and how to apply data to files and create databases.

CO-4: Apply the knowledge in creating own content providers such as messaging, email, mapping a location.

CO-5: Design own web services through HTTP and threading.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Mobile Application Development - Mobile Applications and Device Platforms - Alternatives for Building Mobile Apps -Comparing Native vs. Hybrid Applications -The Mobile Application Development Lifecycle-The Mobile Application Front-End-The Mobile Application Back-End-Key Mobile Application Services-What is Android-Android version history-Obtaining the Required Tools-Launching Your First Android Application-Exploring the IDE-Debugging Your Application-Publishing Your Application	12	CO-1	K1
II	Understanding Activities-Linking Activities Using Intents-Fragments-Displaying Notifications-Understanding the Components of a Screen-Adapting to Display Orientation-Managing Changes to Screen Orientation- Utilizing the Action Bar-Creating the User Interface Programmatically Listening for UI Notifications	12	CO-1 CO-2	K2, K3
III	Using Basic Views-Using Picker Views -Using List Views to Display Long Lists-Understanding Specialized Fragments - Using Image Views to Display Pictures -Using Menus with Views-Using WebView- Saving and Loading User Preferences-Persisting Data to Files-Creating and Using Databases.	12	CO-3	K4
IV	Sharing Data in Android-Creating Your Own Content Providers -Using the Content Provider- SMS Messaging -Sending Email-Displaying Maps- Getting Location Data- Monitoring a Location.	12	CO-4 CO-5	K5, K6
V	Consuming Web Services Using HTTP-Consuming JSON Services- Creating Your Own Services - Binding Activities to Services -Understanding Threading.	12	CO-5	K6

TEXT BOOKS:
1. Jerome DiMarzio, "*Beginning Android Programming with Android Studio*", 4thEdition.
2. Mobile Application Development, Dr. Madhu Goel, Chetna Sharma, ER. SHOBHIT
3. Composing Mobile App, Learn | Explore | Apply Paperback – 1 January 2014 by Anubhav Pradhan (Author), Anil V. Deshpande (Author)

REFERENCE BOOKS:

1. Dawn Griffiths, David Griffiths, "*Head First Android Development: A Brain-Friendly Guide*", 2017.
2. Neil Smyth , "*Android Studio 3.0 Development Essentials: Android*", 8th Edition.
3. Pradeep Kothari, "*Android Application Development (With Kitkat Support)*", Black Book 2014.

Elective Paper Theory – I			
Title of the paper withsubject code	**SOFTWARE ENGINEERING**		
Category of the course	Year	Semester	Credits
Elective	**III**	**V**	**4**
Paper mainly focuses on	**ENTREPRENEURSHIP**		

COURSE OBJECTIVES:

- To introduce the software development life cycles
- To introduce concepts related to structured and objected oriented analysis & design co
- To provide an insight into UML and software testing techniques

COURSE OUTCOMES:

CO-1: Understand the Software Engineering concepts for creation of software project and product.

CO-2: Plan a Software Project involving project scheduling and tracking along with risk analysis of the project undertaken.

CO-3: Discuss the Software Configuration Management system for a software project. Analyze the sequence of steps in software project and do a analysis modeling.

CO-4: Review various Design concepts in Software engineering such as Architectural design and User Interface design.

CO-5: Demonstrate the Component level design and testing techniques and strategies for the software along with the metrics for the software design.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Introduction to Software Engineering: Some Definitions – Some Size factors – Quality and Productivity Factors – Managerial Issues. Planning a Software Project: Defining the Problem – Developing a Solution Strategy – Planning the Development Process – Planning an Organizational Structure – Other Planning Activities.	12	CO-1	K1, K2
II	Software Cost Estimation: Software Cost Factors – Software Cost Estimation Techniques – Staffing-Level Estimation – Estimating Software Maintenance Costs.	12	CO-1 CO-2	K3
III	Software Requirements Definitions: The Software Requirements Specification – Formal Specification Techniques – Languages and Processors for Requirements Specification.	12	CO-3	K4
IV	Software Design: Fundamental Design Concepts – Modules and Modularization Criteria – Design Notations – Design Techniques – Detailed Design Considerations – Real-Time and Distributed System Design – Test Plans – Milestones, Walkthroughs, and Inspections - Design Guidelines.	12	CO-4	K4, K5
V	Verification and Validation Techniques: Quality Assurance – Static Analysis – Symbolic Execution – Unit Testing and Debugging – System Testing – Formal Verification. Software Maintenance: Enhancing Maintainability During Development – Managerial Aspects of Software Maintenance – Configuration Management – Source-Code Metrics – Other Maintenance Tools and Techniques.	12	CO-5	K5, K6

TEXT BOOKS:
1. A concise introduction to software Engineering, Pankaj Jalote, Springer
2. Richard Fairley, Sommerville "Software Engineering – Design Reliability and Management" ,Pearson Education, 7 th Edition
3. Software Engineering, Nasib Singh Gill, Khanna Publishing House

REFERENCE BOOKS:
1. Software Engineering, K.K. Aggarwal & Yogesh Singh, New Age International
2. Software Engineering – K.L.James, Prentice Hall of India Pvt. Ltd., New Delhi, 2009.
3. Fundamentals of Software Engineering – Rajib Mall, Prentice Hall of India Pvt. Ltd., New Delhi, 2003.

Elective Paper Theory – I			
Title of the paper withsubject code	**DATA MINING**		
Category of the course	Year	Semester	Credits
Elective	**III**	**V**	**4**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To learn about data mining Concepts

- To study the different data mining techniques

COURSE OUTCOMES:

CO-1: Understanding the data mining concepts and different types of data warehouse such as Relational, Transactional, Object oriented, spatio-temporal, multimedia databases.

CO-2: Comprehend the data preprocessing techniques such as data reduction, data integration, data transformation, data reduction and discretization.

CO-3: Analyze various data mining techniques such as association rule mining, Multilevel, Multidimensional, and Constraint Based Association Mining and implement Apriori algorithm.

CO-4: Compare and contrast the classification and prediction techniques such as Tree induction, Bayesian Classification and Back Propagation.

CO-5: Review various Clustering Methods such as Hierarchical Methods, Density Based Methods, Web Mining, Spatial Mining and Temporal Mining.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Introduction to Data mining: Motivation - On what kind of data - Data Mining Functionalities - Classification of Data Mining systems - Major Issues in Data Mining systems. Data Preprocessing – Data cleaning - Data Integration and Transformation - Data Reduction - Discretization and concept Hierarchy Generation.	12	CO-1	K1, K2
II	Mining Association Rules in Large Databases: Association Rule Mining - Mining Single Dimensional Boolean Association rules from Transactional Databases - Mining Multilevel Association Rules – Mining Multidimensional Association Rules - From Association Mining to Correlation Analysis - Constraint- Based Association Mining.	12	CO-1 CO-2	K2
III	Classification and Prediction: What is Classification and Prediction - Issues regarding Classification and Prediction - Classification by Decision Tree Induction - Bayesian Classification - Classification by Back propagation - Other Classification Methods - Prediction - Classifier Accuracy.	12	CO-3	K2, K3
IV	Cluster Analysis: What is Cluster Analysis? Types of Data in Cluster Analysis - A Categorization of Major Clustering Methods - Partitioning Methods - Hierarchical Methods - Density-Based Methods - Grid-Based Methods - Outlier Analysis.	12	CO-4 CO-5	K4
V	Applications and Trends in Data Mining: Data Mining Applications - Data Mining System Products and Research Prototypes - Additional Themes on Data Mining - Social Impacts of Data Mining - Trends in Data Mining.	12	CO-5	K5, K6

TEXT BOOKS:

1.HanJiawei Han and Kamber Micheline, "Data Mining Concepts and Techniques", Morgan Kaufmann Publishers,Second Edition,2006.

2. Data Mining: Introductory and Advanced Topics, 1e, Margaret H. Dunham.

3. Data Mining Techniques, Arun Kumar Pujari.

REFERENCE BOOKS:

1. M Barry and G.Linoff ", Mastering Data Mining", John Wiiley, Second Edition

2. Introduction to Data Mining 2e Paperback – 30 May 2021by Pang-Ning Tan Michael Steinbach Anuj Karpatne Vipin Kumar

Elective Paper Theory – I			
Title of the paper withsubject code	**INTERNET OF THINGS**		
Category of the course	Year	Semester	Credits
Elective	**III**	**V**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To understand the concepts of Internet of Things and the application of IoT.

- To Determine the Market perspective of IoT.

- To Understand the vision of IoT from a global context

COURSE OUTCOMES:

CO-1: Understanding the diverse fields where IoT is being used and wider range of IoT-applications

CO-2: Comprehend how M2M value chains are converted to IoT value chains

CO-3: Analyze IoT architecture, reference model and different types of views in IoT model.

CO-4: Deduce how IoT can be applied to factories, Retail Industry, Business models and other smart applications.

CO-5: Review various Governance policies in privacy and security issues.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	IoT & Web Technology, The Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.	12	CO-1	K1
II	M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international	12	CO-1 CO-2	K2, K3

	driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.			
III	IoT Architecture -State of the Art – Introduction, State of the art, Architecture. Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.	12	CO-3	K4
IV	IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and GasIndustry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.	12	CO-4 CO-5	K4, K5
V	Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security	12	CO-5	K6

TEXT BOOKS:

1. Vijay Madisetti and ArshdeepBahga, "*Internet of Things: (A Hands-on Approach)*", Universities Press (INDIA) Private Limited 2014, 1st Edition.
2. Internet of Things, Jeeva Jose, (ISBN: 978-93-86173-591), Khanna Publishing House
3. Internet of Things, Arsheep Bahga and Vijay Madisetti

REFERENCE BOOKS:

1. Michael Miller, "*The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World*", Pearson Education 2015.
2. Francis da Costa, "*Rethinking the Internet of Things: A Scalable Approach to Connecting Everything*", Apress Publications 2013, 1st Edition.
3. Waltenegus Dargie, Christian Poellabauer, "*Fundamentals of Wireless Sensor Networks: Theory and Practice*", **Wiley 2014.**
4. CunoPfister, "*Getting Started with the Internet of Things*", O"Reilly Media 2011.

WEB REFERENCES:

- https://github.com/connectIOT/iottoolkit
- https://www.arduino.cc/
- http://www.zettajs.org/

Core Practical – 5			
Title of the paper withsubject code	**RELATIONAL DATABASEMANAGEMENT SYSTEM LAB**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**3**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- Gain a good understanding of the architecture and functioning of Database Management Systems
- Understand the use of Structured Query Language (SQL) and its syntax.

COURSE OUTCOMES:

CO1: Brief knowledge about SQL Fundamentals.

CO2: Able to handle with different Data Base languages.

CO4: Table View, Log & Triggers.

CO5: Introduction to different Database packages (Oracle/ MySql, etc) Commit & Rollback.

CO6: Handling online Transactions.

CO7: Database connectivity with front-end.

LIST OF EXERCISES

EX NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	DDL commands with constraints.		
2	DML Commands with constraints.		
3	SQL Queries: Queries, sub queries, Aggregate function		
4	PL/SQL : Exceptional Handling		
5	PL/SQL : Cursor		
6	PL/SQL : Trigger	CO-1	
7	PL/SQL : Packages	CO-2	K1, K2, K3
8	Payroll calculation for using PL/SQL	CO-3	K4, K5, K6
9	Creating stored procedures and functions	CO-4	

10	Design and Develop Application for Library Management	CO-5	
11	Design and Develop Application for Student Mark Sheet Processing		

Core Practical – 6			
Title of the paper withsubject code	**MOBILE APPLICATION DEVELOPMENT LAB**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**3**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:
- To give overall view of Mobile application development
- Develop and Publish Android applications using Graphical user interface
- Develop and Publish Android application which can use Location and network services

COURSE OUTCOMES:

CO1: Brief knowledge about Mobile Application Development Fundamentals.

CO2: Develop and Publish Android applications using Graphical user interface

CO4: Develop an application to display your personal details using GUI Components

CO5: Understand how to develop an application that uses to send messages from one mobile to another mobile.

CO6: Handling online Database Transactions.

CO7: Designing an application for Google map locator

Practical Exercises

EX NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	Develop an application that finds greatest among three numbers using GUI Components	CO-1	K1, K2, K3 K4, K5, K6
2	Develop an application to display your personal details using GUI Components	CO-2	
3	Develop an application that uses the radio button	CO-3	
4	Develop an application that uses the image button	CO-4	

5	Develop an application that uses Alert Dialog Box	CO-5	
6	Develop an application that uses Layout Managers.		
7	Develop an application that uses audio mode (NORMAL, SILENT, VIBRATE)		
8	Develop an application that uses to send messages from one mobile to another mobile.		
9	Develop an application that uses to send email		
10	Develop an application for mobile calls.		
11	Develop an application for Student Mark sheet processing		
12	Develop an application for Login Page in Database.		
13	Develop an application for Google map locator (optional)		

Core Paper Theory – 8			
Title of the paper withsubject code	**COMPUTER NETWORKS**		
Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:
- To understand the concept of Computer network
- To impart knowledge about networking and inter networking devices

COURSE OUTCOMES:

CO-1: Recall the concepts of communication, types of networks, transmission mode, types of medium, protocols and addresses.

CO-2: Apply layered protocol approach to communication representing OSI Reference model explaining the functional characteristics of each layer.

CO-3: Analyzing the protocols respective to the physical, data link, network, transport, session, presentation and application layers.

CO-4: Evaluate error control using error detection and correction, flow control using sliding window mechanism, IP addressing and subnet masking.

CO-5: Create an appropriate networking architecture for an organizational structure along with relevant protocols to support the network.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Introduction – Network Hardware - Software - Reference Models - OSI and TCP/IP Models - Example Networks: Internet, ATM, Ethernet and Wireless LANs - Physical Layer - Theoretical Basis for Data Communication - Guided Transmission Media.	12	CO-1	K1
II	Wireless Transmission - Communication Satellites - Telephone System: Structure, Local Loop, Trunks and Multiplexing and Switching – Circuit-switched Networks – Packet Switching. Data Link Layer: Design Issues - Error Detection and Correction.	12	CO-2	K2, K3
III	Elementary Data Link Protocols - Sliding Window Protocols - Data Link Layer in the Internet - Medium Access Layer - Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.	12	CO-3	K3, ,K4
IV	Network Layer - Design Issues - Routing Algorithms - Congestion Control Algorithms - IP Protocol - IP Addresses - Internet Control Protocols – Multicasting Basics.	12	CO-4 CO-5	K5
V	Transport Layer - Services - Connection Management - Addressing, Establishing and Releasing a Connection - Simple Transport Protocol - Internet Transport Protocols (ITP) - Network Security: Cryptography. Application Layer: WWW and HTTP – FTP – Email – Telnet –SSH – DNS – SNMP.	12	CO-5	K6

XT BOOKS:

1. A. S. Tanenbaum, "*Computer Networks*", Prentice-Hall of India 2008, 4th Edition.

2. Computer Networks, M. Dave, Cengage

3. An Integrated Approach to Computer Networks, Bhavneet Sidhu, Khanna Publications

REFERENCE BOOKS:

1. Stallings, "*Data and Computer Communications*", Pearson Education 2012, 7th Edition.

2. B. A. Forouzan, "*Data Communications and Networking*", Tata McGraw Hill 2007, 4th Edition.

3. F. Halsall, "*Data Communications, Computer Networks and Open Systems*", Pearson Education2008.

4. D. Bertsekas and R. Gallagher, "*Data Networks*", PHI 2008, 2nd Edition.

5. Lamarca, "*Communication Networks*", Tata McGraw Hill 2002.

WEB REFERENCES:

➤NPTEL & MOOC courses titled Computer Networks

➤https://nptel.ac.in/courses/106106091/

Core Paper Theory – 9			
Title of the paper withsubject code	**WEB DEVELOPMENT USING OPEN-SOURCE TECHNOLOGY**		
Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:
- To understand Web based programming and scripting languages.
- To learn the basic web concepts using open-source technologies such as PHP, JAVA SCRIPT, MYSQL.
- To learn how to interconnect PHP and MYSQL.

COURSE OUTCOMES:

CO-1: Understand the basics of PHP statements, operators, branching and looping statements.

CO-2: Analyze the usage of Arrays and functions in PHP. Comprehend the concepts of files.

CO-3: Analyze the features of client-side scripting languages such as Java Script such as keywords, operators, functions and DOM extensions.

CO-4: Deduce MySQL database data types, creating and manipulating table operations and data manipulation table aggregation functions.

CO-5: Design application programs with PHP as front-end and MySQL as back-end tool.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**HTML & CSS:** Creating a simple page, marking up text, adding links, adding images, table markup, forms, introducing cascading style sheets - formatting text, colors and backgrounds	12	CO-1	K1, K2
II	**JAVASCRIPT – I:** Introduction- Introduction to Web Development , Client-Side and Server-Side JavaScript, Origin, History and Evolution of JavaScript, Features of JavaScript , Structure of Browsers, Saying *Hello World* to JS , Placement of Code, - Building the Basics - Character Set , Variables , Data Types , Operators , Control Flow Statements - Objects- Properties, Creating Objects , Objects as Record and Dictionary , Operations on Objects, Prototypal Inheritance , Classes , Garbage Collection - Functions - Variable Scope , Declaration , Parameters-Arrays – Properties ,	12	CO-2	K3

	Declaration, Accessing an Array , Built-In Methods, Nesting and Multidimensional Arrays			
III	Browser Object Model- Window, History, Navigator, Location, Screen, Document Object -Document Object Model- Relationship, DOM Tree and Nodes , Document Object , Elements, Accessing Elements, Event Handling- Standard Built-In Objects- Fundamental Objects , Error Objects , Number and Dates , Text or String Processing , Keyed Collections , Indexed Collections , Structured Data ,Value Properties, Function Properties - Validation- Error Handling-Error Handling and Cookies	12	CO-3	K4
IV	**PHP:** Understanding PHP - How to Use PHP, PHP Variables, Operators, Including Files, - Flow Control- Logic Control, Looping, Own Functions, Event-Driven PHP, – Libraries- Text Functions, Math Functions, Date and Time Functions, Image-Handling Functions, - Security- Vulnerabilities, Solutions, - Object-Oriented Programming- the Basics, Class Methods, Loading Classes, Extending, - Sessions and Carts - Persistent Data, Cookies, Sessions, Shopping Carts	12	CO-4 CO-5	K5
V	**MySQL:** Introducing MySQL- data types - Administering MySQL- Administration Tools, User Accounts, Designing and Building a Database- Creating Databases, Building Tables, - Using the Database- Working with Data, Searching for Data, Playing It Safe with Data - Communicating with the Database- Database Support in PHP, mysqli Library, Putting It All Together	12	CO-5	K6

TEXT BOOKS:

1. Vikram Vaswani, "PHP and MySQL", Tata McGraw-Hill, 2005

2. Ben Forta, "MySQL Crash course " SAMS, 2006.

3. Jaworski, Mastering Javascript, BPB Publications.

REFERENCE BOOKS:

1. Tim Converse, Joyce Park and Clark Morgan, "PHP 5 and MySQL", Wiley India reprint, 2008.

2. Robert Sheldon, Geoff Moes, "Beginning MySQL", Wrox, 2005.

3. Alexis Leon and Mathews Leon, "Database Management Systems", Vikas, 2008.

Core Paper Theory – 10			
Title of the paper withsubject code	**SOFTWARE TESTING**		
Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To provide knowledge about various SoftwareTesting concepts.
- To enable students learn different Software Testing Techniques and types.
- To acquaint students with case Tools for software testing.

COURSE OUTCOMES:

CO-1: Investigate the reason for bugs and analyze the principles in software testing to prevent and remove bugs

CO-2: identify the needs of software test automation, and define and develop a test tool to support test automation.

CO-3: Apply Flow/Graphs and Path Testing and Transaction Flow Testing Techniques as testing strategies

CO-4: Deduce Domain testing and syntax testing metrics and state graph methodologies.

CO-5: Device verification and validation tools for various levels of testing for software products such win runner tool.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Purpose of testing – Testing versus Debugging – Designer versus Tester – Modularity versus Efficiency – Model for testing – Taxonomy for bugs.	12	CO-1	K1,K2

II	Path testing basics – Predicates, path predicates and achievable paths – Path sensitizing – Path instrumentation – Implementation and application of path testing – Transaction flows – Transaction flow testing techniques.	12	CO-1 CO-2	K3
III	Data flow testing basics – Data flow testing strategies – Domains and paths – Domains testing – Domains and interface testing – Path product and path expressions – Reduction procedure.	12	CO-3	K4
IV	A grammar for formats – Test case generation – Implementation and application – Decision tables – State graphs – State testing.	12	CO-4 CO-5	K5, K6
V	Strategies for programmers – Strategies for independent testers – Tests as software product – JUnit – Pytest.	12	CO-5	K6

TEXT BOOKS

1.B. Beizer , 2003, Software Testing Techniques, II Edn., DreamTech India, New Delhi.

2.K.V.KK. Prasad , 2005, Software Testing Tools, DreamTech. India, New Delhi.

3. R.Rajani, and P.P.Oak, 2004, Software Testing, Tata Mcgraw Hill, New Delhi.

REFERENCE BOOKS

1. I. Burnstein, 2003, Practical Software Testing, Springer International Edn.

2. E. Kit, 1995, Software Testing in the Real World: Improving the Process, Pearson Education, Delhi.

ONLINE REFERENCE

1.   https://junit.org/junit5/docs/current/user-guide/index.html

2.   https://docs.pytest.org/en/6.2.x/

Elective Paper Theory – II			
Title of the paper withsubject code	**CLOUD COMPUTING**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**
Paper mainly focusses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:
- To understand the concepts in Cloud Computing and its Security
- To understand the evolving computer model caned cloud computing.
- To introduce the various levels of services that can be achieved by cloud.

COURSE OUTCOMES:

CO-1: Understand the concepts of cloud computing, need for cloud computing, advantages and disadvantages.

CO-2: Discuss various forms of cloud services, platform as service, software as service, infrastructure as service and cloud service deployment.

CO-3: Discuss how cloud computing can be used for collaborating contact list, community, corporations, group projects and events.

CO-4: Review various cloud services available can be used for collaborating for online planning, schedule management, task management, project management, database and sharing files.

CO-5: Review web-based collaborating tools, web conference tools and collaborating via blogs and wikis.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**CLOUD COMPUTING OVERVIEW:** Applications – Intranets and the cloud – Why Cloud Computing Matters – Benefits – Limitations – Companies in the Cloud Today – Cloud Services.	12	CO-1	K1
II	**CLOUD COMPUTING TECHNOLOGY:** Hardware and Infrastructure – Clients – Security- Network – Services – Accessing the Cloud - Platforms – Web Applications – Web APIs –Web Browsers –Cloud Storage – Overview – Cloud Storage Providers – Standards – Application – Client – Infrastructure – Service.	12	CO-2	K2, K3
III	**CLOUD COMPUTING AT WORK**: Software as a service – Overview– Driving Forces – Company offerings – Industries – Software plus Services– Overview-Mobile Device Integration –Providers – Microsoft Online.	12	CO-3	K3, K4
IV	**DEVELOPING APPLICATIONS**: Google – Microsoft – Intuit Quick Base – Cast Iron Cloud – Bungee Connect - Local clouds and Thin Clients – Virtualization – Server Solutions – Thin Clients.	12	CO-4	K5
V	**MIGRATING TO THE CLOUD**: Cloud Services for Individuals – Cloud services aimed at the mid-market – Enterprise-Class Cloud Offerings – Migration.	12	CO-5	K6

TEXT BOOKS:

1. Antony. T. Velte, Toby J. Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, Tata McGraw- Hill Pub, Edition 2010.

2. Essentials of Cloud Computing, K. Chandrasekaran

3. Cloud Computing, Pandey & Choudhary

REFERENCE BOOKS:
1. Roger Jennings, Cloud Computing with Windows Azure Platform, Wiley India Pvt. Ltd, 2009.

2. Barrie Sosinsky, Cloud Computing Bible, Wiley India Pvt. Ltd., 2011.

Elective Paper Theory – II			
Title of the paper withsubject code	**ARTIFICIAL INTELLIGENCE**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**
Paper mainly focusses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:
- To Acquire Knowledge on various AI Techniques and Expert Systems
- To have enriched knowledge regarding heuristic search, Knowledge representation

COURSE OBJECTIVES:

CO-1: Cknowledge of the building blocks of AI as presented in terms of intelligent agents and Expert Systems.

CO-2: Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them.

CO-3: Develop intelligent algorithms for knowledge representation using AI programming languages. and also design intelligent systems for Game Playing

CO-4: Experiment different types of learning methods in artificial intelligence and related algorithms.

CO-5: Formulate the capability to represent various real life problem domains using logic-based techniques and use this to perform inference or planning.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**INTRODUCTION**: Intelligent Agents – Agents and environments - Good behavior – The nature of environments – structure of agents - Problem Solving - problem solving agents – example problems –searching for solutions – uniformed search strategies - avoiding repeated states – searching with partial information.	12	CO-1	K1
II	**SEARCHING TECHNIQUES**: Informed search and exploration – Informed search strategies – heuristic function – local search algorithms and optimistic problems – local search in continuous spaces – online search agents and unknown environments - Constraint satisfaction problems (CSP) – Backtracking search and Local search for CSP – Structure of problems - Adversarial Search – Games – Optimal decisions in games – Alpha – Beta Pruning –	12	CO-1 CO-2	K2 , K3

	imperfect real-time decision – games that include an element of chance.			
III	**KNOWLEDGE REPRESENTATION**: First order logic – representation revisited – Syntax and semantics for first order logic – Using first order logic – Knowledge engineering in first order logic - Inference in First order logic – prepositional versus first order logic – unification and lifting – forward chaining – backward chaining - Resolution - Knowledge representation - Categories and objects – Actions - Simulation and events.	12	CO-3	K4, K5
IV	**LEARNING**: Learning from observations - forms of learning - Inductive learning - Learning decision trees - Ensemble learning - Knowledge in learning – Logical formulation of learning – Explanation based learning – Learning using relevant information – Inductive logic programming - Statistical learning methods - Learning with complete data - Learning with hidden variable - EM algorithm.	12	CO-4 CO-5	K5
V	**APPLICATIONS**: Communication – Communication as action – Formal grammar for a fragment of English – Syntactic analysis – Augmented grammars – Semantic interpretation – Ambiguity and disambiguation – Discourse understanding – Grammar induction - Probabilistic language processing - Probabilistic language models – Information retrieval – Information Extraction – Machine translation.	12	CO-5	K6

TEXT BOOKS:

1. Russell Stuart, Norvig Peter, 2004,"Artificial Intelligence – A Modern Approach", 2nd Edition, Pearson Education.

2. A classical approach to Artificial Intelligence, Munesh Chandra Trivedi, Khanna Publications

3. Artificial Intelligence and Machine Learning, Chandra S.S. & H.S. Anand, PHI Publications

REFERENCE BOOKS:

1. Rich Elaine , Knight Kevin, "Artificial Intelligence", 2003,2nd Edition, Tata McGraw-Hill,

2. Nilsson J.Nils, "Artificial Intelligence: A new Synthesis" ,2000, Harcourt Asia Pvt. Ltd.,

3. Luger F. George, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving", 2002,Pearson Education.

Elective Paper Theory – II			
Title of the paper withsubject code	**SOFTWARE PROJECT MANAGEMENT**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**
Paper mainly focusses on	**ENTREPRENEURSHIP**		

COURSE OBJECTIVES:

- To define and highlight importance of software project management.

- To formulate and define the software management metrics & strategy in managing projects

COURSE OUTCOMES:

CO-1: Define Estimation of project cost and prepare cost-benefit evaluation among projects

CO-2: Perform project scheduling, activity network analysis and risk management

CO-3: Apply schedule and cost control techniques for project monitoring including contract management.

CO-4: Deduce quality models in software projects for maintaining software quality and reliability.

CO-5: Design a suitable project organization structure, leadership, decision and motivation styles, proper safety and ethical practices and be responsible to the society.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	**PROJECT EVALUATION AND PROJECT PLANNING** Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.	12	CO-1	K1, K2
II	**PROJECT LIFE CYCLE AND EFFORT ESTIMATION** Software process and Process Models – Choice of Process models - Rapid Application development – Dynamic System Development Method –Basics of Software estimation – Effort and Cost estimation	12	CO-2	K3

	techniques – COSMIC Full function points - COCOMO II - a Parametric Productivity Model.			
III	**ACTIVITY PLANNING AND RISK MANAGEMENT** Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management – – PERT technique – Resource Allocation – Creation of critical paths – Cost schedules.	12	CO-3	K4
IV	**PROJECT MANAGEMENT AND CONTROL** Framework for Management and control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control – Software Configuration Management – Managing contracts – Contract Management.	12	CO-4	K5
V	**STAFFING IN SOFTWARE PROJECTS** Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams – Communications genres – Communication plans – Leadership - Legal Issues in Software - Case Study.	12	CO-5	K6

TEXT BOOKS:
 1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth
   Edition, Tata McGraw Hill, New Delhi, 2012
 2**.** Software Project Management by Archana Kumar, Ane Books Pvt. Ltd

 3. Gopalaswamy Ramesh, ―Managing Global Software Projects‖ – McGraw Hill Education
   (India), Fourteenth Reprint 2013.

REFERENCES:
 1. Robert K. Wysocki ―Effective Software Project Management‖ – Wiley Publication, 2011.
 2. Walker Royce: ―Software Project Management‖- Addison-Wesley, 1998.

WEB REFERENCES:

 ➢NPTEL & MOOC courses titled Software Project Management

 ➢www.smartworld.com/notes/software-project-management

Core Practical – 7			
Title of the paper withsubject code	**WEB DEVELOPMENT USING OPEN-SOURCE TECHNOLOGY LAB**		
Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**2**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To understand Web based programming and scripting languages.
- To learn the basic web concepts using open-source technologies such as PHP, JAVA SCRIPT, MYSQL.
- To learn how to interconnect PHP and MYSQL.

COURSE OUTCOMES:

CO1: Understanding of how PHP is used

CO2: Develop and Publish Android applications using Graphical user interface

CO4: Develop an application to display your personal details using GUI Components

CO5: Understand how to develop an application that uses to send messages from one mobile to another mobile.

CO6: Handling online Database Transactions.

CO7: Designing an application for Google map locator

List of exercises:

EX NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	Creating simple webpage using PHP		
2	Use of conditional statements in PHP		
3	Use of looping statements in PHP		
4	Creating different types of arrays		
5	Usage of array functions		
6	Creating user defined functions		
7	Creation of files		
8	File manipulation using PHP		
9	Creation of sessions	CO-1	
10	Creation of cookies	CO-2	
11	Creating simple applications using PHP	CO-3	K1, K2, K3 K4, K5, K6
12	Creating simple table with constraints	CO-4	
13	Insertion, Updation and Deletion of rows in MYSQL tables	CO-5	
14	Searching of data by different criteria		
15	Sorting of data		
16	Demonstration of joining tables		
17	Usage of sub queries		
18	Usage of aggregate functions		
19	Working with set operators		
20	Working with string, numeric and date functions		
21	Database connectivity in PHP with MySQL		
22	Validating Input		
23	Formatting the Output.		

Core Practical Paper – 8			
Title of the paper with subject code	**Mini Project & Viva Voce**		
Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**5**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVE:

- The aim of the mini project is that the student has to understand the real time software development environment.

- To enable student gain a thorough knowledge in the problem, he/she has selected and the language / software, he/she is using.

COURSE OUTCOME:

CO1: To practice acquired knowledge within the chosen area of technology for project development.

CO2: Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.

CO3: Reproduce, improve and refine technical aspects for engineering projects.

CO4: Work as an individual or in a team in development of technical projects.

CO5: Communicate and report effectively project related activities and findings

Project planning:

B.Sc. Computer Science mini-Project is an involved exercise, which has to be planned well in advance. The topic should be chosen in the beginning of final year itself. Related reading training and discussions of first internal project viva voce should be completed in the first term of final year.

I Selection of the Project Work

Project work could be of three types.

a) **Developing solution for Real Life Problem**

In this case a requirement for developing a computer-based solution already exists and the different stages of system development life cycle is to be implemented successfully. Examples are accounting software for particular organization, computerization of administrative function of an organization, web based commerce etc.

b) **System Software Project**

Projects based on system level implementation. An example is a Tamil language editor with spell checker, compiler design.

b) **Research Level Project**

These are projects which involve research and development and may not be as a structured and clear cut as in the above case. Examples are Tamil character recognition, neural net based speech recognizer etc. This type of projects provides more challenging opportunities to students.

II Selection of Team

To meet the stated objectives, it is imperative that mini project is done through a team effort. Though it would be ideal to select the team members at random and this should be strongly recommended, due to practical consideration students may also be given the choice of forming themselves into teams with three members. A team leader shall be selected. Team shall maintain the minutes of meeting of the team members and ensure that tasks have been assigned to every team member in writing. Team meeting minutes shall form a part of the project report. Even if students are doing project as groups, each one must independently take different modules of the work and must submit the report.

III Selection of Tools

No restrictions shall be placed on the students in the choice of platform/tools/languages to be utilized for their project work, though **Open Source is strongly recommended**, wherever possible. No value shall be placed on the use of tools in the evaluation of the project.

IV Documentation

Three copies of the project report must be submitted by each student (one for department library, one for the organization where the project is done and one for the student himself/herself). The final outer dimensions of the project report shall be 21cm X 30 cm. The color of the flap cover shall be light blue. Only hard binding should be done. The text of the report should be set in 12 pt, Times New Roman, 1.5 spaced.

Headings should be set as follows: CHAPTER HEADINGS 16 pt, Arial, Bold, All caps, Centered.

1. Section Headings 14 pt Bookman old style, Bold, Left adjusted.

1.1 Section Sub-heading 12 pt, Bookman old style.

Title of figures tables etc are done in 12 point, Times New Roman, Italics, centered.

Content of the Project should be relevant and specify particularly with reference to the work. The report should contain the requirement specification of the work, Analysis, Design, Coding, testing and Implementation strategies done.

• Organizational overview (of the client organization, where applicable)

• Description of the present system

• Limitations of the present system

• The Proposed system - Its advantages and features

• Context diagram of the proposed system

• Top level DFD of the proposed system with at least one additional level of expansion

• Program List (Sample code of major functions used)

• Files or tables (for DBMS projects) list. List of fields or attributes (for DBMS projects) in each file or table.

• Program – File table that shows the files/tables used by each program and the files are read, written to, updated, queried or reports were produced from them.

• Screen layouts for each data entry screen.

• Report formats for each report.

Some general guidelines on documentation are:

1. Certificate should be in the format: "Certified that this report titled……………………….is a bonafide record of the project work done by Sri/ Kum ……………………….under our supervision and guidance, towards partial fulfillment of the requirement for award of the Degree of B.Sc COMPUTER SCIENCE of Sri Sankara Arts And Science College, Enathur, Kanchipuram" with dated signature of internal guide, external guide and also Head of the Department/ College.

2. If the project is done in an external organization, another certificate on the letterhead of the organization is required: "Certified that his/her report titled …………………………….is a

bonafide record of the project work done by Sri/Kum................under my supervision and guidance, at the ....department of.......................... (Organization) towards partial fulfillment of the requirement for the award of the Degree of B.C.A of Sri Sankara Arts And Science College, Enathur, Kanchipuram.

3. Page numbers shall be set at right hand bottom, paragraph indent shall be set as 3.

4. Only 1.5 space need be left above a section or subsection heading and no space may be left after them.

5. References shall be IEEE format (see any IEEE magazine for detail) While doing the project keep note of all books you refer, in the correct format and include them in alphabetical order in your reference list.

V Project Evaluation:

Internal Assessment

There shall be six components that will be considered in assessing a project work with weightage as indicated.

1. Timely completion of assigned tasks as evidenced by team meeting minutes 20%

2. Individual involvement, team work and adoption of industry work culture 10%

3. Quality of project documentation (Precision, stylistics etc) 10%

4. Achievement of project deliverables 20%

5 Effective technical presentation of project work 10%

6. Viva 30%

Based on the above 6 components internal mark (40) can be awarded.

External Assessment

Dissertation/Project submitted at the end of third year shall be valued by two examiners appointed by the Controller for the conduct of practical exam. The board of examiners shall award 40 marks based on the following components.

1. Achievement of project deliverables - 20 Marks

2. Effective technical presentation of project work - 20 Marks

3. Project Viva - 20 Marks

There shall be a common written examination conducted for all the candidates in each group together for a minimum of 10 minutes.

(i) Requirement Specification of Project

(ii) Design of Project

(iii) Testing and Implementation of Project

Non-Major Elective : I			
Title of the paper with subject code	**Technical Writing with LaTex**		
Category of the course	Year	Semester	Credits
Elective	I	I	2

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Introduction: Overview – Install LaTex – Create First LaTex Document – Section level and ToC	6	CO-1 CO-2 CO-3 CO-4 CO-5	K1, K2, K3 K4, K5, K6
II	Styling Pages: Paper size and Margins – Page Styles – Header and Footer – Formatting pages – footnotes – Orientation – Page breaks – Multicolumn document – Reading error messages	6		
III	Formatting Content: Formatting Text – Colouring Text – Aligning Text – Spacing Text – Bullets and Numbering – Writing Mathematics	6		
IV	Tables and Images: Creating Tables – Table Borders Merging Rows and Columns – Large Tables – Table Environments – Including Images – Image Properties – Image Borders – Figure and Sub-Figures	6		
V	Referencing and Indexing: Creating Title Page – Hyperlinks – Cross Referencing – Creating Indexes – Creating Bibliography.	6		

RECOMMENDED TEXTBOOKS
1. Firuza Karmali Aibara, A Short Introduction to Latex: A Book for Beginners, Createspace Independent Publishing Platform
2. Stefan Kottwitz, LaTeX Beginner's Guide

REFERENCE BOOKS:

1. George Gratzer, First Steps in LaTeX, Birkhäuser Publication
2. Pooja Raj Verma, Sandeep Kumar, Binay kumar sharma, LaTeX and HTML, Vardhman Publications.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
	Non-Major Elective : I			
	Title of the paper with subject code : **Web Office**			

Non-Major Elective : I				
Title of the paper with subject code	**Web Office**			
Category of the course	Year	Semester		Credits
Elective	I	I		2

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Google Docs: Accessing Google Doc - Sharing a Google Doc - Using the editing tools - Organizing Google Docs -Downloading and converting Google Docs.	6		
II	Google Slides: Accessing Google Slides - Creating presentation in Google Slides -Adding and editing content - Presenting Google Slides - Sharing Google Slides	6	CO-1 CO-2 CO-3 CO-4 CO-5	K1, K2, K3 K4, K5, K6
III	Google Sheets: Accessing Google Sheets - Creating a Google Sheet - Sorting and organizing data - Filtering data - Editing a Google Sheet - Creating charts and graphs - Sharing a Google Sheet.	6		
IV	Google Forms - Accessing Google Forms - Creating a Google Form - Sharing a Google Form - Viewing responses as a summary - Viewing responses individually.	6		
V	Google Drive - Google Calendar – Google Jamboard - Google Meet - Google Maps - Google Classroom - LMS - CANVAS LMS - MOODLE LMS - EDMODO.	6		

RECOMMENDED TEXTBOOK

1. Ian Lamont, "Google Drive & Docs in 30 Minutes - The unofficial guide to the new Google Drive, Docs, Sheets & Slides", 2nd Edition.

Non-Major Elective : I			
Title of the paper with subject code	**Programming Fundamentals**		
Category of the course	Year	Semester	Credits
Elective	I	I	2

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Programming Language: Introduction - classification of programming languages - Machine language - assembly language - high level language - Translator: Compiler - Interpreter - C Language: Introduction - history - structure of C - tokens: identifiers - keywords - variables - constants - data types.	6	CO-1 CO-2 CO-3 CO-4 CO-5	K1, K2, K3 K4, K5, K6
II	I/O function: Scanf() function - printf() function - gets() - puts() - getc() - putc() - getch() vs getche() – Operators.	6		
III	Conditional Statement: simple if - if else - nested if - switch - Looping: while - do while - for - nested for - Jumping statement: goto - continue – break.	6		
IV	Arrays: one dimensional array - two dimensional array.	6		
V	Functions – types of functions – category of function – recursion.	6		

Non-Major Elective : II			
Title of the paper with subject code	**Technical Writing with LaTex LAB**		
Category of the course	Year	Semester	Credits
Elective	I	II	2

LIST OF EXERCISES

EX NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	Create LaTeX document using class, packages, information.	CO-1 CO-2 CO-3 CO-4 CO-5	K1, K2, K3 K4, K5, K6
2	Create LaTex document with 5 sections and corresponding Toc		
3	Create LaTex document with paper size as A4 and margin at 2cm.		
4	Create LaTex document with document name in header and page number in footer.		
5	Create LaTex document with footnote.		
6	Create LaTex document with multicolumn document.		
7	Create LaTex document with text formatting (bold, italic, underline, text colouring).		
8	Create LaTex document with text alignment (left, right, centre, justify).		
9	Create LaTex document with different vertical spaces (\medskip, \bigskip, \vspace{20pt}, \vfill, \pagebreak)		
10	Create LaTex document displaying Input Devices using Bullets.		
11	Create LaTex document displaying Output Devices using Numbering.		
12	Create LaTex document displaying quadratic equation $x = -b \pm \frac{\sqrt{b^2 - 4ac}}{2a}$		
13	Create LaTex document displaying time table.		
14	Create LaTex document with Image.		

15	Create LaTex document with Figures and Sub-Figures.	
16	Create LaTex document with title page.	
17	Create LaTex document with hyperlink.	
18	Create LaTex document with cross reference.	
19	Create LaTex document with Indexes.	
20	Create LaTex document with Bibliography	

Non-Major Elective : II			
Title of the paper with subject code	**Web Office LAB**		
Category of the course	Year	Semester	Credits
Elective	I	II	2

LIST OF EXERCISES

EX NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	Create a Google Doc about your Institution and share with your friends.		
2	Create a Google Doc and allow edit access to your friends		
3	Perform editing in the available Google Doc and download it.		
4	Create a Google Slides about your Institution and share with your friends		
5	Create a Google Slides about yourself and present the Slides.		
6	Create a Google Sheets to add some data and share with your friends	CO-1 CO-2	K1, K2, K3 K4, K5, K6
7	Create a Google Sheet and perform sorting the data.	CO-3	
8	Create a Google Sheet and display the data using Charts and Graphs.	CO-4 CO-5	
9	Create a Google Form to collect the contact information from your friends		
10	Conduct a Quiz by creating Google Forms among your Friends.		
11	Create a folder in your Google Drive and add upload files of different file format.		
12	Share your Google Drive Folder contents to your friends by sharing the link.		

Non-Major Elective : II			
Title of the paper with subject code	**Programming Fundamentals**		
Category of the course	Year	Semester	Credits
Elective	I	II	2

LIST OF EXERCISES

EX NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	Write a C program to print "Hello World"	CO-1 CO-2 CO-3 CO-4 CO-5	K1, K2, K3 K4, K5, K6
2	Write a C program to read an integer value and print the value		
3	Write a C program for calculate area of Circle		
4	Write a C program to perform addition, subtraction, multiplication and division using arithmetic operator		
5	Write a program to find a given number is odd or even		
6	Write a program to print a given a number is positive or negative		
7	Write a program to print a. 1 2 3 4 5 6 7 8 9 10 b. 10 9 8 7 6 5 4 3 2 1 c. 1 3 5 7 9 d. 9 7 5 3 1 e. 2 4 6 8 10		
8	Write a program to calculate sum of n numbers		
9	Write a program to generate fibonacci series		
10	Write a program to calculate factorial value using function		

PROGRAM OUTCOMES

PO-1. Enriching the knowledge in theoretical and practical aspects.

PO-2. Developing research aptitude among the students and encouraging them to take up research projects and publish research papers.

PO-3. Enabling the students to come out successfully in competitive examinations.

PO-4. Developing students' skills, based on current trends by offering Job oriented, Entrepreneurial, certificate courses and Value-added courses.

PROGRAMME SPECIFIC OUTCOME

PSO-6. Acquainting students with basic software and hardware skills, laying a strong foundation for applied knowledge in the field of computer science.

PSO-7. Imbibing students with hands-on practical sessions, catering to the latest demands in the IT field making them more employable.

PSO-8. Equipping students with state-of-the-art technologies and cutting-edge solutions to motivate student's foray into Entrepreneurship.

PSO-9. Augmenting students with necessary skills by training them for various competitive exams like NET, SET and other exams for career prospects.

PSO-10. Inculcating students with a drive and passion for Research aptitude by motivating them to venture into Advanced Research.

PO – PSO MATRIX

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
PO-1	✓				
PO-2					✓
PO-3				✓	
PO-4		✓	✓		

Title of the paper with subject code	**PYTHON PROGRAMMING**		
Category of the course	Year	Semester	Credits
Core	**I**	**I**	**4**

COURSE OBJECTIVES:

- To implement the python programming features in practical applications.

- To write, test, and debug simple Python programs.

- To implement Python programs with conditionals and loops.

- Use functions for structuring Python programs.

- Represent compound data using Python lists, tuples, dictionaries, turtles, Files and modules.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✔				
Unit-2		✔			
Unit-3			✔		
Unit-4				✔	
Unit-5					✔

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1				✔	
CO-2	✔	✔		✔	
CO-3	✔	✔			
CO-4	✔	✔		✔	
CO-5	✔	✔	✔	✔	✔

Core Practical – 1			
Title of the paper with subject code	**PYTHON PROGRAMMING LAB**		
Category of the course	Year	Semester	Credits
Core	**I**	**I**	**3**

COURSE OUTCOMES:

CO-1: Understand the basic concept of Python Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions and File programming

CO-2: Acquire knowledge about the basic concept of writing a program.

CO-3: Role of constants, variables, identifiers, operators, type conversion and other building blocks of Python Language.

CO-4: Use of conditional expressions and looping statements to solve problems associated with conditions and repetitions.

CO-5: Role of Functions involving the idea of modularity.

PSO – CO MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✔				
CO2	✔	✔			
CO3	✔	✔			
CO4		✔	✔		✔
CO5		✔	✔	✔	✔

Title of the paper with subject code	DIGITAL ARCHITECTURE AND MICROPROCESSOR		
Category of the course	Year	Semester	Credits
Core	**I**	**II**	**4**

COURSE OUTCOMES:

CO-1: Demonstrate number systems and the logic gates. Apply Boolean algebra and theorem for simplification of Boolean functions and also apply Karnaugh map, tabulation method for reducing Boolean expressions and working of sequential circuits.

CO-2: Comprehend the basic components of computer architecture and its functions.

CO-3: Deduce the principles of computer architecture concepts such as instruction formats, addressing modes, registers and pipelining concepts

CO-4: Apply computer arithmetic algorithms and memory organization structures.

CO-5: Deduce assembly level programs to perform the conversions between number systems and BCD to write simple arithmetic programs in assembly level language

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✔				
Unit-2		✔			
Unit-3			✔		
Unit-4				✔	
Unit-5					✔

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1	✔				
CO-2	✔				
CO-3	✔				
CO-4	✔	✔		✔	
CO-5	✔	✔	✔	✔	✔

Title of the paper with subject code	DIGITAL ARCHITECTURE AND MICROPROCESSOR LAB		
Category of the course	Year	Semester	Credits
Core	**I**	**II**	**4**

COURSE OUTCOMES:

CO-1: Demonstrate number systems and the logic gates. Apply Boolean algebra and theorem for simplification of Boolean functions and also apply Karnaugh map, tabulation method for reducing Boolean expressions and working of sequential circuits.

CO-2: Comprehend the basic components of computer architecture and its functions.

CO-3: Deduce the principles of computer architecture concepts such as instruction formats, addressing modes, registers and pipelining concepts

CO-4: Apply computer arithmetic algorithms and memory organization structures.

CO-5: Deduce assembly level programs to perform the conversions between number systems and BCD to write simple arithmetic programs in assembly level language

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1	✓				
CO-2	✓				
CO-3	✓				
CO-4	✓	✓		✓	
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	JAVA PROGRAMMING AND DATA STRUCTURES		
Category of the course	Year	Semester	Credits
Core	**II**	**III**	**4**

COURSE OUTCOMES:

CO-1: Conceive the Programming constructs such as branching statements and looping statements of JAVA language, Class, object, and file stream classes.

CO-2: Recall the principles of Object-Oriented Programming paradigm, its advantages, disadvantages and applications. Understand how JAVA programming language can be used to implement the OOP's concepts through Class, Object, inheritance, polymorphism.

CO-3: Understanding the concepts of Packages, Exception handling and Multithreading in JAVA.

CO-4: Comprehend the basic data structures such as stack, queue, Linked-list, applications of stacks.

CO-5: Understanding of Trees, Graphs and their traversals. Calculate the single source shortest path using Dijkstra's Algorithm by representing the problem as graph.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✔				
Unit-2		✔			
Unit-3			✔		
Unit-4				✔	
Unit-5					✔

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✔	✔			
CO-3	✔	✔		✔	
CO-4	✔	✔		✔	✔
CO-5	✔	✔	✔	✔	✔

Title of the paper with subject code	DATA STRUCTURES USING JAVA LAB		
Category of the course	Year	Semester	Credits
Core	**II**	**III**	**3**

COURSE OUTCOMES:

CO-1: Apply object-oriented programming features to program design and implementation

CO-2: Understand object-oriented concepts and how they are supported by JAVA

CO-3: Understand implementation issues related to object-oriented techniques.

CO-4: Demonstrate the ability to analyze, use, and create functions, classes, to overload operators.

CO-5: Demonstrate the ability to understand and use inheritance and interface when creating or using classes.

CO-6: Determine which algorithm or data structure to use in different scenarios and be familiar with writing recursive methods.

CO-7: Demonstrate understanding of the abstract properties of various data structures such as stacks, queues, lists, trees and graphs and use various data structures effectively in application programs.

PSO – CO MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✔	✔			
CO2	✔	✔			
CO3	✔	✔			
CO4		✔			
CO5		✔			
CO6	✔	✔	✔	✔	✔
CO7	✔	✔	✔	✔	✔

Core Paper Theory – 4			
Title of the paper with subject code	DATA ANALYTICS WITH R		
Category of the course	Year	Semester	Credits
Core	II	IV	4

COURSE OUTCOMES:

CO-1: Understand how to download R-package and handling of R packages. Exploring the data types in R.

CO-2: Analyze the data and data frames in R and operators available in R

CO-3: Demonstrate the concepts of linear regression, logistic regression and its types.

CO-4: Understand the decision tree representation in R and clustering concepts.

CO-5: Synthesis association rules and clustering algorithms in Data mining concepts.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✔				
Unit-2	✔	✔			
Unit-3			✔		
Unit-4				✔	✔
Unit-5					✔

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2					
CO-3	✔	✔	✔		
CO-4	✔	✔	✔		✔
CO-5	✔	✔	✔	✔	✔

Core Practical – 4			
Title of the paper with subject code	**DATA ANALYTICS WITH R LAB**		
Category of the course	Year	Semester	Credits
Core	**II**	**IV**	**3**

COURSE OUTCOMES:

CO1: Understand R programming language concepts such as branching and looping constructs.

CO2: Understand various Data analytical procedures using R applications.

CO3: Implement correlation analysis and covariance analysis using R applications.

CO4: Understand the Min-Max normalization and Z-score normalizations.

CO5: Apply decision and iteration control structures to implement algorithms

CO6: Write K-means and clustering algorithms in R.

CO7: Implement Decision tree and frequent pattern mining algorithms.

PSO – CO MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✔	✔			
CO2	✔	✔			
CO3	✔	✔			
CO4		✔			
CO5		✔			
CO6	✔	✔	✔	✔	✔
CO7	✔	✔	✔	✔	✔

Core Paper Theory – 5			
Title of the paper with subject code	**RELATIONAL DATABASE MANAGEMENT SYSTEMS**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**4**

COURSE OUTCOMES:

CO-1: Understand the basics of Database management, architecture, Architecture, Data models, ER diagrams and various types of Normal forms.

CO-2: Infer the concepts of Relational model and relational calculus. Apply the rules for converting ER model to a relational model and implement SQL queries on the relational model.

CO-3: Summarize the normal forms for the relational model based on functional dependencies, multi-values dependencies and join dependencies.

CO-4: Discuss various SQL commands for DDL, DML such as Join, Set and Aggregate functions. Understand the PL/SQL structures, operations and procedures such as exception handling and triggers.

CO-5: Evaluate the concepts of transaction and concurrency controls using Locking protocols.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employ ability)	PSO-3 (Entrepreneursh ip)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✓	✓		✓	
CO-3	✓	✓		✓	✓
CO-4	✓	✓		✓	✓
CO-5	✓	✓	✓		✓

Core Paper Theory – 6			
Title of the paper with subject code	**MOBILE APPLICATION DEVELOPMENT**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**4**

COURSE OUTCOMES:

CO-1: Comprehend the mobile application development platforms and mobile application development life cycle along with mobile application front-end and back-end.

CO-2: Understand the IDE of the mobile application development such as screen orientation user interface

CO-3: Understand various types of view in mobile application development and how to apply data to files and create databases.

CO-4: Apply the knowledge in creating own content providers such as messaging, email, mapping a location.

CO-5: Design own web services through HTTP and threading.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✔				
Unit-2	✔	✔			
Unit-3			✔		
Unit-4				✔	✔
Unit-5					✔

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneur ship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1	✔				
CO-2	✔	✔	✔		
CO-3		✔	✔		
CO-4		✔	✔		
CO-5		✔	✔		✔

Title of the paper with subject code	OPERATING SYSTEM		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**4**

CO-1: Understand the fundamentals of Operating System structures, focusing on process scheduling, memory management, file systems and I/O systems. Summarize various process-scheduling algorithms for a processor

CO-2: Identify the problem of race condition in time sharing operating system and the need for process synchronization. Relate the effects of synchronization on creation of deadlock. Discuss the methods of deadlock avoidance, prevention and ignoring.

CO-3: Compare and contrast different memory management methods and discuss how virtual memory is implemented by memory management unit using page replacement algorithm.

CO-4: Summarize the file structures and directory structure concepts along with its protection, implementation and recovery of file system. Deduce how file systems is implemented in Unix OS and Window OS.

CO-5: Demonstrate how I/O subsystems work and discuss how Mass storage structure work such as disk scheduling and management.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✔				
Unit-2		✔			
Unit-3			✔		
Unit-4				✔	✔
Unit-5					✔

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✔			✔	
CO-3	✔				✔
CO-4	✔	✔		✔	✔
CO-5	✔		✔	✔	✔

Core Practical – 5			
Title of the paper with subject code	**RDBMS-LAB**		
Category of the course	Year	Semester	Credits
Core	III	V	3

PSO – CO MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✔	✔			
CO2	✔	✔			
CO3	✔	✔			
CO4		✔			
CO5		✔			
CO6	✔	✔	✔	✔	✔
CO7	✔	✔	✔	✔	✔

Core Practical – 6			
Title of the paper with subject code	**MOBILE APPLICATION DEVELOPMENT LAB**		
Category of the course	Year	Semester	Credits
Core	III	V	3

PSO – CO MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✔	✔			
CO2	✔	✔			
CO3	✔	✔			
CO4		✔			
CO5		✔			
CO6	✔	✔	✔	✔	✔
CO7	✔	✔	✔	✔	✔

Elective Paper Theory – 1			
Title of the paper with subject code	**SOFTWARE ENGINEERING**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**4**

COURSE OUTCOMES:

CO-1: Understand the Software Engineering concepts for creation of software project and product.

CO-2: Plan a Software Project involving project scheduling and tracking along with risk analysis of the project undertaken.

CO-3: Discuss the Software Configuration Management system for a software project. Analyze the sequence of steps in software project and do a analysis modeling.

CO-4: Review various Design concepts in Software engineering such as Architectural design and User Interface design.

CO-5: Demonstrate the Component level design and testing techniques and strategies for the software along with the metrics for the software design.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employa bility)	PSO-3 (Entrepreneur ship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✓			✓	
CO-3	✓	✓		✓	
CO-4	✓	✓	✓	✓	✓
CO-5	✓	✓	✓		✓

Title of the paper with subject code	DATA MINING		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**4**

COURSE OUTCOMES:

CO-1: Understanding the data mining concepts and different types of data warehouse such as Relational, Transactional, Object oriented, spatio-temporal, multimedia databases.

CO-2: Comprehend the data preprocessing techniques such as data reduction, data integration, data transformation, data reduction and discretization.

CO-3: Analyze various data mining techniques such as association rule mining, Multilevel, Multidimensional, and Constraint Based Association Mining and implement Apriori algorithm.

CO-4: Compare and contrast the classification and prediction techniques such as Tree induction, Bayesian Classification and Back Propagation.

CO-5: Review various Clustering Methods such as Hierarchical Methods, Density Based Methods, Web Mining, Spatial Mining and Temporal Mining.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✔				
Unit-2	✔	✔			
Unit-3			✔		
Unit-4				✔	✔
Unit-5					✔

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✔				✔
CO-3	✔		✔		✔
CO-4	✔	✔	✔	✔	✔
CO-5	✔	✔	✔	✔	✔

Elective Paper Theory – 3			
Title of the paper with subject code	**INTERNET-OF-THINGS**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**4**

COURSE OUTCOMES:

CO-1: Understanding the diverse fields where IoT is being used and wider range of IoT-applications

CO-2: Comprehend how M2M value chains are converted to IoT value chains

CO-3: Analyze IoT architecture, reference model and different types of views in IoT model.

CO-4: Deduce how IoT can be applied to factories, Retail Industry, Business models and other smart applications.

CO-5: Review various Governance policies in privacy and security issues.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✓				✓
CO-3	✓		✓		✓
CO-4	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓

Core Paper Theory – 8			
Title of the paper with subject code	**COMPUTER NETWORKS**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**4**

COURSE OUTCOMES:

CO-1: Recall the concepts of communication, types of networks, transmission mode, types of medium, protocols and addresses.

CO-2: Apply layered protocol approach to communication representing OSI Reference model explaining the functional characteristics of each layer.

CO-3: Analyzing the protocols respective to the physical, data link, network, transport, session, presentation and application layers.

CO-4: Evaluate error control using error detection and correction, flow control using sliding window mechanism, IP addressing and subnet masking.

CO-5: Create an appropriate networking architecture for an organizational structure along with relevant protocols to support the network.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✔				
Unit-2		✔			
Unit-3			✔		
Unit-4				✔	✔
Unit-5					✔

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✔			✔	
CO-3	✔	✔		✔	
CO-4	✔	✔	✔	✔	✔
CO-5	✔	✔	✔		✔

Core Paper Theory – 9	
Title of the paper with subject code	**WEB DEVELOPMENT USING OPEN-SOURCE TECHNOLOGY**

Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**4**

COURSE OUTCOMES:

CO-1: Understand the basics of PHP statements, operators, branching and looping statements.

CO-2: Analyze the usage of Arrays and functions in PHP. Comprehend the concepts of files.

CO-3: Analyze the features of client-side scripting languages such as Java Script such as keywords, operators, functions and DOM extensions.

CO-4: Deduce MySQL database data types, creating and manipulating table operations and data manipulation table aggregation functions.

CO-5: Design application programs with PHP as front-end and MySQL as back-end tool.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✔				
Unit-2		✔			
Unit-3			✔		
Unit-4				✔	✔
Unit-5					✔

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employa bility)	PSO-3 (Entrepreneur ship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✔				
CO-3	✔	✔	✔		
CO-4	✔	✔	✔		
CO-5	✔	✔	✔	✔	✔

Title of the paper with subject code	SOFTWARE TESTING		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**4**

COURSE OUTCOMES:

CO-1: Investigate the reason for bugs and analyze the principles in software testing to prevent and remove bugs

CO-2: identify the needs of software test automation, and define and develop a test tool to support test automation.

CO-3: Apply Flow/Graphs and Path Testing and Transaction Flow Testing Techniques as testing strategies

CO-4: Deduce Domain testing and syntax testing metrics and state graph methodologies.

CO-5: Device verification and validation tools for various levels of testing for software products such win runner tool.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✔				
Unit-2	✔	✔			
Unit-3			✔		
Unit-4				✔	✔
Unit-5					✔

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✔	✔			
CO-3	✔	✔	✔		
CO-4	✔	✔	✔	✔	
CO-5	✔	✔	✔	✔	✔

Core Practical – 7			
Title of the paper with subject code	**WEB DEVELOPMENT USING OPEN-SOURCE TECHNOLOGY LAB**		
Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**2**

COURSE OUTCOMES:

CO1: Understanding of how PHP is used

CO2: Develop and Publish Android applications using Graphical user interface

CO4: Develop an application to display your personal details using GUI Components

CO5: Understand how to develop an application that uses to send messages from one mobile
    to another mobile.

CO6: Handling online Database Transactions.

CO7: Designing an application for Google map locator

PSO – CO MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✔	✔			
CO2	✔	✔			
CO3	✔	✔			
CO4		✔			
CO5		✔			
CO6	✔	✔	✔	✔	✔
CO7	✔	✔	✔	✔	✔

Core Practical – 8			
Title of the paper with subject code	**Mini Project**		
Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**5**

COURSE OUTCOME:

> **CO1:** To practice acquired knowledge within the chosen area of technology for project development.
>
> **CO2**: Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
>
> **CO3**: Reproduce, improve and refine technical aspects for engineering projects.
>
> **CO4**: Work as an individual or in a team in development of technical projects.
>
> **CO5:** Communicate and report effectively project related activities and findings

PSO – CO MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✔	✔	✔		
CO2	✔	✔	✔		
CO3	✔	✔	✔		
CO4		✔	✔		
CO5		✔	✔		

Elective Paper Theory – 4			
Title of the paper with subject code	**CLOUD COMPUTING**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**4**

COURSE OUTCOMES:

CO-1: Understand the concepts of cloud computing, need for cloud computing, advantages and disadvantages.

CO-2: Discuss various forms of cloud services, platform as service, software as service, infrastructure as service and cloud service deployment.

CO-3: Discuss how cloud computing can be used for collaborating contact list, community, corporations, group projects and events.

CO-4: Review various cloud services available can be used for collaborating for online planning, schedule management, task management, project management, database and sharing files.

CO-5: Review web-based collaborating tools, web conference tools and collaborating via blogs and wikis.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✔				
Unit-2		✔			
Unit-3			✔		
Unit-4				✔	
Unit-5					✔

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2					
CO-3			✔		✔
CO-4	✔		✔		✔
CO-5	✔	✔	✔	✔	✔

Title of the paper with subject code	**ARTIFICIAL INTELLIGENCE**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**4**

COURSE OBJECTIVES:

CO-1: knowledge of the building blocks of AI as presented in terms of intelligent agents and Expert Systems.

CO-2: Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them.

CO-3: Develop intelligent algorithms for knowledge representation using AI programming languages. and also design intelligent systems for Game Playing

CO-4: Experiment different types of learning methods in artificial intelligence and related algorithms.

CO-5: Formulate the capability to represent various real life problem domains using logic-based techniques and use this to perform inference or planning.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✔				
Unit-2	✔	✔			
Unit-3			✔		
Unit-4				✔	✔
Unit-5					✔

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2			✔	✔	
CO-3	✔		✔	✔	✔
CO-4	✔	✔	✔	✔	✔
CO-5	✔	✔	✔		✔

Title of the paper with subject code	SOFTWARE PROJECT MANAGEMENT		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**4**

COURSE OUTCOMES:

CO-1: Define Estimation of project cost and prepare cost-benefit evaluation among projects

CO-2: Perform project scheduling, activity network analysis and risk management

CO-3: Apply schedule and cost control techniques for project monitoring including contract management.

CO-4: Deduce quality models in software projects for maintaining software quality and reliability.

CO-5: Design a suitable project organization structure, leadership, decision and motivation styles, proper safety and ethical practices and be responsible to the society.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✓				
CO-3	✓		✓	✓	
CO-4	✓		✓	✓	
CO-5	✓	✓	✓		✓

9. Teaching – Learning Process:

The Teaching-Learning process for the B.Sc. Computer Science programme has been in alignment with the course objectives and outcomes put forth for the programme. It has been ensured that the process is in compliance with the Programme Specific Outcomes and Course Outcomes envisaged for the programme. To enable effective and efficient teaching process various teaching aids have been used including online classes through Google Meet. To facilitate better learning process for the students the Institution has offered online repository such as Google Classroom for online sharing of reading resources and contents to the students.

To meet the set objectives of the course and enable students achieve the expected outcomes of the course the following teaching processes are utilized:

Class Room Teaching:

Time tested regular Class room teaching and face-to-face teaching using chalk and talk method is used to imbibe the theoretical foundations to the students. Using Live Classroom teaching provides teachers with a handle to monitor the mindset of the students and grasp of the teaching. LCD/Projectors can be used in classroom for providing simulated/animated explanations of the concepts of the curriculum.

Laboratory Teaching:

Laboratory Teaching provides hands-on practical sessions for the students to have deep understanding of the theoretical concepts that they learn in classrooms. Laboratory is furnished with state-of-the-art technologies and higher-end software to help students to solve the problems practically.

Forums:

Student forum in the name of Career.Skills is organized every week where Industry experts are invited to provide Guest Lectures for the students to learn the latest trends and technologies prevalent in the industry. Forums are also used for peer-to-peer learning as students take seminars, involve themselves in group discussions on technical topics.

MOOCS:

Students are advised to take up MOOC course such as NPTEL and other industry endorsed online courses to provide blended learning to cater to the needs of the ever-evolving field of Computer Science.

Project:

Students are subjected to carryout Project-based assignments for every core subject. Students are a given a real-time problem. They are to apply the theoretical concepts to the problems, analyse the technical details of the problem, evaluate the possible solutions to the problem and have to propose a computational solution for the given problem.

Final year students in their final semester are mandated to complete a real-time mini-project for the successful completion of the degree.

Assignments:

Home assignments are regularly given to students that comprises of

- Data collection from real-world to prepare themselves to gain insights to the data by comparing the data from various sources and preparing a report for the collected data.

- Solve theoretical problems using practical approaches to provide exposure to real-world problems and industry practices.

10. Assessment Methods:

Assessment methods play a pivotal role in evaluation of student's progress. More importantly the Assessments methods employed are structured in such a way that students can themselves introspect as to what is expected of them by the Institution and by the Industry. Assessment methods provide students with window to know where they lack as a learner and more importantly how to improve upon themselves from the inputs of the curriculum. In bachelors programme of Computer Science, the assessment and evaluation method focus on testing the intuitive understanding of the fundamental concepts of software and hardware along with programming skills in various languages and more importantly the ability to apply the knowledge to real-life applications. The assessment methods try to validate and enhance the well-rounded skillsets of the students such as employable skills, entrepreneurship skills, research-relevance skills and programming-conscious skills.

10.1. Continuous Assessment:

The Continuous assessment occurs on a regular and continuous basis, it is an ongoing formative and summative process, involving the monitoring of students. This assessment is inherently integrated with teaching and involves of series of process like systematic collection of marks or

grades that gradually flow into the final score. The assessment marks or grades collected through various stages of the semester eventually contribute to the final grade of the students.

The continuous Assessment process tests the students on various grounds and aspects such as:

- Continuous Internal Assessment – I

- Continuous Internal Assessment – II

- Continuous Internal Assessment – III

- Attendance

- Class Participation or seminars

- Assignments

The student is subjected to three internal assessment written exams in a semester. The student's regular class attendance proves to be an important factor in the evaluation of the student's credentials. The assessment also takes cognizance of the student's active participation in the class room discussions in the form of seminars and group discussions. The prompt submission of home assignments is monitored for assessing the student's final evaluation of their credentials. The overall marks secured in the Continuous Assessment Process contributes for 25% of the total marks secured in the end-semester examinations.

11. Keywords:

Learning Outcome, Graduate Descriptor, Qualification Descriptor, Skill Enhancement, Core Compulsory Courses, Discipline Specific Elective, Continuous Assessment, Assessment methods, CO, PSO, Teaching-Learning process